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Edited by

António Palma dos Reis

Pedro Isaiás



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e-Society 2003

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IADIS INTERNATIONAL CONFERENCE
e-Society 2003**

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FOREWORD

These proceedings contain the papers and posters of the IADIS International Conference e-Society 2003, which was organised by the International Association for Development of the Information Society, in Lisbon, Portugal, June 3 – 6, 2003.

The IADIS e-Society 2003 conference aims to address the main issues of concern within the Information Society. This conference covers both the technical as well as the non-technical aspects of the Information Society. Broad areas of interest are E-Commerce, E-Learning and E-Government.

The following fifty-two areas have been object of paper and poster submissions: Collaborative Learning; Computer-Mediated Communication; Cyber Law; Data Mining; Digital Regions; E-Business Models; E-Commerce Economics; E-Economy; E-Government; E-Healthcare; E-Learning; E-Marketing; E-Publishing and Digital Libraries; Electronic Data Interchange (EDI); Evaluation and Assessment; Extensible Languages; Global Tendencies; Human Computer Interaction; Information Retrieval; Information Society Case studies; Intelligent Agents; Intelligent Systems; Knowledge Management; Learning Communities; Multimedia; Payment Systems; Privacy Issues; Protocols and Standards; Security Issues; Storage Issues; Tele-work; Ubiquitous Computing; Virtual Communities; Virtual Organisations; Virtual Reality; Wireless Communications.

The IADIS e-Society 2003 Conference had about 280 submissions from more than 35 countries. Each submission has been anonymously reviewed by at least two independent reviewers, to ensure the final high standard of the accepted submissions. Out of the papers submitted, 72 got blind referee ratings that published them as full papers, while some others were published as short papers and posters. The best papers will be selected for publishing as extended versions in the IADIS International Journal on WWW/Internet and other selected journals.

The conference, besides the presentation of full papers, short papers, posters, and doctoral consortium presentations also includes keynote presentations and Tutorials from internationally distinguished researchers, as well as corporate presentations.

As we all know, a conference requires the effort of many individuals. We would like to thank all members of the Scientific Committee (about 170 top researchers in their fields) for they hard work in reviewing and selecting the papers that appear in this book. We would also like to thank all the authors who have submitted their papers to this conference. We wish to thank all members of our organizing committee.

Last but not least, we hope that everybody has a good time in Lisbon, and we invite all participants for the next year edition of the IADIS International Conference e-Society 2004 that will be held in Spain.

May 2003.

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KEYNOTE LECTURES

CONCEPTUAL REPRESENTATIONS FOR LEARNING

by Professor Piet Kommers, University of Twente, The Netherlands

Abstract

Citizens in the knowledge economy face dense communication processes both in professional, social and educational aspects. Learning is not only the exclusive domain for schooling and training. Portable web-connected devices enable an ambient and continuous learning environment where virtual communities play a crucial role. An important process will be the role of "learning partner"; Peer students or experienced experts who facilitate the learning process of others. Web-based learning communities are likely to work on the basis of time credits: those who enable other members to make significant learning progress earn credits to consult even higher level experts for their own learning. We may expect that a voucher system will be kept by trusted bodies for its administration.

Ambient learning implies that the learning domain becomes wider and the incentive is not only a certificate. The key elements are interest, commitment to relevant societal issues and existential motives to acquire a more complete understanding. Meta-cognition and self-regulation are the key issues in learning-to-learn. This invited presentation will demonstrate how external conceptual representations help learning partners to articulate and share cognitive needs and perspectives. A special application for conceptual representations is the orientation and navigation in virtual learning environments. In the DIME project medical experts and -students can negotiate on plans, executions and results of surgical interventions. The targeted discussion is in how far conceptual representations facilitate the search for learning partners via the WWW and to what extent it supports the cooperative learning processes itself.

THE LAUNCHING OF THE INFORMATION SOCIETY IN PORTUGAL: A PERSPECTIVE SEVEN YEARS LATER

by Professor José Dias Coelho, New University of Lisbon, Portugal

Abstract

A personal view of the launching of the information society in Portugal is presented. The situation in 1995 regarding I.S. is described. The green paper for the information society, and the national initiatives for electronic commerce, and for citizens with special needs will be broadly described in their aims.

The European Union Lisbon Initiative up to the E Europe Action Plan will provide the framework for recent developments.

ELECTRONIC COMMERCE AND BUSINESS MODELING: THEORY AND PRACTICE

by Professor Ulf Essler, Stockholm School of Economics, Sweden

Abstract

The Internet and more precisely the TCP/IP protocol suite was adopted decisively by large firms in 1995. We are consequently some eight years into the experience of using this new "space" for business purposes, a space designed for non-commercial purposes. Using established concepts and theories evolved in "real space" from the fields a management of innovation and strategic management to understand "cyberspace" as a business venue have so far generated poor results in both business practice and management theory. Two reasons for this state of affairs are discussed in this presentation. Firstly the unique character of cyberspace and its relative novelty as a business venue, and secondly a delay in acknowledging a fundamental shift in the topology of business relationships. A reformed business model approach is suggested based on new IT seemly working as a "solvent" of organizational structures, i. e., dissolving organizational structures; boundaries between work and leisure, boundaries between hierarchy and market, and boundaries between stationary work and mobile work.

Special Talk

BUSINESS MODELING DRIVERS IN E-SOCIETY FORMATION

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ABSTRACT

One of crucial issues in e-society formation is how to innovate value proposition and process laid down among parties involved. This paper describes some insight gained through Japan e-society formation research. Value innovation must be done prior to process innovation, even both of them have to be done one after another in dual spiral way.

1. E-SOCIETY BUSINESS FORMATION

e-society comprises of business enterprise, government and individuals and is featured by socio information systems which serves for business and non-business purposes. This paper deals with only business realm of such e-society and never touch on the non-business realm, see Figure 1. One major concern in the business realm is *business modeling* that is a framework of pursuing business goals that each party of the esociety has. Mathematical simulation modeling is frequently used method for business modeling, but it can only simulate such business that could be represented by mathematical model. Though the mathematical model can simulate the model behavior under the model condition settings someway, but through such modeling it is hard to innovate value and/or process in e-society formation.

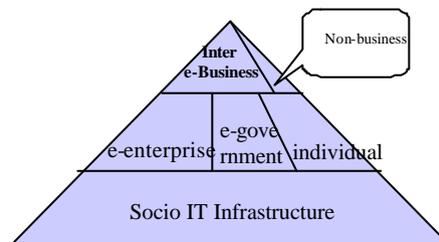


Figure 1. e-society Business Formation

Definitions

Process - its meaning varies depending on discipline and context the term used, from systematic series of actions or changes directed to some end in general, natural out growth in bio, and court action in law. This paper assumes the generic definition of process.

Value – attributed or relative worth, merit, or usefulness and not restrict its meaning only to monetary or material worth, so that value includes convenience in services provided. This paper means value by products or services offered.

Business Model – means philosophy on business design and practically value exchanged between parties utilizing resources. e-business model means a framework where each party gets benefits from value contributors through interaction, especially utilizing merits brought by IT.

2. ISSUES IN E-SOCIETY BUSINESS

Since e-business has drawn people's attention in mid 1990's, e-business modeling has been tried in almost every types of parties such as business companies, customer, government, citizen and furthermore has been experimented in the relationship of each one of them.

In specific industries such as banking, trade, logistics, they have high demand for *process innovation*. Manufacturing industry has needs for *value proposition innovation* as well as needs for process innovation over their supply and demand chains.

In almost esociety concerns, we have to deal with inter-organizational business modeling as well as intra-organizational business modeling. However, "organization" is a generic term and varies its boundaries for each organization with different granularity, e.g., from single stand-alone company to allied corporate enterprise to governmental office. Therefore we should consider issues in internetworked enterprise, interprise in short that is an interrelated enterprise through for example internet [PRI95]. A typical example of interprise is e-trade where different types of organizations are involved from darts to darts, e.g., value provider, mover, insurance, bank, tariff and authorization offices. e-trade still has several issues such as gap in inter-organizational process and less compatibility of data exchanged. In case of supply and demand chains, there are issues in how to renew process collaboration and how to have organization distributed. In case of international banking, clearance still takes longer time and is lack of straight through processing ability, STP for complexity of business procedure reasons. There exists high needs for process integration throughout banking institutes involved in order for reinforcement of their competency. Process integration in banking could be accomplished in several different levels such as intra-organizational, electronic authenticate, and inter-organizational. However almost existing supports like EAI, BusinessWare, work-flow are limited to those capability that interconnects existing systems such as legacy, ERP package, database handling in-house application. There seldom to find methods and tools support Process Innovation.

The localization business industry serving for global value providers is facing at needs of process and value innovations, since the industry is suffering from cost and quality problems caused by inefficient utilizations of skilled human resources due to Multi Language Vendor's enclosure strategy that blocks seamless process integration from client to Single Language Vendors and translators.

Government and its parties have more serious problems than those business and its parties have. For example, trade business has difficulty of having sound interface of process and data, since each government office requires business enterprises and individuals adapt the unique interface each government defined. Generally in e-society X2G or G2X, where $X=\{B|C|G\}$, lack of interoperability is still the biggest bottleneck problem.

Some of these problems are caused by the technical issues of standardization on communication protocol and document format each party use. The other causes are conservative psychology to resist against changing of their business model and practices, organizational responsibilities and authorization and documentation format after all without observing change reasonability.

3. PRIMAL DRIVER OF E-SOCIETY BUSINESS FORMATION

Which should be innovated first, Process, Value or else in e-society formation? As its process and value aspects can be identified, let's concentrate in the pros and cons of Process Innovate First (PIF) and them of Value Innovate First (VIF).

PIF Pros

1. Method Availability

There are useful methods for making process innovation, while value innovation methods are less available for use.

- 2. Easy to understand
Process innovation is much easier to understand by people concerned than value innovation.
- 3. Major Driver
Process innovation can make value proposition innovation happen, for example, bank process innovation can make such value proposition innovation as faster clearance, settlement happen.

PIF Cons

- 1. Opportunity Loss
PIF concentration often loses opportunity of value innovation.
- 2. Non-value
Process Optimum doesn't mean Value Proposition Optimum, e.g., Process Optimum has its goal to achieve such as complexity, cost, time duration.
- 3. Higher Cost
Development Cost unnecessarily increase due to fallback (VI requires Rework of PI)

VIF Pros

- 1. Key concern
Value is the first and ultimate concern. People wants pursue to earn value first. Once people be convinced of value proposition, then they are motivated to innovate process and others.
- 2. VI as Major Driver
Process can be innovated following to and based on the consequence of VI, let's say, Value Map -> Sequence Chart -> Process -> Process Innovate.
- 3. Value as Premise
Local Value Innovation-wise Process Innovation, LOVPROI is good enough. Though local optimum solution does not mean total innovation including, for example, *dis-intermediary*, it is only practically possible way to have e-society innovation.

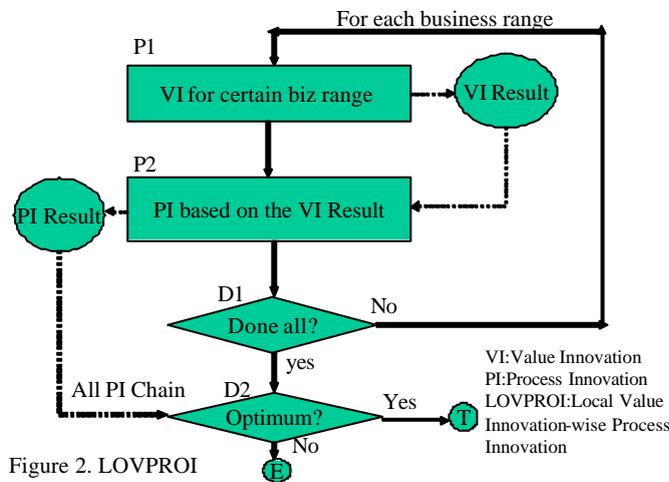


Figure 2. LOVPROI

A purpose of the process denoted P1 is to innovate value proposition for a certain business range and provide the value innovation scheme. The process P2 is to innovate process based on the value provision scheme got in the P1. The decision process denoted D1 is to see whether there remains any chain in the underlining case unchecked. The processes P1 and P2 have to be done until all chains have been checked. The decision process D2 is to see whether all of process innovations of all underlining chains have been optimized. These series of processes is called Local Value Provision-wise Process Innovation, LOVPROI in short. The LOVPROI does not always assure to provide Total Optimum Solution, since set of the local value innovation results simply do not mean the total optimum. Re-Process Innovation took place repeatedly maybe assure to find a total optimum solution.

VIF Cons**Non-Total Solution**

VIF does not always possible to assure optimum solution of e-society totally. PIF has the same problem.

Discussions

In spite of PIF Pros, there are some useful methods for Value Innovation and you can get sound results utilizing those methods. The problem stated in VIF Cons is of *totality* of optimization and not of PIF superiority over to VIF. The totality issue should be discussed separately from VIF-PIF selection. Practically speaking, local optimization for a certain scope of organization is only possible to do and practical solution can be derived from and thorough putting local solutions together.

Locally limited within a range of an underlining organization, it's possible to get value proposition innovation, VPI, while it is tough to make VPI totally encompassing all of the relevant organizations, since total VPI has to resolve possible conflict of interests raised by and among parties concerned. For example in chain of business to government, B2G, government and corporate enterprise have different value sense each other. How you should resolve it? Does top down approach of value innovation assure to have success? It may be possible. One way to do it is *hierarchical* approach that starts to innovate value at higher hierarchical level and proceed on to next level down until reach end, e.g., International – National – Value Chain – corporation levels. A problem is that the decision made in the course of hierarchical value proposition innovation takes much longer time and likely loose business opportunity.

Through scrutinizing of all these pros and cons, Value Proposition Innovation First has bit more advantages than PIF in e-society business formation. However this does not mean there is no need of PIF. It is noted that both of them are used complementarily in the course of the formation.

VI Approaches

At least three types of value innovation approaches are on hand use, i.e., Hierarchical, Distributed, and Federated.

Table 1 Types of Value Innovation Approaches

	Hierarchical	Distributed	Federation
Features	Usually Top Down, rarely Bottom Up	Distributed	Whole Chain and Component
Example	Toyota, especially their supply chain	Sony	e-Trade
Approach	Organizational layer by layer Top Down Optimization	Look for Local Optimization	Harmonize Whole Chain and each Component Elements
Remarks	Timely decision making is crucial.	Hard to coordinate each local optimum other	Federation level value proposition must be clear enough to follow by each elementary.

4. E-SOCIETY BUSINESS MODELING AGENDA

What you should do for modeling e-society business, in short e-business? For a given enterprise run in certain *business life cycle* stage, you have to accomplish series of tasks including at least business visionary planning, e-business architecture modeling and implementation, evaluation of the model and the e-business, and making evolution of the business^{12,13,14} The *business architecture modeling* includes the value proposition planning and e-business process design. Usually information systems modeling and other enterprise sub-models have to be accomplished based on the business architecture, more strictly speaking

based on the e-business process, if top down approach is taken. The other sub-models are those needed for comprising of whole business enterprise. They include organization, resource, economics or financial sub-models. Value proposition plan and business process model comprise of the business architecture model.

Strategic visionary plan and architecture modeling are important tasks for modeling e-business^{.1,6,11} However, these are not exhaustive. The other important and non-trivial tasks for e-business modeling are at least evaluation and evolution. Evaluation is needed, since you want see how the e-business going on. Evaluation basically takes place in two different timings, modeling and operation. Evaluation taken during modeling phase allows you to make decision whether or not you should go with the ebusiness model. Evaluation during operation phase allows you to see measured data of indicators which shows how the e-business is going on.

Model evolution is essentially needed if you are looking for success all the time. Without having model evolution, no one could be survival in e-business competition. We have to be careful that ebusiness evolution is one thing and information systems evolution in the e-business is another. What we should do for e-business evolution include first identifying what should be improved and the reason why it should be. Secondly examine where the problems come from, the model and information systems or the else.⁷ The causes of the problems may be the way of implementation and put into practice. The causes may be from deficit that the model per se has. You have to identify the causes thoroughly from its root to the branches to the leaves. Third identify which part of the model has to be improved if the model is the root cause of the problems. You have to trace and identify what extent of the model in its scope has to be changed. You have to make the change analysis through out the entire e-business models and the sub-models. After complete change analysis, you have to re-build whole e-business systems including the information systems, otherwise no one can carry out e-business with evolution matching well better to the surrounding circumstance and more fit for meeting the goal.¹⁶ See Figure 3 Structure of e-business agenda.

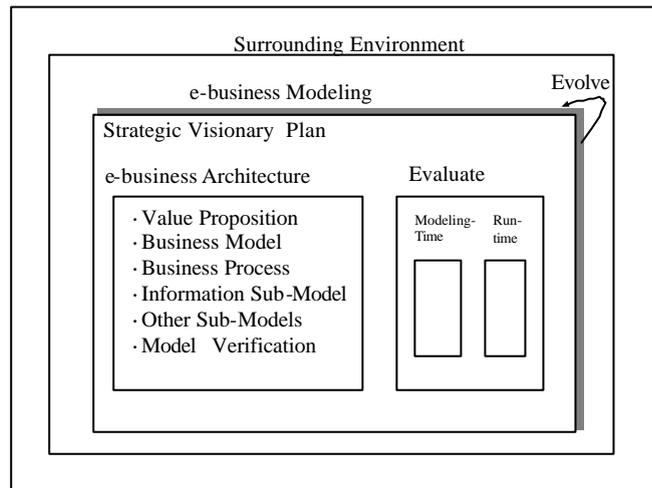


Figure 3. Structure of e-business agenda

5. REQUIREMENTS TO E-SOCIETY BUSINESS METHOD

How you can accomplish the activities shown in the agenda in Chapter 4? There are many requirements for the agenda. Specifically, what follows are some of the priority items but not exhaustive.

1) Strategic Visionary

Need methods for e-business strategic visionary planning and architecture modeling, especially be careful for linking the visionary plan and the architecture model.

2) Architecture Modeling

Need method for ebusiness architecture modeling. Several methods are currently available for business process modeling, but you should be careful to make sure whether it is possible to meet requirements from

inter-enterprise process design. Even in case of intra-enterprise process only, still you must be careful to assure whether it is possible to design web based business process design. It is noted that not only process but also value proposition innovation method is needed as stated below.

2.1) Value Proposition

Get the method for value proposition. Value model is one of the major concerns in e-business design. The method should be useful for innovating value proposition, since the proposition would be a core competency that the enterprise might have.

2.2) Linking Innovated Value Proposition and Business Process Modeling

Need the method for linking innovated value proposition and business process modeling. The link must not only handle inter-relationship between value proposition and business process but also inter-relationship between the proposition and the other e-business sub-models. Unless use such method, no one can accomplish e-business architecture model in a coherent way.

3) Building Information Systems

Hopefully need the method for building information systems directly from and based on the e-business architecture model.

4) Evolution

All the methods mentioned above have to have such capability as making evolution of the model and/or systems until the end of the e-business life cycle.

4.1) Evaluation

Need the methods and/or capability of evaluating the business performance and effectiveness of the model as well as business run time performance.

4.2) Change

Need the methods of changing e-business model in a sound way along with change requirements. Sound way means not the traditional one that results in a “chaos” situation causing you work a lot with confusions even if changing a bit. Dog year means need of quick evolution and not take a longer time for changing.

6. PROMISING SOLUTIONS

As the author stated in the ICEIS'02 panel²¹, there are extensive numbers of methods that are available for use in modeling e-business architecture. However, very few methods have been provided as solutions for fixing the issues stated in Chapter 2 and very few methods allows one to model e-business architecture seamlessly. There are un-neglected gap lay down between business and technical architectures to model.¹⁹ Most of the methods serve for exclusively either business architecture or technical, and seldom serve for both of them. The author has already presented some of the solutions like VPI method for fixing the problems in e-business modeling [MJM BIS02. The whole method is called Value-centric eBusiness Architecture modeling, VeBA.

Value Proposition Innovation Method

In order to have enterprise competitive, value proposition innovation must be a key factor.⁵ As competitive situations always change, enterprise value proposition must be keep innovating and should not stall all the time at the same proposition level. How to keep innovate value proposition would become a key factor for enterprise survival. Therefore, value proposition innovation method plays crucial role in e-business architecture modeling. In the VeBA project, a method called Value Proposition Innovation, VPI has been developed and continuously well enhanced for the purpose. The VPI method facilitates diagrammatic representation of whatever innovated and the diagram presents two folded-views, say, descriptive (as is) and normative (to-be), so that architect can make distinction between normative view of value proposition and existing view of it and could be convinced in the proposition.

The VPI method provides procedural steps for value proposition innovation. Though the VPI method itself is somehow complicate, only summarized steps are presented here:

1) Existing Value Proposition

Describe the existing value proposition and ask reasons about as-is: Evaluation is often made from customer view.

2) Disintermediation

Disintermediation of agent: Explore any possibility of disinter mediation of existing agents and study any feasibility of disinter mediation to see performance and value total increase.

3) New Value Proposition

Envisage new value proposition: find new value proposition carried out by enterprise⁵, which is a concatenated word of Internet worked enterprise.

4) Reintermediation

Reintermediation: determine new value proposition in detail including redefinition of agent role.

5) Value Map

Depict value map: visualize value map in which value contributors can exchange their value each other.

Under the e-business goals and/or objectives, you can explore value proposition innovation as much as you want utilizing method like VPI. Figure 3 demonstrates some example views of come-up from certain service industry’s value proposition innovation.

Recent come-ups from VPI research provide further procedural steps as amendment to the five steps.

6) web-based VPI

Design web-based VPI focusing on interaction among parties. See Figure 6.

7) Action Sequencing

Checking sequence of actions taken and concluding e-business model. See Figure 7 and 8.

Value Innovation Example

Let’s look at trial e-society formation assuming no obstacles mentioned earlier in the Issues Section. In e-trade as an example, let’s assume more than six different parties are involved, say, customer, manufacturer, trader, logistics, services like insurance and bank, government. The value proposition innovation for this example is took place following to the procedures stated above. For simplifying the discussion, every step results are not shown in this paper except most crucial steps. Figure 4 Global Value map shows existing value exchanged between the relevant parties in upper box and normative value proposition in lower box of the figure. After study of the value innovation, a model has been decided to disintermediate the trader and government. This innovation brings merit to customer and other parties.

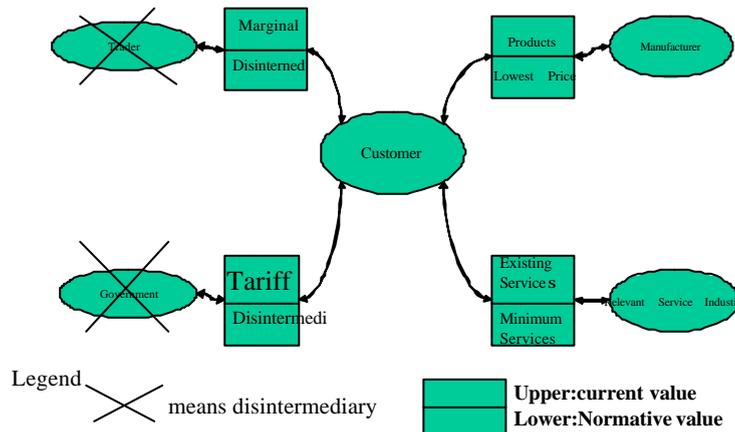


Figure 4. Global View of VPI in e-trade

Figure 4 shows an idea of Value Proposition Innovation given and taken among parties involved in case of e-trade. In this innovation, trader and government are thought disintermediary, so that they will disappear in the value chain. The other parties like manufacturer and logistics, insurance and bank will not disappear and provide product and services with lowest price.

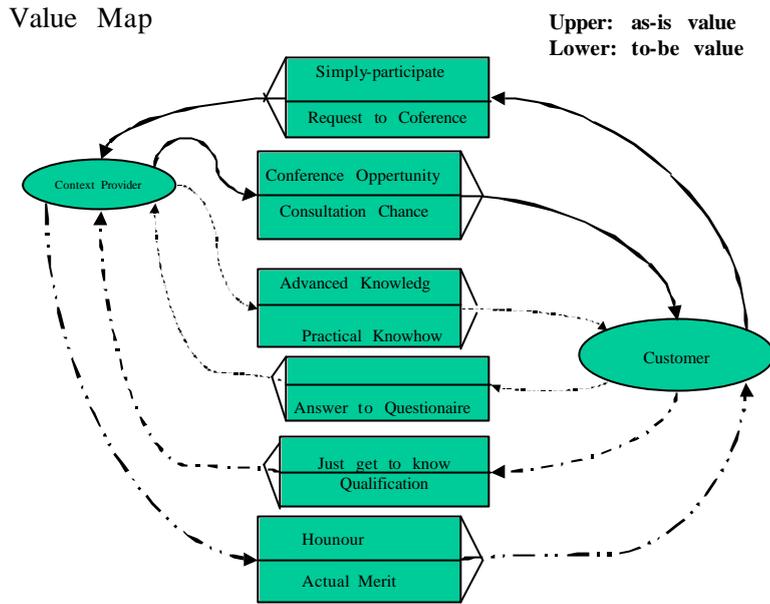


Figure 5. Local View of VPI

Under the global value proposition innovation scheme, Figure 3 shows a local view of value proposition between customer and manufacturer. Consequently, this value proposition scheme allows customer be able to get the best product and services fit to their needs with the lowest price.

If modeler wants to have information systems model that will match to the value proposition scheme, then continue to do following the remaining steps of the VPI method. See, Figures 6,7 and 8 for the results of the design.

Figure 6 represents Interaction scheme with value exchanged between parties involved. Figure 7 represents chronological sequencing of actions taken by the parties. Fig. 8 represents web-based e-business scheme.

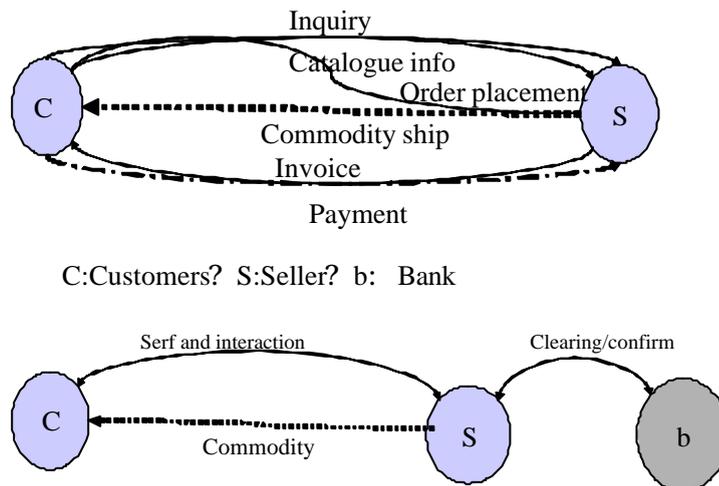


Figure 6. Interactions

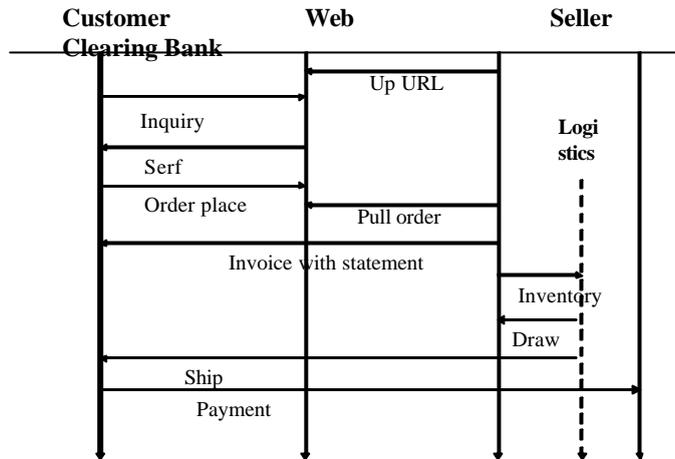


Figure 7. Sequencing of actions

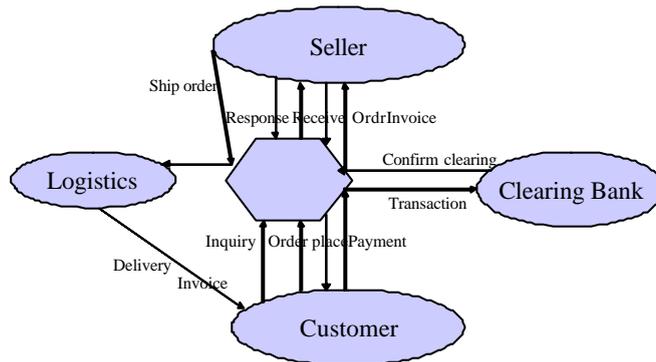


Figure 8. e-business model

Process Innovation Methods

The Process Innovation Method deals with four types of dependencies between depender and dependee, i.e., resources consumed, task to perform, goal to achieve, and soft goal to hopefully achieve. The method is used for clarifying interdependencies among parties involved. Starting at existing dependencies, this method allows modeler to simplify the interdependencies, See Figure 9.

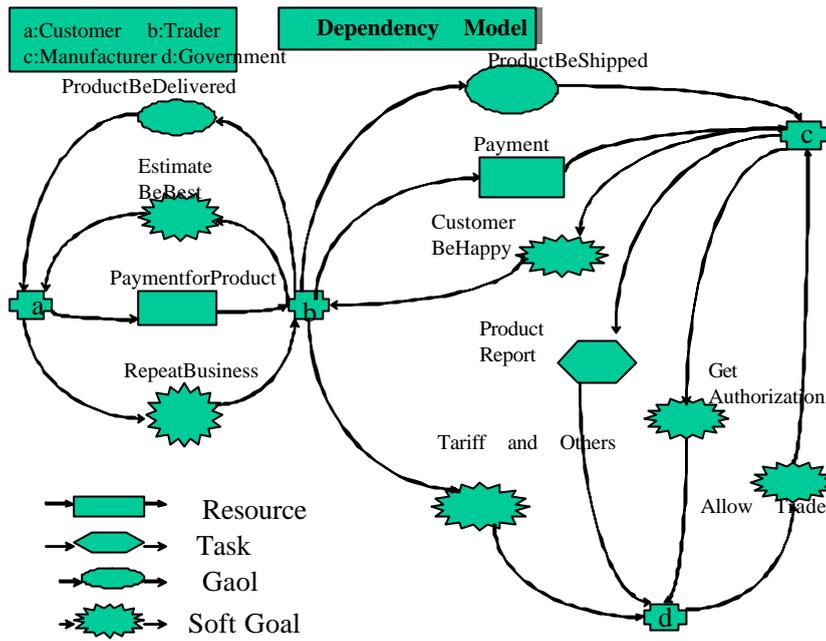


Figure 9

Example e-Trade

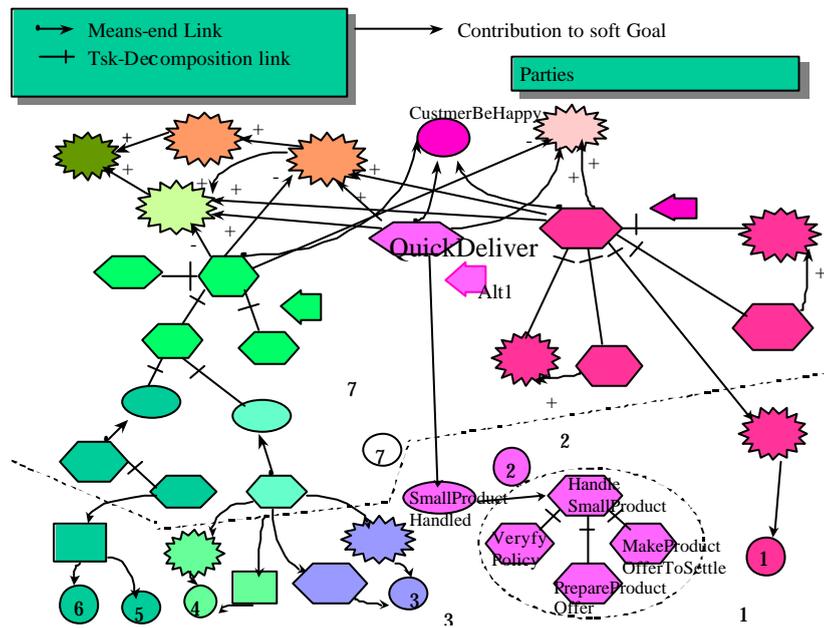


Figure 10

Moreover, this method allows modeler to make clarification means – end links, task decomposition and soft goal contributors, so that this relation helps modeler to simplify the existing process, See Figure 10.

ACKNOWLEDGEMENT

Author express indepth appreciation for all who collaborate in this research project, especially for development and exploit of VPI value proposition method.

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Full Papers

META-OPERATIONS IN THE FIELD OF E-LEARNING

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ABSTRACT

In the field of e-learning we find a lot of systems supporting authors, teachers and learners. Today's development of knowledge transfer systems does not follow common methods or guidelines. Therefore this paper presents a method of generating so-called meta-operations, which are common, essential and reusable. Meta-operations represent the functionality of future knowledge transfer systems in general. The method also considers the knowledge material described semantically by proper meta-data. Based on this method and the resulting meta-operations we can develop architectures including reusable software components and common interfaces for distributed knowledge transfer systems. These systems are able to handle and interchange knowledge material based on standardized meta-data. This paper shows the problem in detail and looks at previous work before the method is introduced. An example shows how to apply this method. The paper results in building up a specific architecture for the knowledge transfer system ED.TEC.

KEYWORDS

Meta-operation, Method, Architecture, E-Learning, Software Development

1. INTRODUCTION

Today's society is an information society and it is on the way to become a knowledge society. To be a part of the knowledge society we need to know how to handle knowledge. In particular the rapid development of information and communication technologies provides new possibilities to find, gather, and consume knowledge in a new manner. Computers and the Internet are able to calculate and transport knowledge based on information, but they cannot replace teachers, trainers, coaches or instructors in education and training. However, computers can support the mentioned roles and their business processes, so that they can achieve their tasks imparting knowledge more efficiently. The idea of this paper is to specify essential operations for computer supported knowledge and efficient use of knowledge with so-called knowledge material in the field of e-Learning.

Knowledge material represents knowledge in an electronic form, which can be processed by computers. So-called meta-data enhances the knowledge material describing it semantically. Meta-data characterizes knowledge material by using different categories concerning e.g. pedagogical or technical aspects. For this reason it is possible to get a more efficient management of documents or knowledge material. Thus the business processes can be fulfilled more efficiently.

The business processes of education and training can be divided in four sub-processes:

- **Knowledge transfer:** Authoring of knowledge material, teaching and learning
- **Stipulation:** Arrangement of legal agreements between customer and supplier
- **Administration:** Human and technical resource management
- **IT-Management:** Quality-based operation of all technical resources

This paper focuses on the knowledge transfer process supported by knowledge transfer systems. The knowledge transfer process consists of three main processes [Feuerhelm et al., 2001]:

- **Authoring:** Materials will be gathered, combined, modularized, and reused by authors.
- **Teaching:** Materials will be presented, commented, explained, and illustrated in seminars, lectures or (practical) courses by teachers, coaches, trainers or tutors. These activities can also be done over the Internet.

- **Learning:** Learners will get knowledge material or attend courses and acquire or adopt the imparted knowledge e.g. over the Internet.

Meta-data describing the knowledge material are standardized by several institutions with different approaches [IMS, 2001, IEEE-LTSC, 2001]. The meta-data schemes consist of several categories, which store information related to certain domains e.g. pedagogy, technical aspects or classification. Using meta-data in practice shows a missing procedure how to handle and use meta-data. There is also a lack of integrating meta-data in IT systems, especially knowledge transfer systems. However, there are approaches how to use meta-data technologically.

There are high level architectures for IT-supported learning, education, and training systems. But these reference systems lack of unique, essential and recurrent operations for using knowledge material and proper metadata. This lack is obvious in designing and developing knowledge transfer system, because of the insufficient consideration of meta-models. Meta-models such as Meta Object Facility (MOF) designed by Object Management Group (OMG) or the use of Unified Modeling Language (UML) and architecture concepts are not considered for a systematic development of knowledge transfer systems by now.

In the field of e-learning there are efforts to support business processes with their business objects (knowledge material and proper metadata) by knowledge transfer systems. Existing knowledge transfer systems such as Content Management System, authoring tools, or kiosk systems focus on single areas of e-learning. A framework for integration of the isolated running systems to support the business processes of e-learning is missing.

Considering Internet-based education and training show the complexity of today's knowledge transfer system. Development of such systems raises the following questions, which clarify the problem:

- How can the requirements be analyzed out of the business processes?
- How can the requirements be transferred in functionality used by the customers? How can the knowledge material and proper metadata be taken into account?
- How does the functionality look like to meet the requirements? Is there a way to generalize this functionality?
- How does a method which is able to generate common operations look like?

The answers for these questions are given by the approach presented in this paper. The mentioned lacks, in particular the handling of knowledge material and proper meta-data in the field of e-learning, are the reason to ask for a method of generating meta-operations supporting knowledge transfer processes.

2. STATE OF THE ART

2.1 Meta-model

One deficit that has been identified is the lack of using meta-models for developing knowledge transfer systems. Therefore some approaches for meta-modeling are presented in the following. Meta Object Facility (MOF) of Object Management Group (OMG) [OMG, 2000] provides a framework for managing meta-objects in distributed environments. Distributed environments are characterized mainly by heterogeneity. With CORBA [Ben-Natan, 1995] a concept exists to overcome the problem of heterogeneity within distributed systems. One solution is defining a common definition language for meta-objects; this was done by CORBA's IDL (Interface Definition Language). The necessary meta-model for describing IDL results in defining MOF by OMG [Crawley et al., 1998]. The architecture of MOF's framework is based on the model of four layer meta-data architecture of CDIF's framework, which is standardized by ISO. The four layers are defined as follows:

- The **user object layer** comprises the information that we wish to describe. This information is typically referred to as "data"
- The **model layer** holds the meta-data that describes information. Meta-data is informally aggregated as models.

- The **meta-model layer** provides the descriptions (i.e., meta-meta-data) that define the structure and semantics of meta-data. Meta-meta-data is informally aggregated as meta-models. A meta-model can also be thought of as a “language” to describe different kinds of data.
- The **meta-meta-model layer** comprises the description of the structure and semantics of meta-meta-data. In other words, it is the “language” for defining different kinds of meta-meta-data.

For example MOF meta-data architecture can be instantiated with models for UML (Unified Modeling Language) as follows: The MOF Model as the meta-meta-model is object-oriented, supporting meta-modeling constructs that are aligned with (though a bit simpler than) UML’s object modeling constructs. The UML meta-model provides constructs to describe UML models, which are situated on the model layer. With UML model it is possible to describe objects as known.

The four layer meta-data architecture has a number of advantages:

- Assuming that the meta-meta-model is rich enough, it can support most if not all kinds of meta-information imaginable.
- It potentially allows different kinds of meta-data to be related. (This depends on the design of the framework’s meta-meta-model.)
- It potentially allows interchange of both meta-data (models) and meta-meta-data (meta-models). (This presupposes that the parties to the exchange are using the same meta-meta-model.)

2.2 N-Layer architecture

Modern software systems are usually implemented as n-layer architecture [Chartier, 2000]. In particular if the functionality is distributed or the functionality is accessible over the Internet, this approach is developer’s first choice. Usually a three-tier-architecture is the most famous one of the family of n-layer-architectures. This type of architecture consists of the following three layers:

- **Presentation layer:** This is the end-user’s system, where the user interacts mostly by graphical user interfaces with the system. The necessary code runs on the client machine or is operated by internet browsers e.g. web forms or java applets
- **Business layer:** This layer operates on business objects and rules and controls the control flow of the system. Its main task beside control flow is data manipulation and transformation of information. It is mostly designed in a stateful manner.
- **Data layer:** The main task is to provide persistence for data. The storage can also be optimized in this layer for performance reasons e.g. by indexing certain data.

Today’s state of the art is an extension of the three layer architecture. The extension provides two more layers to the model:

- The **presentation logic layer** placed between presentation and business layer is responsible for the presentation of data in end-user’s system. This logic has not to be a part of the client. Especially in web application the web server producing HTML or XML is an example for this layer.
- The **data access layer** located between the data layer and business layer abstracts the access to persistent data stored in the database. A more common view of a special database is the result using this layer. In addition, several databases can be harmonized by this layer.

3. ON THE WAY TO FIND A METHOD OF GENERATING META-OPERATIONS

The following approach will be used to solve the mentioned problem by designing a method of generating meta-operations in the field of e-learning. In a first step the requirements of e-learning with regards to the business processes are analyzed. The results will be shown schematically. In the next step the method will be formalized by using the schematization. In particular the identified functionality represented by meta-operations is the subject of the formalization. These proceedings are generalized by developing a method generating meta-operations. Designing a meta-operation model allows us to represent meta-operations in a formal way. Because of the meta-operation model, interfaces for software components can be realized. Out of these components we design a common architecture for knowledge transfer systems.

The requirement analysis of Internet-based education and training focuses on the knowledge transfer processes authoring, teaching and learning. The analysis considers the individual process of each involved role. The objective considering the business processes is to identify requirements. Furthermore, identifying possible meta-operations supporting the business processes with necessary business objects and showing dependencies between meta-operations are additional objectives of the analysis.

The first step of the analysis is to investigate each of the knowledge transfer processes in detail and to find adequate sub-processes. These sub-processes are discussed in detail in a next step resulting in activities with relations to identified business objects. Activities and business objects are the basis for engineering the requirements. Once requirements are identified, we can start finding functionality and parameters which meet the requirements. Based on this functionality operations can be designed. Using interfaces, which are generated out of the operations, leads to the design of components.

The results of the analysis are represented in figures and tables. Figure 1 is a generic form how the results can be described in a non-formal manner. The research along the proceeding mentioned above implies the following experiences:

- Requirements from the business processes
- Possible operations which meet the requirements
- Recurrent business objects in particular meta-data describing knowledge material

The schematization of the analysis of Internet-based education and training does not satisfy any formalization. However, it is the basis for a formal proceeding.

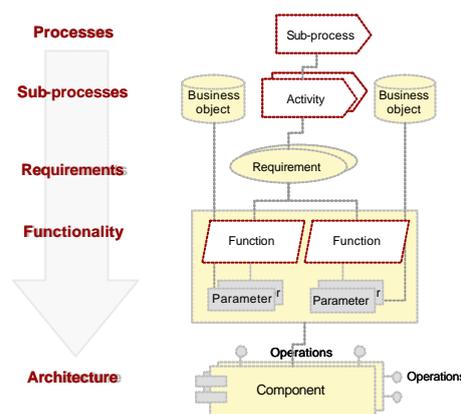


Figure 1. Proceeding Schematic representation of the results of the analysis

4. THE FORMAL METHOD OF GENERATING META-OPERATIONS

The proceeding of the schematic analysis for ascertainment of possible meta-operations described above shows relations between business processes and business objects. Meta-operations represent functionality which is provided by IT systems. These systems operate on the business objects in particular knowledge material and proper meta-data. The functionality is necessary for the fulfillment of the business processes. The formalization comes along with the answers of the following question:

- How can meta-operations be identified and which meta-data is necessary?
- How does a systematic proceeding look like?
- How can an architecture be developed based on the meta-operations?

The method of generating meta-operations was developed based on the familiar software development process. The common software development process consists of three main phases: analysis, development and realization. Common literature mentions the separation of the software development process up to seven phases [Sommerville, 2001]. No further benefits are achieved for our method, if we consider all seven phases. So, we concentrate on the three main phases, which are defined as follows:

- In the analysis phase requirements of the customer derived from the business processes are identified.
- The design phase provides a conceptual solution for identified requirements of the customer.
- In the realization phase the developed concepts are improved and implemented.

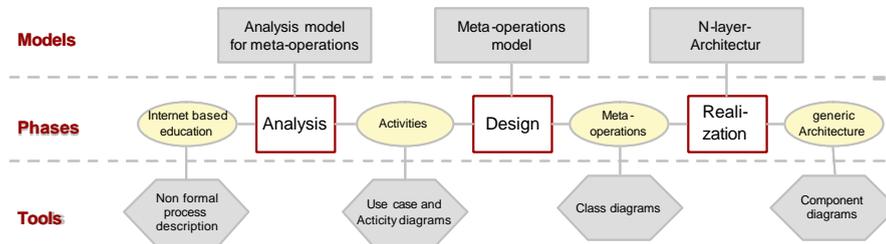


Figure 2. Method of generating meta-operations

The method of generating meta-operations adapts these three phases to meet the requirements, which are verbalized as questions above. Figure 2 shows the phases of the method. The analysis phase identifies activities from a non-formal description of the processes of Internet-based education and training. An analysis model especially designed for this phase supports the proceeding of identifying activities. This phase results in a formal description of activities using UML diagrams, in particular use case diagrams and activity diagrams. These formal descriptions of activities resulting in meta-operations are the basis for the design phase. For this purpose the meta-operation model which supports the design of the meta-operations is needed. UML class diagrams formally describe the meta-operations. Once all meta-operations are designed, we can start the realization phase. By using a third model – the n-layer architecture – it is possible to build up a generic architecture, which can be represented by a UML component diagram.

The analysis phase needs the analysis model, which will be described in the following. For identifying and describing activities it is necessary to have a well-defined scenario of the Internet-based education and training. Therefore a non-formal process description is the basis for the analysis. The analysis itself has four objectives to find activities. These phases are listed in Table 1 with their name, a short description, tools used in the phase and the expected result of the phase.

Table 1. Analysis model

Objectives	Description	Tool	Result
Identification of activities	Based on the business processes each sub-process is researched and divided in activities.	Use case diagram	Use cases, which are named by a pair of objects and activities
Identification of essential data	Necessary, manipulated or new created data can be identified by considering each activity.	Extended use case diagram (shows data flow and each relation)	In- and output data
Description flow	Based on the identified data each activity is described with its flow	Object flow diagram (activity diagram)	Proceeding of each activity with actions and objects
Prerequisites of activity	If there exists temporal dependencies between different activities, identify them here	Use case diagram	Dependencies between activities

The design phase picks up the results of the analysis phase and generates interface representation of meta-operations. The meta-operation model correlates the identified data and actions and provides a method of generating the interface with signatures of the actions. This interface can be implemented by reusable software components. Figure 3 shows the meta-operation model.

The meta-operation model consists of five abstract classes:

- The class KNOWLEDGEMATERIAL represents knowledge material. An implementing class of it has to provide a relation to the existing physical material e.g. file or dataset.
- The class METADATA represents the description of a knowledge material in terms of implemented meta-data standard, e.g. LOM.

- The class SPECIFICATION has all other in- and output data beside knowledge material and meta-data identified in the analysis phase.
- All actions derived from the activities in the analysis phase are stored in the class ACTION. This class owns all in- and output data in particular meta-data and knowledge material.
- The class METAOPERATION owns all actions the meta-operation needs.

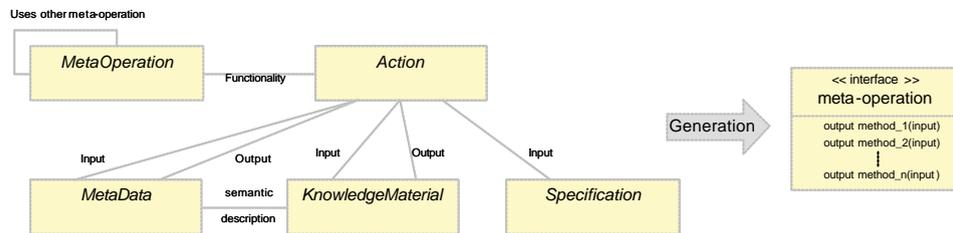


Figure 3. Meta-operation model and a generated meta-operation

Once a meta-operation is described by the meta-operation model an interface for the meta-operation can be generated. A method generating this interface is provided in the design phase. The right hand side of Figure 3 shows a generated interface of a meta-operation. The generation uses the information held by class ACTION in particular the object flow of each action identified before, for building up the operation’s interface. The interface itself needs a proper name provided by class METAOPERATION.

The meta-operation model is modeled by the MOF meta-meta-model and complies with the meta-model layer of the four layer meta-data architecture. The generated meta-operations comply with the model layer of the architecture. The meta-operations allow describing software components with common interfaces. So the meta-operation model benefits from all the advantages which MOF offers. Especially interchanging meta-operations are possible if developers use the same approach.

Once meta-operations are generated the third phase of the method begins. The realization of a generic architecture uses the n-layer architecture model. The meta-operations defined by interfaces will be realized by software components and can be plugged together according to the n-layer architecture model. Figure 4 shows such a software component. The component can realize several meta-operations diagrammed by the interface symbol.

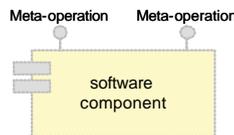


Figure 4. Software component realizing meta-operations

5. APPLYING THE METHOD

The method presented in the last chapter has been applied in an Internet-based education and training scenario of our university and also in an international research project [CANDLE, 2002]. The result is the knowledge transfer system ED.TEC (educational technologies). The ED.TEC system is based on an architecture based on meta-operations. Figure 5 shows this architecture. For a better understanding a graphical representation of software components is used instead of the formal UML representation introduced before.

The ED.TEC architecture was developed according to the n-layer architecture model whereby all five layers were considered. The architecture allows us to bind several heterogeneous databases to the system. The CONTENT INTEGRATION SERVER (CIS) homogenizes the data access. Therefore so-called loaders for each database were developed. A loader can be easily developed by implementing the concepts of an abstract component, which provides functionality to bind databases to the system. The business layer has several components realizing meta-operation of different processes of the knowledge transfer. For example the CONTENT PREPARATION component provides functionality of presenting content in terms of knowledge material.

CONTENT TRANSMISSION provides functionality of recording and sending lectures and courses over the Internet. The presentation logic layer holds a component called CONTENT BROWSER (CB). The CB is a reusable presentation component for navigating through a hierarchical structured course and getting information in particular meta-data of content. Another component of the presentation logic layer is the so-called META-DATA EDITOR (ME), which allows user to describe knowledge material by entering meta-data.

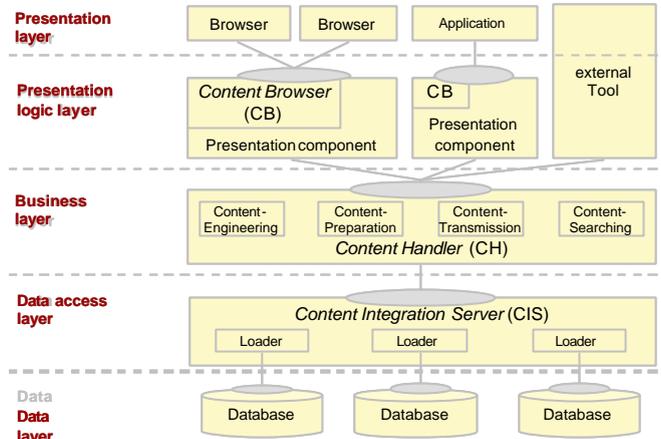


Figure 5. Architecture of the ED.TEC system

The software components are a result of the multiple application of the method of generating meta-operations. Explaining development of the whole architecture would go beyond the scope of this paper [Feuerhelm et al., 2001, Feuerhelm et al., 2002]. However, to clarify the method in practice the development of the component META-DATA EDITOR is described in the following.

Starting from the scenario that a user wants to author material, several requirements for an adequate component do exist. Based on this non-formal description of the process “authoring material” using meta-data the method can be applied. Figure 6 as an example shows one result of the analysis phase in the form of an extended use case diagram. This diagram shows in addition to the uses cases the data flow between the use cases. The use cases are separated in two systems: the production system which supports users to author material and the CONTENT ENGINEERING component which provides functionality of collecting, processing and storing meta-data. .

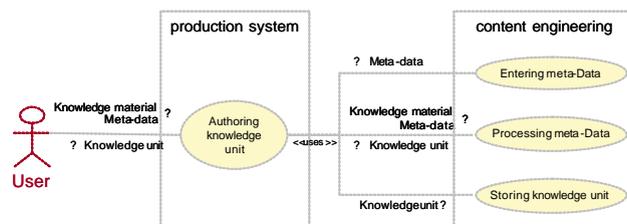


Figure 6. Extended use case diagram as a result of the analysis phase

The activities handling meta-data as a result of the analysis phase are the following three major activities:

- Entering meta-data from user by its front end
- Processing meta-data by attaching to appropriate knowledge material and forming so-called knowledge unit
- Storing knowledge unit in database

Each activity is described by several actions. We discuss the first activity “entering meta-data” in more detail: A user chooses a certain knowledge material, which he/she wants to describe by entering its meta-data. The first action by the system is to load existing meta-data or creating new meta-data. After that, in the next action the meta-data object has to be visualized by showing the meta-data editor with the values of the meta-data object. After entering the meta-data by the user, the meta-data object has to be filled by editor’s values. Each described action and the necessary data are modeled with the meta-operation model. The corre-

sponding meta-operation is called “Entering meta-data”. Figure 7 shows the instantiated meta-operation model for the meta-operation “Entering meta-data”.

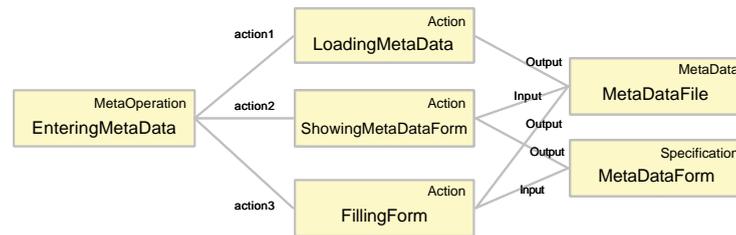


Figure 7. Meta-operation model for the meta-operation “Entering meta-data”

Generating the interface from the meta-operation model is the basis of developing the component. The component META-DATA EDITOR provides the interface for entering meta-data. The system is now able to use the functionality of the component whenever the business processes of the user needs it. In the ED.TEC system this functionality was implemented using Microsoft’s .NET Framework especially the interface was realized using custom web controls. So the component with its functionality can be reused easily.

6. CONCLUSION

Developing systems to support Internet-based education and training can be done in a more uniform way by using the method of generating meta-operations. The integration into MOF provides the advantage that the identified essential functionality can be described on meta-layer which makes the functionality interchangeable. The development process is clear and systematic. In addition, developed components with clear interface can be used ubiquitously in particular over the Internet. The approach has been applied to the area of the knowledge transfer as described in this paper and also to the administration and IT management in the field of e-learning (outlined in [Mayerl and Abeck, 2001]).

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IDENTIFYING LEARNING SCENARIOS FOR A MOO IN AN ACADEMIC LEARNING CONTEXT

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ABSTRACT

E-Learning platforms offer content and cooperation facilities for students. As learning requires active involvement of students, it should be based on domain-specific learning cultures. Therefore, the identification of reasonable learning activities within such learning cultures can contribute to the developing or tailoring of learning platforms, learning scenarios being helpful for this task.

In this paper, the example of JurMOO, a MOO developed for Computer and Law teaching, is presented. The tailoring and implementation of JurMOO is aimed at promoting cooperative, practice-oriented learning as well as gender mainstreaming in a Computer and Law seminar by supporting students' works on their seminar contribution. The example shows that using JurMOO according to the learning scenario helps to improve the seminar preparation of the students. Furthermore, it promotes cooperation, discussion and female participation.

KEYWORDS

Learning Scenarios, Education, MOO, Constructivism, Computer-Supported Cooperative Learning

1. INTRODUCTION

Learning platforms have to be integrated into anticipated learning contexts. One possibility is to start from a status quo analysis and to identify weaknesses in the given situation, which could be overcome by using learning platforms. Related anticipated media uses can be described by means of learning scenarios, and discussed with the domain experts. In this context, learning scenarios can function as an interface between developers and educational experts (such as professors, tutors, and students.) For the developer, the scenarios represent requirements of the demanded technology and guide purchasing, developing, or tailoring of products. For the domain experts, the scenarios allow for comments, critique, and proposals; this is: for participation, which is utmost important because of the iterative nature of related processes.

In the example presented in this paper, a developer team studied the situation at a given institute by interviewing relevant people. By cooperating with engaged partners at the institute, they have developed a conception for the use of JurMOO, tailored a MOO accordingly and used it for student cooperation in the preparation phase of a traditional seminar. JurMOO has been implemented, tried out, and evaluated.

The paper starts with some background remarks, which are to point out why the socio-cultural context of learning has been discovered only recently in the didactical discourse on learning platforms. The following chapter is to make clear, that for learning platforms to function in socially embedded learning environments, tailoring a platform requires the identification of concrete scenarios to be supported. At the end of the paper, the use of JurMOO in a Computer and Law seminar is described. It shows that MOOs allow for a social framing of virtual interactions and thus promote motivation, cooperation, and even gender mainstreaming, and that learning scenarios help when tailoring or implementing learning platforms.

2. THE CONTEXTLESSNESS OF EARLY TEACHING PLATFORM-DESIGN AS A REASON FOR LEARNING SCENARIOS TO BE “DISCOVERED” ONLY RECENTLY

The discourse on learning machines is older than the use of computers in education. The reason for this has been the (instructionist) assumption that human learning functions according to the paradigm of accumulation: the more knowledge is accumulated, the better the learning. Skinner (1971), for example, regarded learning machines as output-generating systems reacting on inputs (which did not require a PC in the modern sense. He interpreted teaching along the lines of behaviorist ideas as a form of conditioning of students. Thus, Skinner interpreted learning as a specific form of input-output-processing: while teaching was a pouring of cognition (content) into the heads of the students. A “learning machine” had to control this effectively without wasting resources (time).

In this sense, learning is a mechanical process, separable from its socio-cultural environment. While the learner was seen as a passive knowledge storage, the active role was that of the machine. The first idea for a “learning machine” was to make student behavior decisive for the speed of representing new units of content (i.e.: lessons or chapters) (Greif et al, 1989.) Such "Pacing" was a form of adaptivity: the speed of teaching was controlled by the success of the learner, being automatically evaluated by means of ongoing automatic tests. To influence the output, the steps between the units of content, the number of explanations, or the time in between two lessons could be changed.

However, Computer-Aided Instruction (CAI) and Computer-Based Training (CBT) did not satisfy all demands, as it did not represent the richness of a traditional learning situation, being based on a teacher who – by his knowledge of the students - uses applied teaching strategies. Therefore, Stulorow (1965) had proposed more sophisticated teaching machines allowing for flexibility and use of experiences with learners.

However, the complexity required when stepping more into sophistication, was only supportable with the invention of Intelligent Tutorial Systems (ITS) using intelligent agents (IA) to structure the navigation in expert components dynamically and according to specific learner components (Strittmatter et al., 1997). Additional flexibility could be reached, when it no longer always had to be the computer which adapts itself in a given way, but when the teaching became adaptable (Specht, 1998.)

A general critique on the instructionist didactical conceptions of computer-based learning came from constructionism. The early constructionist critique was on computer use in education in general, contextuality being seen as a problem for programmed teaching (Duffy et al., 1992). A different view emerged, when contextualization was discovered as a chance for education. In the 90s, the interactive potential of the computer moved into the focus, while it had been more in the periphery at the beginning (Specht, 1998). Students should no longer be considered as mere consumers (De Paula, 1999), but as decisive actors. Computer-supported collaborative learning (CSCL) emerged besides programmed learning as a new field trying to orient education more to practice. The student should learn by practice about practice (Spiro, 1992), this is: by developing cooperative activities of their own (Greeno et al., 1993).

In other words, experience is always situated (Suchman, 1987). Data can become information only when being framed. Such framing being based on expertise, it can be a basis for misunderstanding - or for reflection (Wenger, 1998.) Therefore, learning cannot be reduced to data storing in the brain, but requires understanding in much broader sense.

Education should not be reduced to a pouring of content into the heads of students in appropriate doses, but should be seen as an opportunity for students to understand and test expert roles: students should be helped to develop competences by anticipating practice. This illustrates the deficits of context-free design of learning platforms. However, these deficits could only be addressed, when inter-personal cooperation had become mediated by means of computers, a process strongly promoted by the growth of the internet. However, contextualization is not for free: it requires domain-specific knowledge in the design process, which can be acquired by try and error, by the integration of domain experts, or by empirical studies. In any of these cases, the effort required is high, this being one reason for the lack of didactical perspectives in many design projects.

3. LEARNING SCENARIOS AS A MEANS OF DEVELOPING DIDACTICALLY EMBEDDED SYSTEMS SUPPORTING LEARNING

Computer use can be analyzed in a de-contextualized manner. In this regard, the use of technology is merely determined by technology. Use cases show sequences of system events triggered by the activity of an actor, producing a result for the actor, and, eventually, other actors (see: Jacobson et al. 1992) and thus can help to identify possible human-machine interaction forms under a technical perspective. In so far, use cases may be used to understand the interactive potential of a technology. While sometimes use cases and learning scenarios are used in a synonymous way (Jarke et al., 1998), the RION project differentiated between both, which is also a usual use of words, either (ibid.)

For the RION project, use cases show what possibly can be done with a technology, whereas scenarios describe what should be done with it. Use cases specify a product as a technical artifact, scenarios describe it as a part of a socially embedded interaction. This differentiation makes it possible to use scenarios to develop use cases, for example, when designing (new) computer support for a given social environment. However, it makes it also possible to find implementation opportunities by studying use cases of products, this is: after their development.

Regarding learning platforms, learning scenarios can be used in different ways. One possible way could be the development of a learning platform for a completely new learning context. Another situation is given, when it comes to support existing learning contexts. In this case, one has to integrate learning platforms into given learning contexts. In order to be able to do so, one has to study the status quo of teaching at the institutes, where a platform is to be implemented. In this case, which will be presented in this case study, the anticipated system is seen as an enhancement of the given educational culture.

However, developing and implementing technical media into a given social context will change this context. The re-integration of such a change in a social system requires a legitimation to be based on commonly shared values, a common understanding of weaknesses of the existing system, and a discourse on applied strategies of change. In other words, the integration of learning platforms into a given educational systems requires active participation of the affected people. In the case of the RION project, such an attempt has been undertaken in regard to the implementation of a MOO into a traditional seminar context which will be described in the following.

The acronym MOO consists of another acronym: MUD. A MUD is a multi-user domain, in an elder terminology: a multi-user dungeon (the genesis of MOOs laid in the field of computer games). A MOO is a Mud, programmed in an object oriented manner. This means that all elements may be changed easily (Haynes et al., 1998, p.2). MOOs can be seen as sets of websites, which are textually described as "rooms", "characters", and "objects" in general.

The use cases for a typical MOO are characterized by the opportunities to "walk" into (=open) and out of "rooms" (=close websites), to read their descriptions (=open related website), or to "talk" (=write text) to the people in the room (who can read the message, following a quotation "xyz says", xyz being the author of the message.) "People outside the room" (=users with other websites open) cannot see the message. "Whispering" (=writing a message to a special addressee) is not related to co-presence in a room, and the related messages cannot not be seen by others than the addressee. It is possible to search for people, rooms and objects.

At first glance, MOOs seem to be enhanced chatrooms. However, there are additional use cases in MOOs. For example, "non-playing characters" ("npc") can be programmed, softbots which may interact with users. Furthermore, users can change the environment, if they are given the rights to do so. The opportunity to "drop" things implies an opportunity to upload. The opportunity of such uploading make MOOs possible platforms for asynchronous cooperation, too. Therefore, the great potential of MOOs is its combination of information and communication, and the easy shifting between them (Hoadley, 1999). However, the use cases of MOOs have to be embedded in didactically developed educational contexts, learning scenarios being extremely helpful for this task.

4. IDENTIFYING LEARNING SCENARIOS

In order to find possible learning scenarios in the given learning context, the RION team developed questionnaires and distributed them to the students of the partner institutes, collected them after their completion and analyzed them. Additionally, RION studied the curricula of the partner institutes, visited them, participated in seminars and suchlike, and discussed with the professors, the tutors, and the students.

On one of these discussions, tutors of a RION partner institute described a bad-case scenario of a seminar as follows: Students join preliminary seminar meetings in order to find a topic, which can be studied, described, and presented afterwards (the preliminary seminar meeting is organized some months before the seminar in order to allow students to prepare their papers.) Students seldom use the opportunity to discuss their papers before the seminar event, which leads to misunderstandings and wrong emphases of their presentations. In order to be polite and appear interested, the professor asks questions after the presentation. The auditorium, however, is more or less passive, which - to a certain degree - is due to the poor understanding of what the others present. Students "wake up" when it is up to her / him to read her / his paper. Discussions among the students are rare.

The RION team and the tutors agreed that it is crucial to integrate the students into the preparation of the seminar, to promote awareness of what the other students are doing, and cooperation. For the promotion of cooperation, the coordination of the contributions of the students remains a promising field. In the situation given, coordination between different presentations for the seminar is only organized, if students contact the docent or tutors before a seminar, which occurred seldom.

Giving the students the opportunity to discuss their work together provides them with the opportunity to take over from others, or vice versa. Obviously, this is related with interests, and discussing conflicting ones thus can be a promising mean to promote a cooperative working culture. Furthermore, it may produce more awareness of the implications of the individual work among the students. Traditionally, communication and negotiation processes related to seminar contributions are restricted to the preliminary seminar meeting, which takes place before students become familiar with the issues to be discussed, and which consists of merely one single event. Therefore, promoting similar discussion processes among the students by using JurMOO could be a promising learning scenario.

The RION team, the professor and the tutors developed the following learning scenario: tutors are to moderate jours fixes and to promote student-student-interaction. The jours fixes, among others, are to promote an awareness for the preparation phase to be an important part of the seminar. This means that while students may meet in JurMOO at any time they want, there are certain virtual meetings in JurMOO with the tutors on fixed times.

So far, the applied use cases of the MOO only cover typical chat functionalities. However, students can additionally "walk" around and read room and person descriptions, make and describe rooms of their own and themselves. The upload-functionality supports the opportunity for students to find documents in JurMOO. In order to promote cooperation in the preparation of a seminar, important documents are the outlines of the student papers. Additional information can also be presented in JurMOO, including a help functionality.

The design of the learning scenario has to take into account that the students have to remain aware of their benefits from such additional efforts demanded from them. For example, the upload of their outlines was integrated into synchronous discussions on the topics to be covered in the seminar presentations and an avoidance of overlapping. The learning scenario thus was based on the upload of preparation materials, being reflected on common synchronous discussions, mediated by the tutors. The geographical metaphor of JurMOO was used to structure the discussion: every student has his own "room", where he was asked to "drop" his outline and summary. Additionally, there was a common "seminar room". Students were asked to walk around and leave comments, critique, and so on.

5. PERFORMANCE AND FINDINGS

The preliminary seminar meeting was attended by nearly twenty students, half of them being female. Personal data were collected with a special participation list including email address, gender, computer literacy, Internet access, and JurMOO name. After the distribution of the seminar tasks, the RION team gave a

short demonstration of JurMOO. The demonstration of JurMOO provoked great interest. All students had Internet access. The preliminary seminar meeting was followed by a distributed online JurMOO training consisting of two evenings. The online training some days later was so much enjoyed by the participants that even after the training, some students remained in JurMOO joking, discussing and making appointments. From that time on the students were to "meet" in the JurMOO every fortnight at a given time with tutors being virtually present.

Although an explanation of "netiquette" normally should be integrated in any educational use of a MOO (Haynes et al., 1998, pp.5-8), RION did not invest much time in that. The result was, that after a short period of unstructured chaotic interaction, some effective rules emerged "on the fly" – the tutors often being catalysts for related self-organization. The students used their JurMOO names when communicating, names which they had chosen by themselves.

The relative complex structure of the rooms and their undefined purpose made their use as a mean to structure communication more difficult than the chatting itself. Students tended to remain in the plenum even to discuss "private" or sub-group issues waiting for a break to bring them forward, the related delays and the changing subjects causing some frustration. The possibility to join other "rooms" was not always used. Obviously students did not know if they were, for example, allowed to leave a common meeting. However, tutors could initiate rules and motivate "pioneers". This was especially important, as chatting normally started with a "tentative socializing" with little structures and little hierarchy. While this phase was important for any emergence of "netiquette", there seemed to be a related over-stability hindering the participants to switch over to new interaction forms such as dealing with task-related questions.

For untutored groups without strong "pioneer" personalities effective switching from preliminary chit-chat to task-oriented discussion may be problematic and, on the longer run, lead to "empty postboxes" and a decrease of interest and commitment. With the tutors, however, this was no problem. On the other hand, tutors got a direct feed-back on their intervention, which can be very helpful, as the following example shows (JurMOO names changed, dialogue translated, the source is the JurMOO log):

Frewy says: "*Gamma, what about meeting each other?*"

Gamma says: "*si*"

Gamma says: "*real?*"

Frewy says: "*HEEE???*"

Gamma says: "*phone afterwards?*"

Tutor says: "*IMPORTANT: NO TELEPHONE!*"

Gamma says: "*What?*"

Frewy says: "*Why no phone?*"

Tutor says: "*OUR AIM IS TO HAVE YOU COOPERATE WITH THIS TOOL !*"

Admin grins

Tutor says: "*SO ONLY IN UTMOST EMERGENCY!!!*"

Tutor says: "*IF YOU THINK THAT IT DOES NOT WORK LIKE THAT: FEEDBACK!*"

Frewy says: "*This should be a reason not to phone? Know each other personally*"

Gamma says: "*Everything roger, but I prefer the phone for personal things*"

Tutor says: "*Private things can still be communicated by the phone, of course. It would only be nice if you would discuss the content in the MOO.*"

Tutor says: "*I misunderstood, obviously.*"

Tutor says: "*sorry*"

Frewy says: "*Do we have to discuss anything??*"

Gamma says: "*no pasa nada.*" (Spanish: nothing happened)

The example shows how synchronous interaction allows for critique and recursion – like a face-to-face dialogue. This could also be the case for asynchronous media. However, in synchronous media the feeling of co-presence seems to be stronger, being based not on immersion, but on the personal experience of discursive spontaneity of the chat partners, which makes it easier for the students, for example, to criticize each other.

While all students used JurMOO to present the outline of their papers (technically: uploading it while "dropping" "things"), annotations were mostly made in two ways: tutors commenting on the proposals of the students and students commenting on their own ("only a first attempt"). This means that students first rarely

used the opportunity to annotate the documents of other students. One possible interpretation could be to see it as a general tendency of students to be too nice to each other (see Veerman, 1999). However, students uttered a lot of critique and proposals, but mostly by means of synchronous interaction. The reason could be, that in synchronous interaction, students are able to see the reaction of the counterpart, and thus to “test out” interaction “on the fly”.

Instead, in asynchronous media, to annotate (upload critique) on someone’s “dropped” text remains present like a sign left in somebody else’s document. This cannot so easily be re-interpreted like in a synchronous interaction. The lower hurdle for critique and its better framing in synchronous tools seems to us to be a strong argument against Veerman’s (1999) general preference for asynchronous ones. A dialogue out of the MOO-log may demonstrate the “testing out” of interaction (dialogue translated):

Gamma says: “*are you fearful?*”

Gamma says: “*hihihi*”

Frewy says: “*Oh, terribly !!*”

The dialogue shows that the emotions can be of relevance for seminar participants. In a distributed situation, the emotional framing of work has to be done by the media at hand. However, addressing emotions is no easy task. Therefore, the first attempt is “coloured”, “broken”, by means of irony, a relativation, which is immediately accepted by Frewy. But without commitment, there cannot be help from the others. Therefore, the dialogue continues with additional actors involved:

Beta (Juridicum) whispers to Gamma (Juridicum): “*Gamma, somehow I’m scared that I could fail!*”

Gamma (Juridicum) whispers to Beta (Juridicum): “*so do I*”

Gamma (Juridicum) whispers to Beta (Juridicum): “*or that Frewy and me are overlapping*”

Gamma (Juridicum) whispers to Beta (Juridicum): “*the worst, for me, is the presentation, or better to say, the bizarre questions asked afterwards*”

Beta (Juridicum) whispers to Gamma (Juridicum): “*Gamma, so I’m not the only one to be yellow!*”

Gamma (Juridicum) whispers to Beta (Juridicum): “*Shurely not the only one yellow*”

The students used “whispering“ in order to exclude other students from their confessions (students have been informed about the log to be used for scientific evaluation in an anonymous manner.) The example shows that students can give each other emotional support. Such mutuality is a pre-requisite for a shared identity. However, such framing of cooperation would hardly occur in an asynchronous medium, where it is more difficult to test out and “colour” commitment.

Besides fear, students discussed problems with basic concepts of scientific work such as “paper”, “summary”, “presentation”, and “abstract”: some students, for example, uploaded their summaries under the heading: “abstracts”. The log also shows that related questions were quite numerous: “What should a presentation look like?” “Should it be presented with Powerpoint?” “How many slides?” “How long is a paper?” “Is there a difference between a presentation and a paper?”...

Discussing such basic and formal questions must not necessarily have produced a better quality of the individual results. However, it contributed basic knowledge to the students and provided a greater transparency to the seminar, making students feel more secure, and leading (as the professor assured us) to greater homogeneity between the individual presentations. This shared aesthetics in return made the understanding easier and fostered a certain feeling of community. The professor, having been very skeptical, reported in an ex post interview, that the seminar (unlike others) obviously needed no “warming up” phase, constructive discussions being so intense that he has to stop the students again and again in order to keep in line with the agenda!

The tutors moderated the ongoing preparation of the students on the jours fixes. Tutors reported to be very content with using JurMOO. To a certain degree this has to do with the tutor-student relation becoming more structured (restricted to the jours fixes) and more convenient at the same time: participants could join from their homes, and tutors could stick to the weekly time schedule and feel better prepared than being asked on occasional meeting in corridors. The tutors reported that the regular investment of time is counterweighted by the opportunity to place the session into calmer time slots such as evenings (7pm-8pm) without having their students protesting.

A tutor, who had feared further isolation of the individual students by means of computerization, admitted that the use of JurMOO in the virtually supported seminar preparation led to the contrary effect: an increase of interaction and even face-to-face appointments, meetings and discussions between the students. How much the preparation phase in JurMOO contributed to inter-student cooperation may be derived from the fact that students, meeting after the face-to-face seminar, switched back to their JurMOO names when addressing each other.

The average value for fun given by students working for the preparation of this law seminar dedicated to this simple, new and unknown software tool on a scale ranging from no fun (=0) to enormous fun (=10) was 6.8! This is the more interesting, as the female students were even more content with the use of this tool (7.4) than the male ones (6.3) making the use of JurMOO promising for gender mainstreaming as well. The playing features of JurMOO might have contributed to the acceptance among the students. The fixed tutored dates, however, consisted nearly completely of task-related interaction.

According to interviews with the students after the seminar, the high acceptance of the tool seems to be a result of its support for student participation. Being able to read the outlines of other students, to compare them with ones own proposal, to discuss them and even to negotiate about possible divisions of the presentations was seen a great benefit. Students have been enthusiastic about their opportunity to communicate with each other and with tutors, and participate in the seminar preparation. Thus MOOs, in spite of their limitations for traditional top-down teaching (Bruckman et al., 1995), are able to support active groups of learners (Rogoff et al., 1998).

6. CONCLUSION

In the given case, the learning scenario was based on the tutoring of students preparing and negotiating their contributions for a seminar. This use of JurMOO as a virtual support for the preparation of a seminar proved to be a good mean for improving the quality of tutoring. Furthermore, JurMOO allowed for a framing of task-related activities, if necessary. However, JurMOO also contributed to a promotion of task-related cooperation and discussion, especially during the tutored "jours fixes".

With the given learning scenario, the potential of the medium is far from being exhausted. One could, for example, think of using the geographical metaphor of MOOs as navigation help for information retrieval for information seekers, the related room structure being a possible design task for student team work.

Concrete visions of what is going to happen are important for using, tailoring and developing educational media. For the domain experts, it is important to secure the necessary resources, academic acceptance etc. This can be done by using the learning scenario. On the other hand, the learning scenario is of utmost importance for developers, which have to tailor and administrate the medium. In the given example, learning scenarios proved to be extremely helpful instruments when dealing with learning platforms.

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A SUCCESSFUL EXPERIMENTATION IN SCIENCE EDUCATION: THE VIRTUAL COMMUNITY OF ALTRIMONDI.NET

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ABSTRACT

In this paper, an experience of on-line scientific communication in educational field is described. Using Bioastronomy, the new Science which investigates about the possibility of Life in other worlds, and using Information and Communication Technologies as vehicles, we obtained a lot of results in approaching young students and in stimulating them in studying scientific disciplines.

KEYWORDS

Education, Communication, Science, Bioastronomy, virtual community

1. INTRODUCTION

Until less than two years ago inserting the keywords "Vita nell'Universo" (Life in the Universe) in any web search engine resulted in a long list of web sites published by private citizens or pseudo-scientific associations and containing descriptions of U.F.O. or people kidnappings by aliens.

The same search repeated today on the major available search engines from Google to Yahoo, from Lycos to Excite, brings very different results. The first in the list is the site of the Italian Education Ministry which reports the project "Vita nell'Universo" described in the present paper; the second is the web site of the initiative itself: Altrimondi.net (www.altrimondi.net).



Figure 1. The results page of Google, www.google.it: the picture shows the firsts 3 links.

Next in the list are links to various institutes of scientific research dealing with Bioastronomy, followed by more references to papers or associations, such as Anisn (*Associazione Nazionale degli Insegnanti di Scienze Naturali* that is the National Association of Science teachers), again describing our project.

Such change of direction has two reasons: first, research in Bioastronomy has grown more and more over the past few years both in the United States and in Europe and therefore also in Italy; later we shall briefly tell why and how. The second reason is that “*Vita nell'Universo*” really exists!: as a matter of fact Altrimond.net is currently the only wide and well structured Italian Web resource addressed to young students and capable of dealing with the topics of this new Science.

2. BIOASTRONOMY

Officially established as a Science in 1982 by Commission 51 of the International Astronomical Union¹, Bioastronomy investigates the possibilities of the existence of life in other places than the Earth.

It is clearly a young and multidisciplinary Science, characterised by a large impact on the public opinion and very close, despite the intentions, to ethical and religious problems. It is easy to imagine how delicate it may be to face the issues pertaining to this new branch of Science, especially when addressing to young students, who in their recent past have been literally “fed” on Science fiction movies and video-games telling unlikely, although fascinating, alien stories.

The difficulty comes also from the multidisciplinary approach that Bioastronomy requires.

As a matter of fact, this discipline is so wide and complicated that it requires the contribution of many fundamental sciences. A few examples: Astronomy, which tells us if the conditions under which our Solar System was formed can be present elsewhere in the Universe; Chemistry, which investigates the phenomena that lead to the formation of complex molecules in space, and finally Biology which tries to understand the origin of life.

The continuous increase of the number of detected extra-solar planets (California & Carnegie Planet Search: <http://exoplanets.org>) and the more and more massive employment of human and economic resources in space missions dedicated to the search of traces of life in the Solar System, or to the more accurate detection of other planetary systems, leave no doubt: Bioastronomy is a branch of Science which will become more and more popular in the near future. And this holds both for scientific institutions and for the media.

3. THE INITIATIVE

3.1 What is “Vita nell’Universo”

On such a background in April 2001 “*Vita nell'Universo*” was started as an Italian national programme addressed to the schools with the aim of inviting young students to think and know more about the fascinating subject of the search for Life in the Universe.

The initiative, addressed to all Italian students, was proposed as an educational project, promoted by EAEE (European Association Astronomy Education) and took advantage from the collaboration with many research institutions, educational associations, astronomical observatories and university departments.

Within the project competition called Altrimondi was announced, open to young students between 13 and 18, with money prizes for the first ten winners. The competition invited the students to investigate and analyse in depth the issues pertaining to Bioastronomy.

¹ The International Astronomical Union (IAU) was founded in 1919. Its mission is to promote and safeguard the Science of astronomy in all its aspects through international co-operation. The scientific and educational activities of the IAU are organized by its 11 Scientific Divisions and, through them, its **50 more specialized Commissions** covering the full spectrum of astronomy, along with its 70 Working and Program Groups. Its Web Site: www.iau.org/

The contest lasted one year, from April 2001 to March 2002, during which the participants (groups of or individual students) produced their work, either in the conventional form of a written research or in the form of hypertext, play for the theatre, game, movie.

The younger (under 13) students were invited to join a non-competitive contest, Altrimondi Under 13, which consisted in submitting a work prepared during the school year.

For each contest a closing event was held, in Torino and Bologna respectively.

3.2 Altrimondi.net

The starting point and heart of the entire initiative was the Web site “*Vita nell'Universo*”, called Altrimondi.net (www.altrimondi.net), created and managed by the Astronomy diffusion and education team “Catch the stars in the Net!” (“*Prendi le Stelle nella Rete!*”) of the Astronomical Observatory of Padova and, especially, by the author of the present paper.

Altrimondi.net provided the participants with all the tools required to take part in the project and in the competition.

Throughout the site it was possible to give information and updates in the form of a weekly information Newsletter and thanks to the daily update of the site. Besides, the students and their teachers were put in contact with the experts, i.e. the researchers involved in Bioastronomy.

Within a short time, a virtual community of young people interested in the subject arose. Besides, the many works submitted to the competition Altrimondi proved to be valid from an educational view point and considerably enriched the contents of the site.

3.3 The numbers

The initiative was expected and was very successful, as clearly shown by the following figures:

- 600 registrations to the weekly information Newsletter
- 200 participant groups to either of the two contests (Altrimondi and Altrimondi Under 13)
- 3000 young students present as a whole at the two events in Torino and Bologna that signed the end of the two competitions.

3.4 A successful experimentation

Which were the key features of this project, that turned out to be capable of attracting such a large number of participants?

We recall that POS (Physics on Stage), i.e. the educational projects promoted by ESO (European Southern Observatory: www.eso.org) consisting in competitions of international importance, in their last three editions (200,2001,2002) have reached only a maximum of 20 registered groups, as many as those taking part in the Physics competitions open to Italian Schools.

We have already explained how strong the impact of a Science like Bioastronomy can be on the large public, but we have also pointed out how delicate it can be to face such a subject when addressing to the general public and even more when dealing with young students.

On the other hand, the line “We do Science, not Science fiction” (this line is a TV publicity slogan very famous in Italy), although may seem quite appropriate in this context, is no longer applicable, does not appeal to today's children and teenagers; on the contrary, it may have the effect of pushing them away.

The choice made by Altrimondi.net has shown to be winning just because the new generations need, in their learning process, stimulation and languages close to the imaginary world with which they are familiar since their first years of life. At the same time they demand, with increasing strength, the practical application of what they learn at school.

Hence the Net as a primary vehicle and multimedia as a constant feature. New technologies are not new to the young students to which we address; they are taken for granted, natural; in other words, they are part of their everyday life. In very few cases teachers played the role of mediators in the subscription; mostly, the students themselves subscribed and proposed to their teachers a project to develop.

Apart from children up to 10 years of age, the students of intermediate and secondary schools joined the programme by themselves and only afterwards informed their teachers and their schoolmates about it, sharing with them the material available on the Web site.

Some students participated even without the support of a teacher, although always under parental agreement.

The learning process, although in an educational form opposite to/far from the traditional one, came as a natural consequence of the participation to the programme.

Children, especially today, are naturally multimedia, in the sense that they use all the available tools in order to get in relationship with the world and with themselves.

They are not constrained by the control which is typical of written communication. They are in fact beings under formation, who welcome all the available instruments in order to get in contact with the world.

Therefore all the learning that takes place by means of multimedia takes advantage of resource, joint-participation and pleasure.

This is the result obtained by "*Vita nell'Universo*".

4. WEB AND MULTIMEDIA IN THE INITIATIVE

4.1 The web site design

4.1.1 Graphics, language and contents

The Web site was prepared with appealing graphics and language: the virtual guide of the site is Alien, but he is a kind of alien that doubts of his own existence and stimulates the young visitors to learn more, to take part in the Human Community towards which it is impossible not to feel "a sense of membership", opposite to the alien diversity of the Guide.

The language plays a fundamental role: it is rigorous when speaking, for example, about molecules in Space, of biological experiments, of astronomical observations; it is winking when the scientific dissertation turns to be more colloquial. The Alien Guide, taken from Fiction, represents a means to communicate, an interface behind which children can find, right from the start, rigorous scientific contents.

Imagination and reality are obviously different, although they are kept together by a game which is appealing not only to children and teenagers but also to a considerable number of adults.

The line used by the Guide, which in the Web language is called tagline, sounds like this: "Are you sure that I do not exist? Enter this site and you'll understand what I'm talking about. I will be your Guide".

This sentence has showed to be a good tagline, or, to use the words of Steve Krug in his last book, "*a short sentence that characterizes the entire programme, summarizing the meaning and the values, put at the right place, near the title or the logo in the most visible area of the Home page of a web site*".

If it is impossible to say everything in one page, then a tagline can evocate, appeal, promise.

And in fact our line explicitly addresses an ideal target for the "young human" that has bumped into Altrimondi.net. Such target is modified or widened as the user navigates and visits the site.

Using attractive graphics and languages does not necessarily mean creating complicated, tricky and hardly usable sites.

Altrimondi.net makes use of a good metaphor, i.e. the Alien Guide that accompanies the young human through the comprehension of the proposed subjects, and, as just described, of an efficient tagline.

Then it sticks to the most common usability criteria, such as visual economy (in other words, there are no useless additions), completeness (everything is listed and documented, subdivided in sections and somehow reachable) and redundancy (there are many different ways of accessing the same pieces of information).

The site is divided in three areas, labelled as: Participate, Survive, Communicate, three keywords through which a teenager can identify quickly with the site and obtain the necessary information respectively to join the human community of Altrimondi (registration), to disentangle in the sea of information present in the site by means of the provided tools (educational manual, web forms, questions, pieces of information at various levels) and to communicate both with other children and with the experts of Bioastronomy.



Figure 3. The home page of the site www.altrimondi.net. Besides the animated graphics, a sound reproduces the voice of the Alien Guide.

The game played by the young user is a joke regarding the form, but is serious about the contents.

As a matter of fact, there are very precise rules to be followed when writing contents for the Web. A rather frequent mistake, that occurs at least once to all who work for the Web, is that of starting a game with the users, making them curious, providing obscure data with the aim of creating a growing interest that should push them to read more. This does not work.

Users do not want to waste their time in the Net, not even the youngest ones. They want to understand quickly whether they will find something interesting or not.

“If the first sentence is promising, then they will want to know more and reach the end of the story” like the English philosopher Paul Grice (1913 - 1988) said (actually he was best known for his work on meaning, especially the relation between speaker meaning and linguistic meaning).

Therefore, in Altrimondi.net, after the first click required to enter the site, the connection to the contents is immediate: subscriptions to the Newsletter and to the contests, educational forms, information, news, Bioastronomy web maps, email addresses to use for asking questions to the experts.

If the first key factor is the undoubted attraction that the proposed subject produces on the public, the second important aspect is certainly the experience gained over six years of work in the field of communication, diffusion and astronomy education of the team "*Prendi le Stelle nella Rete!*". Thanks to this experience it has been possible to create valid contents also through the collaborations started with some representatives of scientific disciplines different from Astronomy but all equally involved in Bioastronomy research. This has constituted the third and fundamental key factor.

Another important aspect of the Web site of Altrimondi.net is the continuous communication between users and scientists through the person of the Alien Guide that “takes the user by hand” through the various sections of the site, the available services and the resources required to face such a difficult subject. In this respect, the already mentioned service of weekly Newsletter through electronic mail (with almost 600 recipients) is fundamental.

4.1.2 The newsletter weekly Service

The Newsletter, or, alternatively, the “letter of news”, is today one of the most serious, essential and concrete communication tools within the Net. It has large impact on the public and provides a valid tool of control and

reliability of the users. Its appearance is coherent with that of the site as much as the language and the approach to the users.

With this service the user of Altrimondi.net is weekly informed about the latest news in the field of Bioastronomy research and about meetings and workshops on the subject and is guided, in the form of a serial, to the comprehension of the fundamental elements of this Science.

The two main questions:

- What is life?
- Under which conditions Life may have developed in places other than the Earth?

are analysed under many different view points, such as biological and astronomical, with a rigorously scientific approach, but they are always kept simple. It is clearly pointed out that a scientific definition of what Life is has not been given yet.

Then, assuming that the kind of life we are looking for is the same we know, the evidence of the presence of it far from the Earth has not been found yet.

As a matter of fact there is no precise test to state the existence or absence of Life and up to now it has not been possible to identify a unique feature common to all living beings.

The weekly Newsletters so conceived managed to reach all the users participating to the initiative, including those who, for lack of time, of economical or computing resources as often occurs in the schools, cannot stay connected and navigate the Web site.

The clarity and the simplicity of the language used in the Newsletters have hit the target as far as the comprehension on behalf of children is concerned.

Two are the facts supporting this conclusion:

1) the many questions asked by the users (roughly 10 per week throughout the duration of the competitions, i.e. 1 year) aimed at understanding the fundamental concepts and the Bioastronomy latest news, while only few messages (no more than 5/6 as a whole) contained questions about the presence of aliens on the Earth, crop circles, civilization on Mars, and so on.

2) 90% of the works presented both by the teenagers registered to Altrimondi (intermediate and secondary schools) and by the children who joined the non-competitive contest (Altrimondi Under 13) were relevant to the scientific issues related to the search for Life in the Universe.

The weekly Newsletter, as mentioned above, has constituted a valid tool in the building up of trust between Web site and user because it has provided a continuous feedback on behalf of the members of the project.

Telling every week something new, answering within a short time to all the questions that follow a newsletter, understanding whether all the registered users read the email, checking how many still want to be registered to the service, all this helps to consolidate the relationship between the web site and the user and to constantly verify the usability of the site itself.

The role played by the feedback is therefore crucial in growing trust towards the site, and this is neither exclusively related to the efficiency of the registration procedures, although this is a very important aspect, nor to the easiness of use.

4.1.3 The Astrobiology Manual

Beside the newsletter, other valid instruments were made available to the public. As a matter of fact, the site of Altrimondi.net is rich in material and scientific resources, among which a valuable manual addressed both to children and teenagers and to their teachers. This Astrobiology (Bioastronomy is often called Astrobiology) manual is the translation and the fitting to the Italian educational language and context, of the Astrobiology Manual "The Life on Earth ...and Elsewhere?" that is one of the educational resources of Nasa.

The manual has showed to be a useful working tool especially for the teachers, being full of suggestions, hints of reflection and games studied to approach the subject.

4.1.4 Collaborations

The collaborations that have taken place during the life of the project do not concern only representatives of the scientific world and of school, but also traditional media such as the Radio (in particular *Radio 24* which is one of the most popular Radio channel in Italy) that dedicated to Altrimondi an entire cycle of instalments of a

programme for children. The protagonists were the children with their stories written at School and then read on the Radio and accompanied by comments and interviews with the Astrobyologist.

4.2 The “Human” Virtual Community

The wide consensus of public has led to the birth of a virtual community of amateurs.

To clarify the idea of a virtual community, we report the words used by the Italian philosopher Paolo Ferri (he is best known for his work on digital and New Technology revolution) in an interview made by one of the most important television and telematic program, in Italy, about the problems of communication in today Society, *Mediamente*: "To use a metaphor from literature and in particular from Bruce Sterling, one of the most authoritative cyber-punk literary experts, I would say that the virtual communities are islands in the net, tridimensional worlds that arise within the net and where, just like in a square or in an Agorà of ancient Greece, people meet and establishes relationships".

Nevertheless, the reason why virtual communities do form is still under study: they are places where people learn and exchange knowledge and concepts.

There are sites dedicated to particular aspects of culture, where experts on the subjects are present and come from any place in the world; this last feature represents one more advantage of virtual communities over real ones, that is they can be joined from places very far from each other.

They are Islands in the Net, then, where people learn and meet. The community of Altrimondi.net fully satisfies this definition: it is made up of young students from schools distributed over the Country, from Sicily to Torino, from Trieste to Roma, interested and curious about the issues concerning the search for Life in the Universe, of their teachers willing to get new, up to date and interesting educational material to use with their students, and finally of the scientists keeping an eye on the new generations and on the need of diffusing their own knowledge within a larger public.

4.3 The Advantages Offered by Information Technologies to the Teachers

We would like to spend a few more words concerning the teachers. The advantages offered by information technologies must be exploited not only for helping the youngest but also in view of their use on behalf of the teachers. In many cases one of the advantages is the opportunity of using new material when required by the lessons. This is very far from just re-introducing something that teachers already do. It is much more efficient.

Our experience has taught us that children are attracted by the possibility to find new and exciting information on the Web, material which otherwise would be hardly available everyday to the teachers, due either to the lack of time or to insufficient resources as in the case of Bioastronomy.

On the other hand, for the teachers it would be very difficult to find the time to prepare brand new educational material and develop the will to become authors of hypertext or Web sites.

Projects of this kind were proposed on many occasions but they always failed.

5. CONCLUSIONS

This kind of experience has been very interesting also for our Astronomy diffusion and education team and has allowed not only the development of the project but also the promotion of more successful programmes.

As a matter of fact a new guide, a new educational journey dedicated to primary schools has been launched at the end of 2002.

This new educational tool has been realized by some teachers, among those who took part in the non-competitive contest Altrimondi Under 13, that have formed a group in collaboration with our team and the Planetary educational classroom of Bologna.

Another recent project, launched in September 2002 by "Prendi le Stelle nella Rete!" at the beginning of the school year, has reached about 500 registered groups and more than 200 individual student members after only one month from the opening. The subject is "*Alla scoperta del Cielo*" (Discovering the Sky!) and

develops through four steps, four virtual nights of observation of the Sky in an ideal Astronomical Observatory during which the main astrophysical topics are discussed.

Again information is transferred through the Net: once a week the students receive, through electronic mail, contributions suitable to their age (four categories of age are foreseen: 6-8, 9-10, 11-12, 13-14). At the end of every step, a test is made to check the acquired knowledge. The most active and curious can connect to the dedicated Web site, www.scopriticielo.it, and find more details, suggestions, games.

Through the site it is possible to ask questions to astronomers, participate to guided chats and even contact other students joining the project.

Teachers receive in advance by means of separate communications the full description of every step, auxiliary material and suggestions for additional activities.

Also this project includes a competition, "*Scopri il Cielo nella tua Città*" (Discover the Sky in your Town): this time the students are invited to look for the many forms of representation related to the Sky among monuments, artistic expressions, engineering works in their own town (buildings, paintings, sundials, etc).

We conclude by saying that "*Vita nell'Universo*" has been and continues to be a special project because it has given the chance to experiment a new educational approach: starting from the students to reach the Schools. This has been made possible by the subject itself, by the experience gathered over the past years of work in the field, by the language adopted and, not last, by the technologies employed. It has produced satisfaction, not only to the youngest but also and especially to the teachers who have found in "*Vita nell'Universo*" a valid support to their fundamental and essential role of educators.

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IMPLEMENTING E-LEARNING IN AN EXECUTIVE MBA SETTING: CRITICAL CHALLENGES AND SUCCESS FACTORS

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ABSTRACT

While e-Learning is not a new concept, there remain numerous unanswered questions regarding how students as well as instructors can most effectively interact in “virtual” web-based learning environments. One thing is clear; the ability to deploy information and communication technologies (ICT) to facilitate learning in a virtual environment is not entirely a matter of technology. Rather, those seeking to deploy such technology in learning environments must consider a host of human as well as technology-related factors (Laudon & Laudon, 2002).

The purpose of this study is to report the results of an e-Learning initiative at a private university’s executive MBA (EMBA) program. While a number of studies have examined e-Learning in other contexts, relatively few have studied this phenomenon in EMBA contexts. One notable exception to this has been DeSanctis & Sheppard’s (1999) of Duke University’s EMBA distance program. Through reporting these results, the authors intend to provide reader’s with useful information that may help future attempts by others to initiate e-Learning initiatives in similar learning environments. The following section provides background on the EMBA program initiative as well as the technology used to initiate the e-Learning initiative. Next, we discuss how our data were collected and analyzed. The final two sections discuss our results and conclude with recommended strategies for implementing e-Learning initiatives in EMBA environments.

KEYWORDS

Executive MBA, EMBA, e-Learning, Blackboard

1. EMBA PROGRAM

Horizon University’s (a fictitious name) Executive MBA program offers a high quality customized MBA for students that are older, have considerable work experience, are motivated learners, and that have a shortage of disposable time to commit to course work. Table 1 below provides some basic demographics of EMBA students. Further statistics provide information of EMBA student demographics by functional area as well as industry (Figure 1).

Table 1. Horizon University EMBA student profile

Horizon University EMBA Student Profile	
Average work experience	14 years.
Average age	38 years
Ethnic minority	23%
Average class size	33
Students	81% men; 19% women

One important aspect of an Executive MBA program involves convenience. These programs are structured to teach a maximum amount of material in a shorter overall time frame. Much of this is accomplished by intense evening and sometimes weekend sessions. Course material focuses more on business solutions than core knowledge. Students are expected to use their professional experience to explore up to the minute

strategies that can be applied to their own work situation. Flexible scheduling is another convenience. . Students need to be able to maintain their work responsibilities while taking courses. Flexible scheduling is accomplished by e-learning. E-Learning is a way for students to access course content when they choose and from where they choose. Many business environments already have group communication software and it makes sense that a business academic Program use groupware skills to add flexibility to their course work.

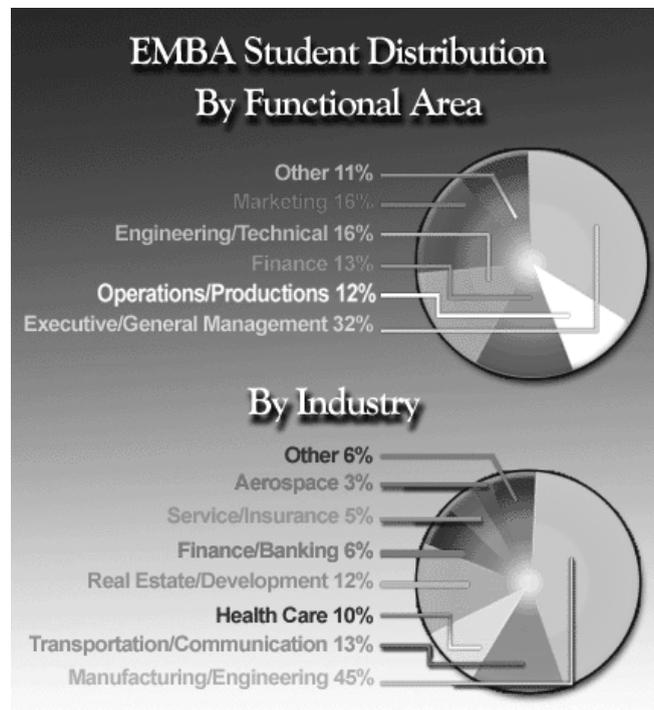


Figure 1. EMBA student demographics by functional area and industry.

To accommodate EMBA students' needs for flexible class schedules and less time in the actual classroom setting, Horizon University EMBA instituted an initiative that combines the traditional classroom with e-Learning and which allows busy regionally based executives to participate, without giving up critical projects or missing important office time. In 2000 a proposal that requires transitioning 25% to 40% of each course to an electronic delivery system was approved by the faculty. The goal was to effectively use valuable class time for integrative, applied experiences. Since the decision to use Blackboard was made at the university level, EMBA administrators were compelled to follow suit in their choice of an eLearning tool. The resulting courses now present twenty-five to forty percent of the course work through Blackboard. Therefore, this new program was hybrid in nature; neither being 100% traditional nor 100% e-Learning. In contrast, EMBA executives sought to achieve the most appropriate mix of time between conventional traditional classroom settings and the e-Learning environment.

2. TECHNOLOGY

Blackboard has several features that may be appropriate for electronic delivery to students with certain geographic and time restraints. The most widely used feature is used to publish content. Blackboard allows the instructor to group content by announcements, course information, instructor information, course documents, assignments, or custom areas. For extensive content, Word, Excel, or PowerPoint files can be store with the course and linked to the web page. These files can either be viewed through an internet browser or downloaded and viewed locally. Small messages for announcements and faculty information are

keyed in. If files are to be available for only a certain period of time, the instructor can set a beginning and ending date and time for availability.

Communication between faculty and students can easily be implemented using Blackboard Email. When a student is registered in a class his e-mail address is stored. The instructor has the capability of sending messages to the entire class or to individual students. The class can be divided into groups where he can send messages to all groups or individual groups. There is an option allowing students to send messages to each other, only to members of their group, or not at all. Another feature provided by Blackboard is the Digital Drop Box which is a better way for students to turn in assignments than e-mail. Students submit a file containing their assignment to the drop box and it is instantly stored in the instructor's drop box. The instructor doesn't have to manage his e-mail inbox because the assignments are stored with the course. They are available and easily accessible at any time if there is a question concerning the assignment. Other features provided by Blackboard are both synchronous chats and asynchronous discussion lists for either individual groups or entire classes. With the discussion list, the instructor sets up a forum that includes the discussion topic and usage options including allowing anonymous posting, allowing the author to edit or delete what he has posted, or to allow attachments. He specifies which students can participate in this forum. The Discussion Board can be set available for the entire course or a limited time period. Synchronous classroom discussions and presentations are available through Virtual Classroom, a java enabled browser and Turnet Virtual Classroom. When students and faculty are on-line at the same time there are areas for group discussion, question and answers, questions submitted to the instructor, slide presentation, and a white board where the instructor can write notes and draw pictures that the class can see.

On-line assessment, tests or quizzes, is also available through Blackboard. Instructors can write their own questions or incorporate test banks from other resources. They can create random tests or a single test that is saved with the course. These tests can be made available for a particular time period if that is important to the instructor. Instructors can also set the assessment so that it can only be accessed once. Test questions can be multiple choice, multiple answer, true false, fill in the blank, matching, ordering, short answer or essay. The instructor is able to set weights to individual questions. Objective questions are graded by Blackboard and students can be allowed to see the results immediately. Essay questions are graded by the instructor or assistant and the points are entered. When all has been graded Blackboard calculates the final score including bonuses. The completed assessments are stored with the course and can be accessed by the instructor at any time if questions arise.

The last major function is maintaining grades. The instructor can set up grade categories for assignments, exams, projects, etc. On-line assessments are automatically entered into the grade book. Other grades must be entered individually. The information is stored with the course and a student can see his grade using an internet browser whenever he wishes.

3. RESEARCH METHOD

This research used a case approach to gather and analyze data. The case approach is useful when researchers seek to gain rich insights into emerging, novel phenomena (Yin, 1989). The researchers used a semi-structured interview (see Appendix A) approach to collect data from a sample of six faculty to answer a wide variety of topics related to the types of features used, relative success at using these features, and suggestions for successfully incorporating eLearning into their respective classes. The field of information systems, economics, accounting, and marketing helped to insure a greater degree of generalizability across academic disciplines. Table 3 (below) provides a summary of these interview results. The following section presents the results of these findings.

4. RESEARCH FINDINGS

Our results show that the primary use of Blackboard as an E-learning tool was for the online publication of course content related to Power Point slides, syllabi, test questions, problem sets, and links to online articles. All six respondents indicated at least moderate to heavy use of Blackboard for this purpose with high degrees of success. The most common comment was that it was extremely user friendly for faculty to post content as

well as for students to access it. Email was the second most prevalent feature used by faculty in the e-Learning. All but two of the faculty reported using email with no mention of problems with it.

In contrast to this, three of the six faculty questioned reported that they had attempted to use the virtual (synchronous) "chat" feature of Blackboard all with dismal results. As one professor reported, "it was a disaster". Another reported that group chats simply "weren't worth the trouble". In another case, a faculty member discontinued the use of chat sessions and reverted instead to traditional conference calling with student groups. Some of the reasons cited for failure with this feature were: (1) poorly designed user interface, (2) technical problems logging into the chat session, as well as (3) the inappropriateness of the technology to support the task.

These findings can be interpreted at least in part from the information systems literature which has investigated the relationship between task-technology "fit" as such outcomes as technology acceptance (Dishaw & Strong, 1999), ease of use (Mathieson & Keil, 1998), as well as individual performance (Goodhue & Thompson, 1995). The basic point of this literature as applied to our context is that the underlying technology must be well-suited to the type of task being undertaken. In the case of publishing course content via the web, Blackboard technology is extremely well-suited to this. Therefore, it is not surprising that faculty reported high levels of success in using Blackboard for this type of task. In contrast, the Blackboard technology seemed to be ill-suited to facilitate the rich type of complex interaction inherent to face-to-face EMBA classroom discussions. Therefore, faculty reported low levels of success as well as frustration with using Blackboard to facilitate "real-time" virtual chats. Anecdotal evidence suggests that most of the EMBA students actually preferred to learn in a rich face-to-face environment where complex interactions involving body language and other non-verbal cues can take place. These findings suggest that more real-time web-conferencing (see you-see me) video conferencing may be more suitable for virtual online discussions. Such technology was not incorporated into Blackboard.

Another finding was that all but two faculty respondents appeared to lack understanding of some of the key capabilities of the Blackboard technology. As a result, they had not even tried to use some of these features either because they weren't aware of them or they didn't fully understand their capabilities. Such features included the digital drop-box, synchronous and asynchronous communications, and online testing. These findings are somewhat puzzling since most of the faculty took Blackboard training sessions prior to implementing this e-Learning initiative. An explanation for this might be that those conducting the training either were not teachers or they did not sufficiently understand the nature of instruction in an EMBA environment. This suggests that training for faculty using e-Learning tools should be done by those who are familiar with teaching at the EMBA level and who also understand the underlying e-Learning technologies that can be used to support these teaching efforts. Therefore, technology must be viewed as something that must be tightly linked and interwoven into underlying teaching styles, processes, as well as learning styles.

Another theme that emerged from these interviews is that faculty must be able to articulate their purpose or goal of using an e-Learning tool prior to implementing it. When asked to comment on what they believe to be the keys to successfully incorporating an e-Learning tool into their EMBA classes, two of the faculty responded that it was very important to determine up front what their goals were. One of these respondents felt that he had used the technology without clearly thinking through its pedagogical implications. While we have no empirical evidence to support this, our findings suggest that lack of success in using Blackboard technology could have been avoided by faculty simply thinking through the goal of what they were using the technology for. Our findings suggest that EMBA administrators seeking to institute e-Learning initiatives should encourage faculty to think beyond the mere capabilities of the technology itself, but to also engage in a deeper level of examination to envision the purpose of the technology in supporting certain learning processes. Also, when soliciting proposals from perspective faculty to teach in EMBA-based e-Learning programs, administrators should require that faculty be able to clearly articulate how the technology will be linked to effective teaching practice in an EMBA environment.

Table 2. Summary of respondent interviews

	Primary Uses of e-Learning Tool	Successful Uses of Technology	Challenges Faced	Other Comments
1	Publishing content (syllabus, slide presentations, readings, exams and assignments), email, asynchronous & synchronous chat, and online grades.	(1) High degree of success with posting all types of content for student access. (2) Ability to email specific individuals as well as specific groups or overall class was extremely easy and beneficial. (3) Online grade book.	Encountered major “human” as well as technical problems with synchronous group chat. Also limited success with asynchronous “discussion list”.	“The teaching task must fit the technology in order to be successful.” “It is important for the instructor to have an idea what his/her goals are.” Didn’t understand the drop-box technology.
2	Publishing content, email, and digital drop box.	Respondent used technology effectively for posting content and to communicate via email with students.	Had some technical problems with use of digital drop-box and group synchronous chats were not “worth the trouble.”	The students were not resistant to the technology.
3	Publishing content and to a lesser extent synchronous chat.	Used technology effectively for posting content for student access.	Respondent encountered major difficulties with group synchronous “chat” --reverted to conference calls.	Didn’t appear to really understand the technology.
4	Publishing content (problem sets) and email	Used technology effectively for both content publishing and email		Respondent lacked knowledge of certain technology features
5	Publishing content (exams) and to a lesser extent the digital drop box feature.	Experienced significant success in publishing course content and to a lesser extent digital drop box.		Respondent commented that he was still learning features of the tool.
6	Publishing content (syllabus and assignments) and email.	Successful at both content publishing and email.		Advanced features were not used due to lack of understanding of technology.

While our evidence is not conclusive, our findings suggest that the two MIS faculty clearly made greater use of the technology as evidence by their attempts to use multiple feature (synchronous & asynchronous communication, group features, online grading, and digital drop-box). These findings seem reasonable considering that MIS faculty typically work with a wide-range of information and communication (ICT) technologies. The implication of this is that MIS faculty teaching in EMBA settings may be ideal candidates for instructing other non-technical faculty regarding the useful features of certain e-Learning tools and how they might be integrated into EMBA learning environments.

A final comment relates to assessment and feedback on e-Learning initiatives. In conducting an e-Learning initiative, it is important that participating faculty be able to “tell stories” with each other related to e-Learning successes and failures. This “story-telling” or tacit knowledge sharing can be particularly useful in helping faculty to transfer “best-practices” within their assemblage by sharing learning experiences about what works and what doesn’t in an e-Learning environment. EMBA administrators should seek to provide a basic structure or forum through which this type of knowledge could be shared. Little evidence of this was

found during the initial stages of the eLearning initiative at Horizon University. This could take place informally through social extents or through more formalized settings like online discussion lists. Finally, it would be extremely useful to gather EMBA student feedback regarding their perceptions on specific aspects of e-Learning initiatives. This feedback could then be passed along to the faculty and then incorporated into subsequent e-Learning courses.

5. CONCLUSION

Our results are summarized in Table 4 below which outlines (a) the types of challenges or issues that may be faced by those seeking to implement e-Learning initiatives in an EMBA environment as well as (b) proposed recommendations for solutions to these issues.

Table 3. e-Learning Challenges and Proposed Recommendations

Challenge	Recommended Solutions
Lack of “fit” between e-Learning technology and teaching task	<ul style="list-style-type: none"> • Design e-Learning teaching curriculum to insure that technology appropriately fits the teaching task • Evaluate and incorporate richer forms of e-Learning technologies to support virtual classroom interaction (e.g. web-based video conferencing) • Educate EMBA faculty as to the importance of task-technology fit.
Lack of understanding of features of technology	<ul style="list-style-type: none"> • Develop e-Learning training programs for EMBA faculty with those who understand <u>both</u> the underlying technology capabilities as well as the nature of effective teaching practices in an EMBA environment • Identify technically “savvy” EMBA faculty to head-up training sessions for other faculty in e-Learning technology and integration with teaching practices
Lack of Goals	<ul style="list-style-type: none"> • Require all EMBA faculties participating in e-Learning initiative to explicitly state their goals as to how the e-Learning technologies will be used to support specific instructional outcomes.
Lack of Faculty Knowledge Sharing of Effective Practices	<ul style="list-style-type: none"> • EMBA administrators should provide some type of forum (either formal or informal) for faculty to share insights regarding “best-practices” in e-Learning programs
Lack of Assessment	<ul style="list-style-type: none"> • Gather feedback from EMBA students regarding e-Learning “best-practices and disseminate feedback to EMBA faculty.
Lack of Technology Assessment	<ul style="list-style-type: none"> • EMBA programs need to maintain contact with technology professionals to stay current on emerging e-Learning technologies that may potentially be incorporated into the EMBA environment.

While we acknowledge that our sample of six faculty from a single university setting limits the generalizability of these findings, we also argue that these results help to identify a common set of challenges that may occur regardless of the particular EMBA setting. Since “story-telling” normally occurs in informal settings, our semi-structured interview approach was not conducive to capturing this type of tacit knowledge. However, future research should seek to better understand how individuals share best-practices in “story-telling” sessions. Also, subsequent investigations should seek to further understand how various e-Learning tools and technologies can be best used to accommodate different teaching tasks as well as instructor teaching styles. Finally, future research should look at how e-Learning tools and technologies accommodate different learning styles.

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APPENDIX A. STRUCTURED INTERVIEW QUESTIONS

1. On a scale of 1-5, to what extent did you incorporate Blackboard (BB) into your class?
5-extensive
4- great
3-moderate
2-some
1-none
2. Using the scale above, rate what you feel to be your overall level of success in incorporating BB into your EMBA course. Why do you think this was the case?
3. Using the scale above, indicate the extent to which one or more of the following features of BB were used in your class:
To Publish content (e.g. articles, ppt slides, quizzes etc) _____
For instructor-student email communication _____
For class asynchronous discussion lists _____
For synchronous classroom online chats _____
To maintain grades _____
For students to send in assignments (digital dropbox) _____
To provide online assessments _____
4. Of those features listed above, which of them did you have the most success with? Why?
5. Of those features list above, which of them did you have the least success with? Why?
6. What do you think are the keys to successfully incorporating eLearning into an EMBA classroom setting using a tool such as Blackboard?

OVERCOMING TECHNICAL FRUSTRATIONS IN DISTANCE EDUCATION: TELE-TASK

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ABSTRACT

Modern information technologies are transforming the way people learn. E-learning provides new possibilities for personalized learning at home or in the workplace, reduces the need for costly classroom training, and enables an optimal balance between traditional and innovative forms of knowledge transfer.

But facts have proven that content creation for online courses is time-consuming and costly. Also most of them are not easy to call up. A simple and efficient solution of content creation for online courses is strongly required. Our new system, tele-TASK [1]- Teleteaching Anywhere Solution Kit, paves the way for these requirements. With the help of the new developed system tele-TASK a new, drastically simplified entrance technology for on-line lectures has been reached. Not only contents of teaching, which are presented to the students in the lecture-room by either a whiteboard or a video beamer are delivered but also video and audio of the lecturer. For tele-TASK a special hardware (T-Cube) is now available, which permits the creation of Real or Mpeg4 streams in different bandwidth ranges on the fly. Thus a pre-installed standard player can be used.

1. NOWADAYS E-LEARNING

Our society today is characterized by what is called „informational society“. Our communication culture and information organization is going to change, as the importance of the internet is growing.

As in the term of the ‚informational society‘ is expressed knowledge is a central aspect of people`s lives, that is – as soon as it is learned – antiquated. So people are forced to lifelong learning not to miss their connection to future developments. At the same time globalization calls for mobility and flexibility. In consequence the processes of learning have to be adapted. They have to be untied from time and place.

E-Learning creates new possibilities. So Urry talks about the begin of the ‚comptime‘ [2]. Knowledge is de-territorialized and turned into bits of information resulting in ‚information blizzards‘ [3]. Besides the mentioned flexibility the use of New Media changes the processes of learning, too. Tele-Teaching is one of this new modes.

The public and scientific opinion in reference to E-Learning is ambivalent. While some authors emphasize the revolution of our work via E-Learning, its cost-effectiveness and its greater social inclusion, others speak of a crisis of E-Learning and its little acceptance. Certain is that E-Learning changes the quality of learning experience itself.

The reason why critical voices are raised is the fact that many of realized ELearning projects don`t overcome the status of a pilot project. Why? The answer is given by Hohenstein & Tenbusch [4]: They are missing a perspective paying attention to the functional and structural qualities of a system. In the development of an ELearning project it is unalterable to consider the aspects ‚organization‘, ‚man‘ and, ‚technique‘ equivalently and simultaneously.

ORGANIZATION	MAN	TECHNIQUE
Environment	Personality	soft-/ hardware
- culture of learning	- qualification	- infrastructure
- structure	- acceptance	- quality
- process	- motivation	- meshing

see Hohenstein & Tenbusch 2002 [4]

Organization

Initiators of E-Learning projects should be prepared to changes of structures and processes as a result of the introduction of media based learn methods.

Man

A successful realization of E-learning projects presupposes the analysis of target groups.

Wilbers [5] distinguishes several dimensions concerning the requirement on the part of potential users: the principle of learning, the principle of curriculum and the principle of competence.

The principle of learning contains personal styles, aims, the speed of learning and motivations, that have to be analyzed as conditions of the field of work and learning. Trainers must ask for the available technical knowledge of the future users. Those have to know and understand the important terms. Furthermore, they have to be able to apply the central tools. Moreover the experiences of the learners with the internet have to be examined as their experiences with online-teaching, the use of learn programs, the use of web-based services.

Curriculum principle means the consideration of the learner’s future professional situation. The principle of competence is seen as the task to get a picture of the competencies that should be realized and their connection to further aims.

Technique

The technical conditions have to focus on human needs. They have to support the users in facilitating the processes of learning and working. E-Learning should integrate - concerning man - all processes of management of information and management of working, -concerning organization - administration and winding-up, the culture of organization and its aims.

Existing communication structures are to be proven if there is a possibility for implementation. The technical infrastructure functions as a „City of knowledge“ [4].

An E-Learning project is successful, if it stands the test in all three mentioned dimensions. Changes in one of them must effect changes in the other ones [6].

Now we will concentrate on our project TeleTASK. We want to introduce you to our ideas, that lead to a successful realization of our teleteaching project.

2. THE TELE-TASK CONCEPT

The tele-TASK system was originally deployed for recording, transmission and archiving of the computer science lecture "Information security in open networks" at the university of Trier in the summer semester 2002. High access numbers express the perfect problem-free and easy possibilities of using tele-TASK. In this semester another lecture titled "Internet security" is being offered at the University of Trier and simultaneously transmitted to Beijing University of Technology, China. Here Chinese students take part in the lecture via Internet together with students in Germany. Practical testing proves that our solution is successful.

In the following, we would like to introduce the new "easy to use" internet based teleteaching package tele-TASK, which accomplishes all requirements to modern teleteaching systems. Furthermore, we will present the complete all-in-one solution "T-Cube", which allows you to create online-courses on the fly without previous training for students and operators(!).

In reference to the target group analysis we expect to have students, which are able to use a standard web browser. We will later see, that tele-TASK has no further requirements subjected to the technical abilities of the learners.

2.1 The Content Creation Problem

Today, there are several ways of electronic content creation for online courses. The most common way is to create the content of the lecture for web-use by means of creating static or dynamic web pages with HTML or PHP. The disadvantage of this method is the extremely high cost for development. On the average, one can calculate one person working for a half up to a full year for the preparation of electronic learning content for only one course. By assuming that course data, esp. in computer science, changes very fast, costs for updating will occur.

Other possibilities for content creation are the specific application development (e.g. Java applets for web-use) or the use of multimedia production tools (e.g. Multimedia Toolbox [7]), Macromedia Flash [8]. But these solutions all have one thing in common: high costs.

To avoid such high costs, systems for the creation of electronic course content during a normal lecture were developed. TTT [9] and AOF [10] are examples for this approach. The big advantage of those systems are the reduced costs for the creation of electronic course content. As we discussed in the sections before, a very important feature of e-learning systems should be the easy practicability. When analyzing those two tools for this important requirement, we see that it is not easy for operators or students to produce or access the electronic content. In field experiments we determined that the programs restricted users in various ways. The most important restriction was the need of installing special programs to access the content. In the case of TTT also JAVA and JMF had to be installed. Even computer science students were not able to do so.

2.2 Online Lecturing Needs

As described in the previous section, past teleteaching systems limit operators and users to various ways. On operator's side the lecturer is often rigidly bound to an operating system or to necessary bandwidths. Also widely spread is the restriction in using special presentation systems [9,10], e.g. PowerPoint, which finally leads to the lecturer's degradation to a slide commentator. Today, a good lecture should contain dynamic contents, such as animations and demonstration programs, as well as arbitrary information from the WWW. An unrestricted use of all usual operating systems is also desirable.

On the users' side, students and other interested persons, who want to retrieve courses via the Internet, should not be subjected to the torture of complicated installation and operating steps. In the winter semester 2001/2002 for the first time teleteaching systems [9] were tested and used at the local chair. All applied systems were very difficult to install and to use, due to the need for Java or other software packages. In addition, a lot of programs were very instable. The experience showed that even computer science students were not able to furnish and operate such special software packages correctly. Proceeding from these observations, we improved the development of a less limited, better applicable and at the same time more efficient teleteaching software system. Apart from the requirement of easy to use, a transmission of the lecture should be possible down at the modem speed, since not every student has a wide-band Internet connection. The use of standards, the permission of any operating system and any presentation software are also required for the development of a new teleteaching system.

The following list shows the requirements of a modern tele-lecturing system in order of their importance:

- ✓ Complete mapping of the classroom situation (Beamer, Video, Voice)
- ✓ Simple usage for the student. Most desired is:
 - Use of standard pre-installed software
 - Platform independency
- ✓ item Simple usage for lecturer. Most desired is
 - "One-Push-Button" technology
 - Integrated all in one solution
 - Usage of own equipement (e.g. Laptop)
 - Web integratable
- ✓ Modem speed is enough for a transmission
- ✓ Online (live, on-demand) and Offline (CD,DVD, Download) capable

At the University of Trier, at the chair "Theoretical concepts and new applications in computer science", a new teleteaching concept has been developed and tested, which grants an entrance to on-line lectures in the simplest possible way and breaks down the barriers for producing and accessing distance learning content.

Tele-TASK represents itself as a result of these considerations and developments. The experiences in the field use in the summer semester 2002, the reactions of the users and the high access numbers confirm the quality of our concept.

2.3 tele-TASK Content Creation

Based on the above considerations, we thought about electronic content creation with the needs of online lecturing and the reduction of the traditional costs in mind. Our basic idea is, to use the original lecture to produce e-learning content on the fly. But the most important requirement was the easy use for operators and end-users. The complete classroom situation including the desktop of the presenters computer, the video and the audio should be mapped into electronic course material. We desire to transfer the complete course live and on-demand to the internet. Also for offline usage, the course data should be saved. Figure 1 shows the structure of the tele-task system.

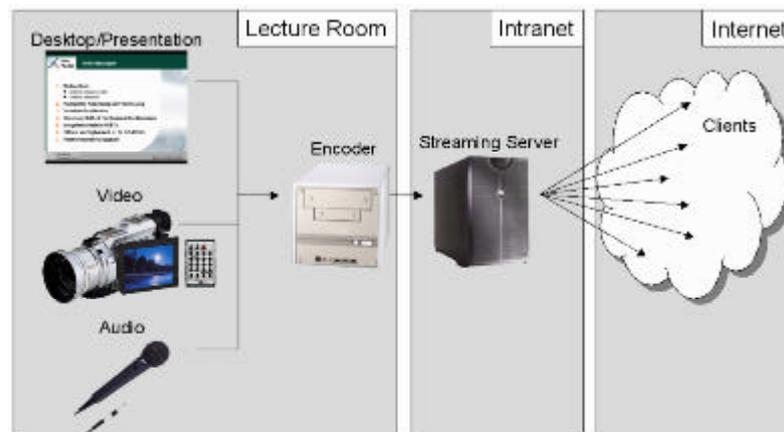


Figure 1. Structure of tele-TASK

In the following we show the different parts of the system.

2.3.1 Transmission of the desktop

Various online lecturing systems (see Real [11], Microsoft [12], AOF [10], ...) have to run on the presenter's computer. In these cases special requirements are claimed to the presenter's computer. Often, those solutions call for special operation systems, special presentation software or high CPU power. In the case of non-computer science lectures this presents a big problem. Most lecturers are unwilling to install anything new on their computer, or they do not have permission to do so. The solution is to deliver the desktop to another computer. This transmission is done with VNC [13]. VNC allows to transfer a desktop, no matter which operation system, to another computer without the loss of quality. To reduce the bandwidth we are using tightVNC [14] which transfers less packets than original VNC and it also compresses the packets. On the encoding machine, the desktop is processed further more.

2.3.2 Capturing Video and Audio

tele-TASK supports two different ways of accessing videos. The first solution is to use a video device connected directly to the encoding machine. By using the Microsoft DirectX library [15], we can access any video device connected to the encoding machine. This could be e.g. a cheap webcam, an analog video camcorder or firewire videocamera. The system supports multiple video devices which could be switched during the recording. Video resolution can be set up for each device separately. Audio can be delivered via Firewire over the videocamera to the encoding machine, or by the analog or digital audio input.

The second way of transferring the video is to send it over the network. tele-TASK provides a tool for transmitting and receiving video and audio over the network. In those cases, the encoding machine can be set up in different locations.

2.3.3 Synchronisation of the streams

The encoder consumes altogether three streams (video, audio and desktop). The developed tele-TASK software package combines the three input streams. Figure 2 shows an example for the arrangement of 4 Streams (Video, Audio, Desktop and Table of Content). The arrow shows the coherence between the video and the desktop stream. A student is easily able to recognize the actual discussed part of a slide by comparing the slide to the video.

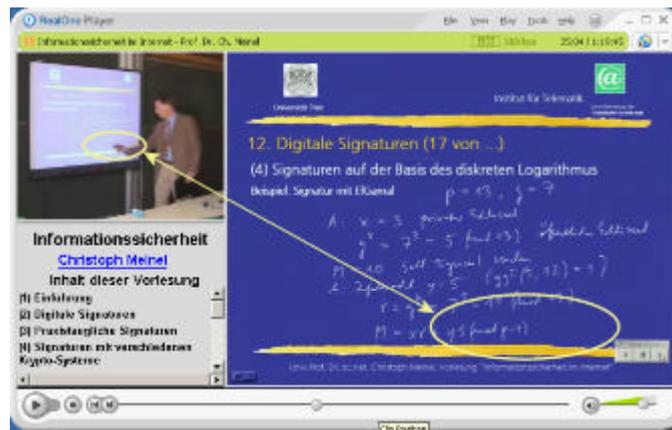


Figure 2. Lecture Playback in RealOne Player

Video and audio are synchronized to each other and then treated as one stream. The synchronisation between audio, video and Desktop is thus guaranteed. A text stream can contain additional information in the form of e.g. links or tables of contents. The operator of tele-TASK can position and dimension the streams freely (see figure 3).



Figure 3. Layouting the streams

Usually the video stream is put in field 1, the desktop stream in field 2 and the text stream in field 3. The composition of the streams is done by SMIL (Synchronized Multimedia) [16]. By supporting multiple input devices (Video, Audio and Desktop) it is possible to change the layout dynamically. In case of presenting high quality video scenes during the presentation, the desktop can be hidden and the video can be set up to fullscreen mode. Such cases often appear in medical presentations.

2.3.4 Output Formats

After assembling the input streams, tele-TASK encodes them into a standard format. Currently 3 different formats are supported:

1. Real output
2. Special low bandwidth format
3. MPeg4

The Real output directly supports the Real streaming server. Real streams can be set freely to arbitrary bit rates. Praxis has shown that 250 kBit/s is enough for high quality online lectures including video, audio and desktop. The software computes the Real stream in real-time, saves it to hard disk and streams it live to a streaming server.

Parallel to the real encoding, tele-TASK encodes a special version for very low bandwidth. With only 38Kbit/s it is possible to provide video, audio and a perfectly rendered desktop. The only cutback is that animations on the presenter's computer cannot be shown. During a normal slide presentation the desktop doesn't change a lot. The idea is to scan the desktop for changes and only the changes are saved and sent to the client in a compressed way. Figure 4 shows a slide in which two new lines have appeared.

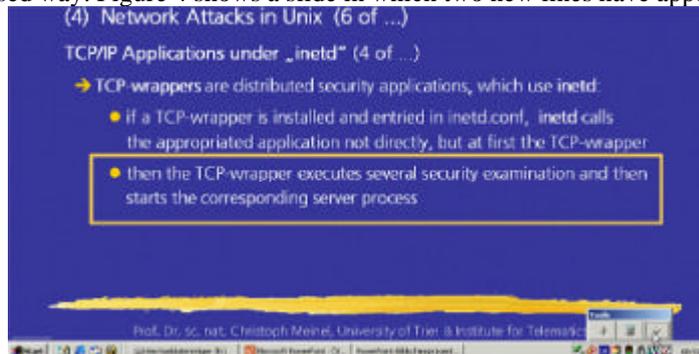


Figure 4. Slide with two new lines (marked)

tele-TASK grabs out the changed area and computes the exact difference between the old and the new state. Figure 5 presents the exact difference between the two states.



Figure 5. Changes between two slides

Only the white areas are saved and sent in a compressed way. For 90 minute slide presentation including annotation we save and send about 200 to 300 desktop updates. In total we need about 1 Megabyte for the complete high quality (about 600*400 Pixel) desktop. [17] shows an example.

The last output format of tele-TASK is MPEG4. The software computes MPEG4 streams in real-time. Like the Real output the MPeg4 stream can be saved to hddisk and sent to a streaming server. Apple provides the free and open-source MPeg4 streaming server Darwin, which can be used directly.

For each output format the usually pre-installed standard players like Realplayer, MS Mediaplayer, Quicktime Player can be used. By supporting these standard players, we fulfill the most required feature: Make the access as easy as possible for end-user.

2.4 T-Cube – Make the production as easy as possible

Besides of the easy call up of learning content for the student, another quite important feature for distance education is to break down barriers for the production of electronic content. With T-Cube, a high integrated easy to use device based on tele-TASK is given. The T-Cube is a small computer in the shape of a cube. The T-Cube has two network devices. One is for connecting to the local network and the second for the presenters

computer. The interface for the local network has to be configured once by a system administrator. The second one provides a direct connection to the local intranet, not depending on the network settings on the connected laptop. This feature is also done by tele-TASK. It masquerades the range of all IP-addresses including the faking of all possible gateway IPs. The big advantage is that every lecturer can use his own laptop without configuration. The laptop can be connected directly to the T-Cube and has access to the local intra-/internet without having to be adjusted. This is very important for conferences where presenter want to use their own laptop.

Once connected to the T-Cube, a small software is started on the laptop via a web-interface. This software allows to export the desktop and to control the T-Cube. By the use of hotkeys the lecturer can start/stop/pause the lecture. By using the integrated solution the lecturer doesn't need much knowledge about the system in use. He can easily start and stop the session by himself.

Cameras and microphones can be connected directly to the T-Cube. The streams can be sent to the streaming server and saved on a local harddisk parallel. After a presentation a CD/DVD with the recorded content is burned automatically. The configuration of the tele-TASK software can be done by a webinterface or by an external program. The T-Cube does not need a monitor, keyboard or mouse. It is just a black box which can be switched on and off.

3. TELE-TASK IN PRACTICE

3.1 Successful transmissions with tele-TASK

After testing and using other tele-lecturing software in the beginning of 2001, tele-TASK is in practical use since summer semester 2001. For the first time, tele-TASK was used for the course "Information Security in Open Networks". Especially aspects of cryptography were explained. By using an electronic white-board, the lecturer was able to write complete mathematical proofs onto the slides. The whole course including video, audio of the lecturer and his laptop's desktop was digital recorded and sent live to the internet. In comparison to the former used system, we registered a dramatic increase of live and on-demand accesses. In user surveys we realized, that the reason was an easier calling up of course content. Students were using the system in case of time overlapping courses, so that they were able to join both courses. Also at the end of the semester students used tele-TASK course material in order to replay complicated sections of the course.

tele-TASK was also used to record two conferences about e-Payment and e-Medicine at the Institute for Telematics in Trier, Germany. Each time overall 200 people joined the conferences live in the internet.

In the winter semester 2002/2003 the University of Trier is holding a course about the security concepts in the Internet with tele-TASK. This course is simultaneously transferred to Beijing, China. There, at the University of Technology Chinese students are joining together with the students in Germany the lecture. The quality of the recorded lessons was so high that lots of students all around the world joined the lessons via the internet.

In the time of 9 month we got about 40.000 hits on electronic tele-TASK content. The high access numbers and the positive feedback of students and other learners proof the success of the concept.

3.2 On operator's side

tele-TASK is a complete program suite for providing high quality teleteaching. The package contains all necessary programs and tools for generating streaming material for the web. The whole system works like a one push button automat. It takes less than five minutes to set up the T-Cube and the technical environment. The complete equipment fits into only one small bag, so that it is possible to offer teleteaching anywhere you are at. In practice, the streaming server is not at the same place as the encoder.

Once tele-TASK is installed, nearly any lecture can be recorded. A lot of universities are talking about offering tele-lectures. But if you want to find something in the web, you will have to prepare for a long search. With a system like tele-TASK a university or an institute for further education can allow the students to access and replay all courses they want to see. Also, it is very easy to make the lessons available offline. Only one CD-ROM contains about 6 hours of recorded courses including video, audio and the desktop of the lecturer.

The intuitive use of tele-TASK makes unnecessary to train the lecturers. By the use of an electronic whiteboard (e.g. Smartboard) the lecturer can easily anotate his slides with electronic pencils. Another big advantage for the lecturer is the kind of copyright on his lectures. By making scripts of a lesson available online, the copyright trademarks are not protected. Everyone can copy and paste the text to his own documents. With streaming data, it is much more complicated to do this.

3.3 On users side

By integrating tele-TASK documents into webpages makes a calling up very easy for the consumer. By clicking on the corresponding link the player starts up automatically and plays the lesson. In comparison with other teleteaching systems, tele-TASK is very easy to use. Even laymen are able to access the lectures through the internet. The experience with other teleteaching software, which was complicated to use on operator and viewer side, taught us to provide an "as easy as possible" technology for the consumer side. The positive feedback and the high access numbers shows the effectiveness and efficiency of tele-TASK.

4. CONCLUSIONS AND FURTHER WORK

With tele-TASK it is possible to provide high quality teleteaching without a large technical and financial expenditure. The use of standard pre-installed players makes an access of contents independent of time and place easy. The past users emphasized the simple applicability of the system. Especially the high-quality and the smooth transmission of the Desktops speak for an expansion of the employment on the range of further training (e.g. training courses for Linux, Word, or other programs). Two big advantages make tele-TASK very useful for further education. Online courses can run separately from and simultaneously to traditional forms of courses. The number of potential attendees increases dramatically. Further, after a course CDs with the recording can be given to the participants.

Currently we are developing automatic content extraction for tele lectures. With the help of XML and RDF we are building semantic networks of words and topics. Once having such semantic networks, new possibilities for learning, searching and accessing of information are given.

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HYWEB: A BLENDED E-LEARNING SOLUTION FOR THE DELIVERY OF TERTIARY EDUCATION

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ABSTRACT

Traditional learning versus e-learning is often subject to debate within the tertiary environment. As a result blended learning models or hybrid systems are becoming more common. The authors have, for the last few years, been developing a hybrid system within the teaching environment for Web-design and multimedia authoring. At this point, the outcome is a hybrid system, known as HyWeb, and short for Hybrid-Web, which has been partially reported in various papers throughout its development (Jo, *et al.*, 2000; Jones, *et al.*, 2001; Jones, *et al.*, 2000). Its development has evolved from combining online delivery with traditional teaching to create an appropriate and effective environment. This experience has provided a better understanding of student learning needs and signified the need for a holistic approach to course design and delivery. The authors believe this is not only practical but also essential. This hybrid system, also referred to as blended e-learning, is viewed as a dynamic and evolving entity. Various features and improved delivery methods have been added to enhance the quality and efficiency of the system, as they were required. This paper will describe the experience of course development and discuss the relevance and benefits of a blended e-learning solution for course delivery.

KEYWORDS

Blended e-Learning, HyWeb, Online Education, Hybrid systems.

1. INTRODUCTION

There is currently much debate about the benefits of e-learning over traditional learning. One of the major outcomes is the use of blended learning models or hybrid systems. Blended learning involves the use of two or more distinct methods of delivering education material. This may include: traditional classroom instruction (both lectures and tutorials); online (web) instruction; online discussions or forums; communication via email, face-to-face (F2F), online notice boards or online communities; simulations and online assessment. Valiathan (2002) also suggests such techniques as event-based activities, F2F classrooms, live e-learning, and self-paced learning.

Blended e-Learning (Be-L) may offer the ideal solution for the delivery of tertiary education in today's fast-paced world. Traditional instructor-guided learning offers F2F real-time interactivity while student-

guided e-learning can offer the advantages of cost in terms of money, time and convenience. With this in mind, many tertiary institutions are offering some form of Be-L.

Finding a suitable Be-L solution is essential. A Be-L system was developed at Griffith University, Gold Coast. The staff at the university's School of Information Technology developed the system, known as HyWeb. This approach uses a number of methods to deliver effective teaching and learning. Implementation has been ongoing since 1999.

2. BACKGROUND

The need to provide more flexibility and easier access to tertiary courses has intensified as the tertiary student population has grown. This has been happening for some years and looks to continue. There is also a great diversity within today's student population, each with distinct and varied needs, commitments and learning expectations when compared to previous generations of students. Mature-age students make up a significant proportion of the student population bringing life-experience and skills from wide-ranging backgrounds (Neeley, et al., 1998). The younger students are also uniquely different than students of the past, in the sense that they have been exposed to information technology from a young age, many having regular access to a home computer and the Internet for some years before embarking on tertiary studies.

Another factor is the competitive environment emerging between today's tertiary institutions. In Australia, tertiary education was revolutionised during the 1970's when university entry was made more easily accessible to the general public. There was a great increase in the number of students, which has continued into the 21st century. As students now "pay" for their education through the government subsidised HECS scheme, there is also the added attitude by students of a consumer society within the realm of education. For this reason our universities need to offer good quality, effective learning environments in order to attract a high student intake each year.

3. CURRENT ISSUES

Be-L courses have the potential to offer the convenience and flexibility of online courses yet still maintain the interactivity and F2F contact offered through traditional courses. It has been suggested that many students are reluctant to abandon this hands-on contact and prefer the assurance of lecturer F2F communication (Jones, et al., 2001). Be-L courses are also more likely to be accepted by faculty members, confident in an educational system that has worked for centuries, and who may feel apprehensive about the changes a purely online course may bring (Young, 2002).

The integration of online and traditional instruction in the form of Be-L, has been described as "the single-greatest unrecognized trend in higher education today," by Graham Spanier, president of Pennsylvania State University. There may also be various reasons for an institution to adopt Be-L courses such as lack of classroom space, as was the case at the University of Central Florida which was forced to rent space in a nearby multiplex theater during the day to accommodate students (Young, 2002).

3.1 Student Diversity

A proportion of today's tertiary student population fit the category of non-traditional or returning students. The trend is analogous with growth of higher education and the opportunities offered, especially for those students wishing to finish the schooling they missed during their youth (Feenberg, 1999). As expected, any tertiary study requires student commitment and dedication, yet there are circumstances when students may find it difficult to maintain the required level of study. Common challenges of today's students (both mature-age students and students under 25, some straight from secondary school) include: Household commitments; Being a parent, especially a single parent; (For women) – pregnancy; Working full or part time during study; Distance from educational institution.

These factors may also be addressed by the addition of more flexibility within the system. Jackson (2001) suggests that flexible learning has the potential to maintain a sense of student involvement, connection and progress when they cannot attend classes.

3.2 Online Education

To remain competitive in the global education marketplace, universities need to make drastic changes in the way they design and deliver their courses. Learning environments must reflect the needs of the students, utilise the current technologies while acknowledging and focusing on the desired goals and outcomes (Kavanagh, 2000).

Most universities today offer some form of e-learning, be it separate online courses or Be-L courses. In an article, "Teaching at an Internet Distance" (1999), two essential ingredients for high quality online instruction were proposed. Firstly, new paradigms are required to cope with today's limited bandwidth and secondly, the "human touch" is needed to maintain the students' attentiveness. These concerns are undeniably very relevant to today's online design issues. The problem of limited bandwidth is diminishing with time, but the "human touch" still needs to be nurtured and sustained. Communication, involvement and connectivity can be addressed by a more flexible approach to online education in the form of a Be-L course.

4. BLENDED E-LEARNING SYSTEM

HyWeb, was developed at Griffith University, Gold Coast and is represented in Figure 1. The Teaching Resources represent the educator's perceptions and understanding of content plus the underlying principles and concepts. The Course Material is the actual teaching material, such as information in textbooks and content of lecture notes. The Information Channels represent the delivery elements as described later in this paper.

With the introduction of a Be-L solution significant advantages can be realised. In Table 1, below, the advantages and disadvantages of both traditional and online learning are presented. However, by using a Be-L environment the advantages of both delivery methods may be combined to create a hybrid e-learning solution.

Table 1. Comparison of delivery systems

Delivery Method	Advantages:	Disadvantages
Traditional	Flexible development and delivery (for educator)	Travel to and from institution – inconvenient and costly for students
	Real-time application of knowledge	Student schedules and timetables must be coordinated
	Immediate interaction between students and educator	Educator-controlled learning - students unable to work "at own pace"
	Immediate feedback/guidance	Numbers may be limited by classroom size - limited scalability
	Chance for immediate feedback from the educator	Difficult to standardise instruction (with multiple instructors)
	Educator-led format (familiar situation for students)	Same time / same place – inflexible
	Familiarity – students "get to know" educator – face-to-face contact	Time-consuming to prepare
	Easy to reinforce important points	Educator controls what to teach rather than learner controls what to learn

	F2F communication and personal interaction	Program designed for average students – may be too easy for some or too difficult to others
Online	Flexible delivery (for student)	Student may become isolated
	Easy Access (any time/ any place)	Cost of resources
	Consistency	Delayed interaction between students and educator
	Student-controlled education (Self-paced)	Need ongoing support & updating
	Feedback/guidance available through electronic means	Technical problems (bandwidth, CPU speed)
	Easier to reach a large audience	Difficult for teacher to supervise students
	Easy to update & deploy	Long development & delivery time
	Easy to track	Continuous streaming – may be difficult to stop and repeat a part of the whole teaching activity depending on design
Blended / Hybrid	See Advantages – Traditional Delivery See Advantages – Online Delivery	

When considering a traditional classroom, we find many elements, or channels of information, are utilised. The educator will present various items in text on a whiteboard or overhead projector (visual), explain elements to the students by speaking about them (verbal) and reinforce information using images, flash cards, or gestures (visual). Often students may listen to music or watch a movie or video (dynamic). Educators may provide handouts or refer to textbooks (printed material). When a student has a question, the educator can explain it to all students or just the one student (F2F and communication). These activities can now be implemented using the Be-L system, HyWeb (see Figure 1):

- **F2F-** includes all face-to-face traditional-style lectures, tutorials and other contact. This can take many forms. Apart from the traditional-style lectures and tutorials, students can consult with the lecturer or tutor at other times. Also, it is not uncommon to meet in passing when the student may put forward a question and receive a verbal response.
- **Visual and Verbal** – this includes traditional lectures and Web-lectures (lectures delivered via the Internet) and can include slide shows, videos, sound, animation, and downloadable files, also voice-over and movies in QuickTime and Real Video Streaming, synchronised with the lecture slides.
- **Visual and Dynamic** – the slide shows, videos, sound, animation, QuickTime, Flash animation and Real Video Streaming. **CD-ROM** can be included here. This can be used in conjunction with the course web site. The purpose is to provide high volume files such as graphics, audio/video files, animation and movie files in order to avoid affecting the data transfer rates over a low-bandwidth Internet connection. These files can be retrieved and synchronised with the material from the Main Server when students access the web page.

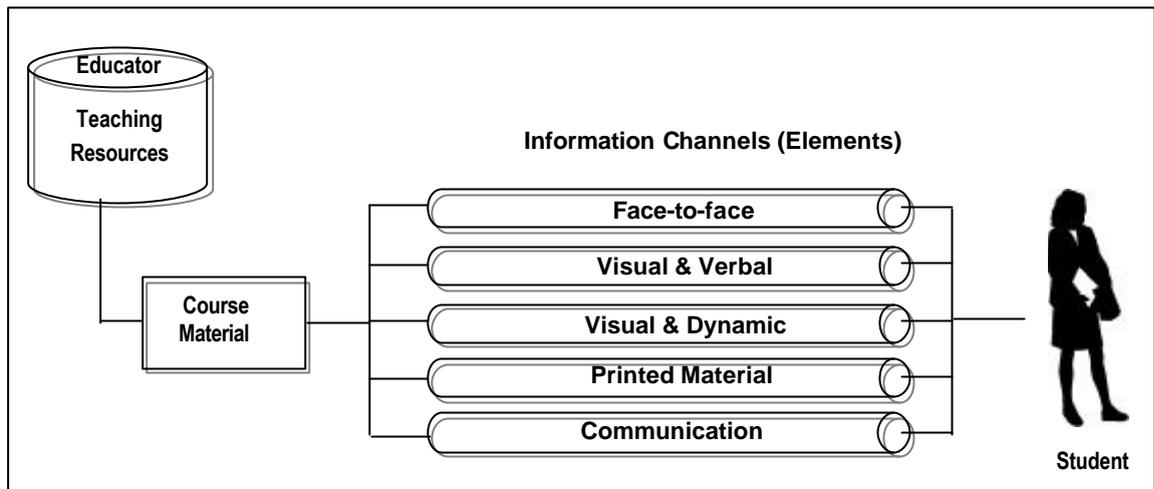


Figure 1. HyWeb - Blended e-Learning System using Multiple Information Channels

- **Printed Materials** - a textbook (if required), booklets and notes. Printouts can be convenient in the matter of portability, weight and ease of access.
- **Communication** – this can be both F2F and online. The introduction of **Wireless Technology** allows added channels of information– with a WAP mobile phone and/or a handheld device such as a PDA, students can receive and send data. Also material often provided as handouts can be accessed electronically and wirelessly, allowing the convenience of a printout, yet portable and easy to access. The portability and convenience can be a great benefit to a busy student.

Some of the issues involved include:

- Different channels can be used for different situations - some require large volume storage while others may need to be delivered via an alternate delivery method. Another consideration is that some elements may need regular updates and some may not.
- The various channels need to be utilised and controlled effectively and efficiently in order to synchronise information. The online system will be able to control and run some information by working in conjunction with data available on the CD. It will also be able to automatically detect the presence of the CD_ROM.
- Some channels can be active while others are not, depending on the situation or the user's preference.
- Some channels can provide a brief or shortened version of an element. For example, when using wireless technology, information appearing on the Mobile phone's view screen could be a summary or an index of the other channels.

5. CONCLUSION

The HyWeb developers believe that the incorporation of multiple channels of information (see figure 1) can establish an adaptable and robust partnership of today's technology. It enables easy modification of the system and allows for growth and flexibility. Be-L offers a unique educational solution with the multiple channels of information and a variety of delivery formats. One of the major advantages of this system is that students get the diversity and choice that allows this style of e-learning to cater to a large student audience with varying learning styles. By using the concept of elements, or channels of information, the educator can present the content in a variety of ways. Students can also use the self-paced e-learning material to prepare

for a F2F class, as well as work at their own pace. With students working at their own pace, the system becomes a streamlined, individualised e-learning plan.

The HyWeb Be-L system is constantly evolving. New advancements in technology are integrated into the system as they emerge. This is believed to be very relevant because the course content covers aspects of multimedia. However, this should not be considered a limitation for use in other fields of study. Another important factor is the convenience of being able to make "last-minute changes". With the addition of wireless technology this component is taken a step further. The educator is provided with the chance to make these changes, allowing for greater content control.

Research shows that student success rates in Be-L courses compare well to the traditional F2F courses, and that Be-L can also result in lower dropout rates than totally online courses (Young, 2002). This type of system can also fit well with students' lifestyles. However, in using a Be-L solution, not only can the students' learning experience be improved, but an ideal balance can be achieved between the old and the new (traditional and online) systems of teaching and learning.

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ANALYZING THE ATTRIBUTES OF PERSONALIZATION INFORMATION AFFECTING STORAGE LOCATION

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ABSTRACT

In this paper the properties of different type of personal information used for providing personalized services are studied. Different dependencies of the information as well as the ways of using that information are considered. The objectives of the study are to minimize the amount of redundant personal information and to increase the usability of services. As a result the attributes of personalization information are reflected to the proper location of the information.

KEYWORDS

Personalization, personal information, information location, information dependencies, privacy.

1. INTRODUCTION

The past few years have shown us the rapid development both in the Internet and in the mobile communication services. At the same time the amount of users of electronic services has been growing. This means that the preferences on service usage and type as well as accessing equipment and method vary a lot. Therefore, techniques allowing identification of the valuable services and content as well as customizability are required. Personalization is a technique that allows this.

Personalization can be seen as a technique that allows targeting the requested information or services according to the user's preferences. Personalization is also an effort where the company offering services and the customer using those services has to cooperate. Customer has to provide the necessary information and the company has to use it for providing targeted services. By giving up the asked information the customer relies on the company and its ability and intentions to use the information only for the favor of the customer. For the user point of view this means increased risk, as the customer loses the control over his own data. For company point of view the customer data is needed for making the personalization possible but also for increasing the customer satisfaction and thus the loyalty of the customer. Therefore personalization is beneficial for both parties and will be one of the key aspects of future services. In order to increase the usability of services the location of the necessary information should carefully be considered.

Personalization is not only very important aspect but also very challenging as several factors affect the final result. The balance between usability and privacy has to be taken into account [MAB][VOT]. In this paper the underlying structures of personalization are studied. Based on studies of existing services using personalization both the properties of the required personalization information as well as the use of this information is considered. All the factors are related to the storage location of the personalization information. By doing so the amount of redundant personal information is minimized.

2. PLACES TO STORE THE INFORMATION

Personalization typically consists of two players, user and the service provider. Therefore, the logical place to store the information is either at the *user* or at the *service provider* end. In currently used personalization approaches the information is mostly stored at the service databases from where it is used whenever needed. This however is not always the most optimal place for the information as shown later on. The other logical possibility would be to store the information at the user's end at some device from where it could be easily modified. A third viable possibility is to have *trusted third party* that holds the personalization information and provides it for the service providers. All the cases are shortly analyzed below

Service provider: This is the traditional place to keep the customer information, as it does not require any special equipment at the user end. Service provider holds huge databases containing different information about the users, such as name, address, phone numbers, etc. After the information is gathered it is accessible by the service all the time, but only for the services using the given database. This usually means that when joining to a new service the user has to give the personal information in order to get personalized services. Figure 1 presents a case where user registers into two different services and thus provides the information for both service providers.

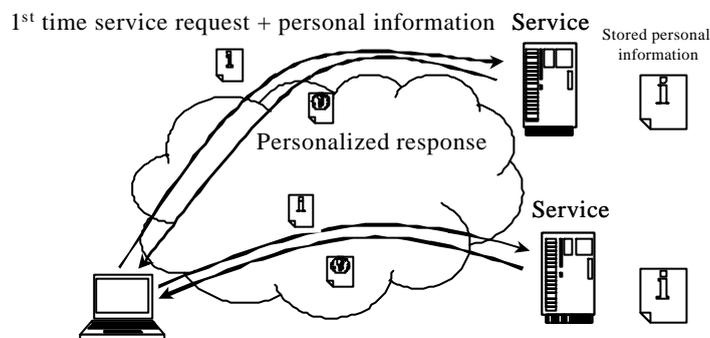


Figure 1. Service provider based approach

Drawback of this method is that several services require the same information. Thus user has to provide the information for all the services separately. This applies especially to mobile users who might need to use various location or service provider dependent mobile services. Another big issue is the accuracy of the information. When the same information is stored on many different places, it is hard for the user to keep it updated at everyplace. Therefore, it is very likely that most of the services eventually hold outdated information. It is also good to remember that most of the credit card numbers have been stolen from databases of web stores instead of the transmission path. [SCH]

Third party: In order to reduce the redundant information a third party approach could be used. In this approach a well known third party can hold the personalization information, from where it can be accessed by various services. For user this means that he has to update his information only at one place. This will make it more likely that the information stays accurate. Figure 2 presents this approach. As user requests service the service provider and third party negotiate the necessary personalization parameters. As a result user receives personalized response.

While the personalization information is at one place, the third party is the single weak link of the system. If the connection to the third party server breaks, there is no access to the personalization information. There is no way for the user or the service provider to affect on the properties of the third party server. On security point of view there is only a single place where the information is stored and it is very likely that a third party that provides such a personalization service takes extra care of the information it stores. This might not be in the case of all service providers.

There exist two single sign-in (SSI) architectures, i.e. Microsoft .NET passport [PAS] and Liberty Alliance [LIB]. Currently .NET passport requires the service provider to pay a fee to Microsoft. This means that small services are not going to adopt the passport. It is also unlikely that conference arrangers are willing to do the extra work required to join in the SSI system especially when all they need is simple registration information for one time event. In Liberty architecture service and identity providers form circles of trust, in which participants transfer information about the user. The creation of a circle of trust requires negotiations between the participating partners. Like in .NET passport this is not suitable for one time services provided by small service providers. Therefore, a simpler solution is required.

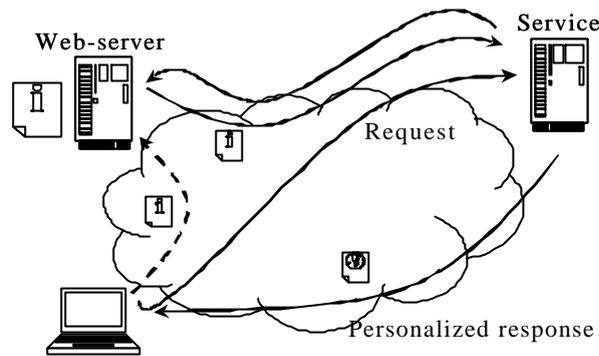


Figure 2. Third party approach

User: When the information is stored at the user end, the user can easily access and change the information. It is more likely that the user upkeeps his information locally than in some remote server. Two locations for the user-based approach have been identified, namely a personal trusted device and a personal web page.

Personal trusted device: Personal trusted device (PTD) could be anything from mobile phone to PDA. The user carries the device most of the time himself. The information is accessible by the service whenever user device is with the user. This makes it possible for user to control and update the information. If the service providers follow the idea and don't store the personal information they gain, user has pretty much the control of the security of his own personal information. This also allows the use of personal information in services that the user has not used before. Figure 3 presents the personal trusted device approach.

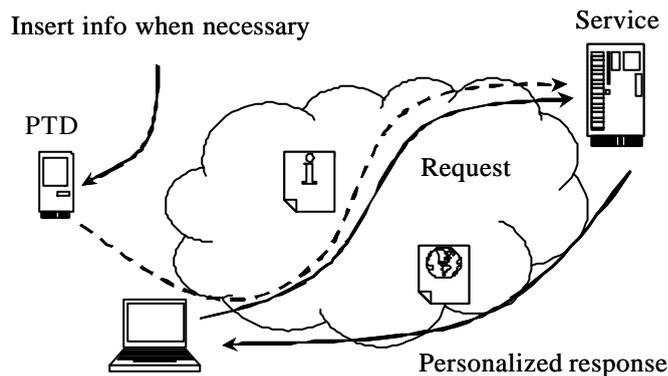


Figure 3. Personal trusted device approach

While new wireless technologies are applied to mobile devices to provide ad-hoc communications, there is no standard for exchanging various types of personal information. SyncML [SYN] supports vCard [IMC], which can be used to exchange information held in business cards, but there is no support for other type of personal information [HAN]. This might slow the operation of this approach.

Personal website: Since personal trusted devices tend to have small amounts of memory, only part of the personal information fit in it. The more space taking information can be centralized in persons own website. The data in website is controlled by the user and is accessible by the service whenever user allows it to be so.

Table 1 presents a comparison of the properties of each approach. Different storage locations have their upsides and downsides. Current mobile devices don't have very much space to store the information, compared to the dedicated servers. On the other hand, Compact flash cards, such as IBM microdrive can already hold as much as 1GB of information. As the new mobile devices support Compact flash standards the storage space on mobile device is no longer an obstacle.

Table 1. Properties of different personalization information locations

Properties of location	Service	3 rd party	User: mobile	User: website
Space available	Megabytes	Megabytes	Kilobytes	Megabytes
Operation	User types in all the information for each service.	User updates 3 rd party. 3 rd party server sends the information to the service when required.	User updates information and takes care that information is send to the service when necessary.	User updates website and the server uses website as 3 rd party.
Information update	Many places	One place	One place	One place
Accessibility for the service	Always accessible to the appropriate service.	Requires connection to 3 rd party server and a contract with 3 rd party.	When personal trusted device is at communication range of service accessing device.	Requires connection to the user's website
Accessibility for the user	Requires connection to the service	Requires connection to 3 rd party server.	Requires the mobile device.	Requires access to the website
Form of data	Can be service specific	Requires standard	Requires standard	Requires standard
Security	Depends on all the services where information is stored.	Depends on the security of the 3 rd party server.	Depends on the security of mobile device.	Depends on the security of the website.

Another big difference is the first time use of the service and the initialization of the personalization data. On service specific approach, user has to type the personalization information to every new service he uses. For other three approaches it is enough to type it only once. This also means that if information changes, it has to be updated only to one place. In order to this be true in third party approach the service provider has to have a contract with the same third party as the user for getting the information.

When using third party personalization server or personal website the personalization requires reliable connection to the given server. This means that personalization information might not be available in all places. Also unreliable network or poorly managed server can prevent the usage of information. Personal trusted device approach requires common communication medium, such as Bluetooth [BLU].

It is not enough to get access to the personalization information, but the information has to be in a form that the service understands how to use it. When the information is stored on service this is not a problem, as service provider can define the way he stores and uses the information. On other approaches the stored information is intended for use of various services and a standard way to define and transmit the information is needed.

3. PROPERTIES OF THE PERSONAL INFORMATION

As customers provide personal information for companies, it is hardly ever thoroughly thought what is really needed and what is unnecessary by the companies. If customers feel that the information is unnecessary they do not give that or give some false information. If neglecting some part of information errors may be generated. False information leads into unwanted personalization results. Better results can be achieved by carefully considering the actual needs and the properties of the required information [KAS]. The following list presents some properties for consideration:

Necessity for storage: The length of time the services need some specific personal information may vary considerably. Some information is needed by service only for a short time and some may be required for longer time periods. For example, if a web store doesn't send any advertisements through mail, then the mail address information is needed only for the delivery of ordered items and can be asked at the moment of order. On the other hand if this information is saved by the company, there is no need to request it every time. According to this study the service should store only the information it needs when customer is not using the service. While connected the information may be retrieved from the user's device.

Stability: Some information is stable, some change rarely and some frequently. For example birthday never changes and is thus stable, mail address may change rarely and the balance of a bank account quite frequently. While designing services the stability of the requested information should be considered carefully. Information that changes should be stored at the service only for the time it is needed. Frequently changing information should be stored at the user's device so that the user may update it when necessary.

Size of the information: Current personalization approaches are mainly based on textual representation of the information. As the amount of information is still quite small it does not have too much influence of the place where it is stored. In the future other forms of presentation, such as audio-visual content, could be used for the personalization. This may affect the amount of communication and thus the optimal location of the information.

Generality of the information: While a lot of information is independent from the service user still has to type this information over and over again when he wants to use new service from new service provider. This approach makes it highly impractical to provide personalized services for one-time visitors. For example a company might provide computer with Internet access to its visitors. In order to read mail and the computer need to be customized. The visitor has to type the necessary information such as the mailbox address.

Service specific information is information that is considered useful only for the given service, e.g. user ID number for some service or customer behavior. Restaurant for example may have user specific knowledge like the fact that customer likes fish. If this information is combined with the service dependent information about the types of fish dishes customer have ordered on last few times, the restaurant can offer the customer a fish meal he has not yet tried out. ***User specific*** information should also be on place where various services can access it, whereas the service provider is only usable place for storing service specific information.

Origin of the information: Information can also be categorized according to its origin. Some information may be generated by the service (e.g. web browsing habits and thus some preferences) and some other information deliberately asked from the user. Although automatic information gathering might work well, some users may want to have the control over their data or are at least quite suspicious about the issue. In all cases the user has to have the possibility to limit the use of the information. Information generated by the service provider may be provided to other services with the user permission. Liberty project offers an approach for service providers to share the information about the customers through the circles of trust [LIB].

Privacy: The level of privacy greatly differs according to the piece of information and the user. Users may have preferences concerning the required privacy level. Some information is very private for some users whereas the same information may be public for other users. The final decision concerning the location of the information storage has to be on the customer.

The properties of personal information affect to the optimal storage location. Based on the properties the service should carefully consider the information it needs. The final decision concerning the storage location should always be on the customer

4. PERSONAL INFORMATION DEPENDENCIES

Personal preferences are not always the same all the time, but they are dependent on the situation. When you are on a workday driving through unknown city and want to eat, you probably want to find a place where you get your lunch fast. On the other hand when you are on vacation with your wife it is more likely that you are looking fancier place to eat than a burger place. During the research five dependencies were identified.

Time: When talking about personal preferences time matters. While user might want to get latest news on his mobile phone with loud beep at the day time, at the night time such notes are more likely to be annoyance. Time is rather easy to determine by the service especially if the time zone where the user resides is known.

Location: Location of the user may affect the needs of the user. While quick burger lunch is ok at hometown, more exotic choice might be attracting, when visiting another country. Location can also affect the time parameter. At the wintertime a user might prefer hot rum, when he is in Finland. On the other hand, when he is visiting Australia at the January something cold is more likely the user's preference.

The usual way to determine rough user location on the Internet services is to ask it from the user. On services accessed with mobile devices the location information can be provided by the user device that has GPS (Global Positioning System) capability or by sophisticated service access network. [JÄP].

Role: People have many roles on their lives such as worker, father or soccer team captain. Depending on the role the preferences change. As the worker the user will more likely to select different books than as the father.

Situation: Sometimes time, role and location do not give accurate enough information about the user preferences and the user's situation is needed. Phone calls for special offers are probably not welcomed when user is at lunch or at the meeting.

The role as well as the situation in which the user is at the time is hard to predict. In some extent situation can already be determined in some mobile phones, e.g. Nokia 6110. Those have adjustable profiles function for different usage situations with call grouping and caller group identification [NOK]. Similar approach could be used also for the role and thus the mobile device could provide the information of role and situation of the user.

Equipment: Equipment affects the representation of the information. Information should be provided in a different way on a desktop or on a PDA device. This may limit the presented content [HJE].

The dependencies do not directly affect the location of the personalization information but they have to be identified when the user uses the service.

5. WAYS FOR USING PERSONAL INFORMATION

A lot of information may be gathered for the personalization purposes. These personalization attributes are then used to choose various service parameters or attributes. The following list shows four general methods how these attributes of personalization can be used to determine service attributes and to provide personalized service.

Direct: The information is used as it is and nothing is compromised, e.g. if the user prefers black background with white letters then he gets them. In this model there is no need for computing power to provide the personalization to the customer. To determine one service attribute one personalization attribute is enough.

Indirect: The information is used indirectly to provide personalized service, e.g. if the user prefers black background with white letters, service provides interface with dark background color and light letters according to the official color schema of the company. Very little computational power is needed for generating the correct service attribute. One personalization attribute can be used to determine many service attributes.

Approximated: Personalization is approximated from the various types of information, e.g. if person likes sci-fi movies and holds huge sum of spare money, he is suggested to buy a shuttle trip to the space. Approximated model requires a lot of computational power to generate the service attribute from the set of personalization attributes. Same attributes in different sets can be used to determine many service attributes. In approximated mode either the service attributes or personalization attributes can be stored to provide the personalized service when customer returns.

Profiled: User's personal information is used to profile the user and then to determine which predefined group the user belongs [ARD]. After that the user is treated as the member of this group, i.e. the actions are performed as for any person in this group. The profiles have been generated beforehand and thus little computing power is needed when determining which profile is used for service creation. Many personalization attributes are used to choose one service profile containing the attributes. After profile is created there is no need to store the personalization attributes used for generating the profile.

Table 2. Usage of personal information

	Direct	Indirect	Approximated	Profiled
Required computation when using information	None	Little	Lot	Little (creation of profiles requires a lot)
Source information: Personalization attribute	1:1	1:M	M:M	M:1
Stored information	Personalization attributes	Personalization attributes	Service or personalization attributes	Profile
Required communication	Amount of personalization data	Less than in direct model	Lot	Little from one user
Required storage space	Lot	Lot	Lot	Little

The first three ways are more or less personalization whereas the last way is more like grouping. Considering the needs of every person is much more difficult than considering the needs of only a predefined number of groups. These different ways of using personal information are compared in Table 2.

When information is used directly, the amount of information needed can be rather big as one piece of personal information determines only one personalization attribute. This also results to heavy traffic when personalization is used. In the case of indirect and approximated models the situation is almost the same. A lot of storage space is required for the personalization information. The difference is in the amount of computation required.

The profiled method differs from the others in a way that once the user is categorized into one profile it rarely is changed. Therefore, the amount of transferred data remains low. Optimally different profiles are stored at the service while the user device holds the identifier of which profile the user matches at. This ensures that once the user has profiled he don't have to send his personalization information again to the service thus reducing the amount of data transfer and providing better security as the user's identity is not linked to the profile at the service database.

From the remaining methods indirect model requires least data transfer and therefore the personal information can be stored on the personal trusted device and used from there on most services. Approximated model requires lot of information about the user to generate various personalization attributes therefore the information should be accessible to the service rather easily. Internet storages or at the service itself are recommended places.

The optimal place for personal information storage in direct model depends on the amount of personal information needed for service. When little is needed the best place is to have it at user device, but if a lot is needed the transmission medium becomes bottleneck on service usage. In this case the information should be stored at the service.

6. CONCLUSIONS

The objectives of this study were to minimize the amount of redundant personal information. This goal was achieved though the analysis of location, properties and dependencies of the personalization information. As the result of this analysis the usability of services and the security of private information will be increased.

Overall the optimal place is not just one location but the combination of given locations. Generally the user specific information should be stored at the personal trusted device. Services should store only the service specific information and the information they require when the user is not using the service. 3rd party should be used when forming circles of trust in which services are allowed to share their own specific data or exchange authentication information as is done in Liberty alliance's approach.

In order to exchange the personalization information a method for transferring the information is needed. In our study the Bluetooth wireless communication technology has been used for connecting the user's device into the network. Although this is not discussed in this paper it should be considered as a candidate for transfer media from PTD to service accessing device. Also to use the information a notation for describing the personalization information is required. Currently service providers have their own proprietary solutions.

Several independent projects have been defining XML based markup for some personal information. Unfortunately none of these are widely accepted.

Right information in right place can increase usability of the services of e-society dramatically. When user has device holding the information, the service provider needs less space for storing user preferences and user can determine a bit better where his information is going and thus decide the balance between usability and privacy.

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THE IMPACT OF WEB SITE PRIVACY STATEMENT CHARACTERISTICS ON USER COMFORT LEVELS

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ABSTRACT

The commercial web site privacy statement is the common method of providing web site users with information about the organization's use of personal information. In spite of their widespread use, there is a substantial variation in the content and accessibility of web site privacy statements. This study examines the question of how web site privacy statement characteristics affect the comfort level of web site users. The results of this study identify characteristics of web site privacy statements that affect the comfort level of the user in submitting personal information to the commercial web site that is required for electronic business transactions. The results demonstrate that the comfortable level of web site users is significantly affected by some specific privacy statement characteristics and that firms could increase the user comfort level of providing personal information to a web site by the construction of the privacy statement.

KEYWORDS

Privacy Statement, Internet, Personal Information.

1. INTRODUCTION

In order for the Internet to realize its full potential as a medium for commerce, widespread acceptance of the Internet as a commercial medium is required. There are a number of dimensions relating to the issue of user confidence in the use of the Internet for business purposes. One widely discussed concept is that of trust. This is both an evolving concept and one which has been and continues to be investigated. The issue of trust in Internet based transactions has been the subject of a number of surveys, research reports, and studies. Bhattacharjee [Bhattacharjee, 2002] presents a review of trust issues in his development of a scale for measuring trust in online entities.

Privacy and trust are related concepts in that the online sharing of personal information has the potential for reducing the trust in the information sharing relationship. In general, the use of online shared information is viewed as a part of the privacy policies of the receiver of the information. Hoofnagle [Hoofnagle, 2002] provides an overview of the legal dimensions of consumer privacy in the United States that highlights the risks faced by a web site user who provides personal information online. He also delves into the differences in the legal aspects of privacy as they exist in the international arena which serves to emphasize the uncertainty regarding the sharing of personal information. Another recent study of online consumers by Jupiter Research reported to the Federal Trade Commission [Leathern, 2002] states that 70% were concerned about privacy, 43% did not find privacy statements simple and easy to understand, and online privacy

concerns would produce an opportunity cost for online sales of \$24.5 billion by 2006. This would seem to suggest that a firm engaging in online sales should be interested in the potential for increased sales as a result of an improved customer perception of privacy. Another report of a Jupiter Research study [Mazuris, 2002] states that 82% of consumers could be easily induced to give away personal information to a new shopping site and that most companies budgeted less than \$40,000 per year for online privacy initiatives. This ambiguity between consumer opinions about privacy and online behavior can account for the lack of consumer protection in the privacy policies of some online commercial web sites. However, these data suggest that improved user confidence in providing online personal information could result in even faster growth.

The use of privacy statements on web sites that collect personal information from users of the web site is the common approach used on commercial web sites to alleviate user concerns and inspire confidence in the transfer of personal information via the web site. The emergence of a standard Platform for Privacy Practices (P3P) [Marchioni, 2002] is intended to produce increased comfort for some web site users but some feel that it is not universally viewed as a complete solution to user privacy concerns [Festa, 2002]. There are a number of organizations concerned with the concept of privacy from one or both sides of the online information transfer. These organizations provide extensive coverage of privacy issues, privacy laws, and recommended privacy practices from either the viewpoint of the consumer or the firm. Among organizations that all in the group are the Electronic Privacy Information Center (www.epic.org), National Advertising Initiative (www.networkadvertising.org), Online Privacy Alliance (www.privacyalliance.org), Privacy and American Business (www.pandab.org), the Privacy Foundation (www.privacyfoundation.org), the Global Internet Liberty Campaign (www.glic.org), Privacy.Org (www.privacy.org), Privacy International (www.privacyinternational.org), and the Privacy Rights Clearinghouse (www.privacyrights.org). These organizations provide extensive coverage of privacy issues, privacy laws, and recommended privacy practices.

While the widespread adoption of P3P may produce increased comfort for web site users, users still depend on individual web site specific privacy statements to find out about the privacy policies associated with that web site. Consequently, the commercial web site user remains dependent upon the privacy statement of each specific web site to establish a comfort level in providing personal information to that web site. If the specific characteristics of the privacy statement affect the web site user's level of comfort in providing personal information, it becomes important to know which specific web site characteristics have a measurable effect on the user comfort level. This knowledge will allow firms to hopefully craft privacy protection policies and privacy statements that will address the most significant user concerns.

2. ANALYSIS OF PRIVACY STATEMENT CHARACTERISTICS

This study focuses on the privacy statements of web sites that require the users to submit personal information. The sample data for this study consists of evaluations of 155 commercial web sites with privacy statements. The evaluations were performed by a group of university students who were familiar with web based applications and the online transfer of personal information. While these web site evaluators may not represent the Internet population as a whole, they do represent a segment of the population that could be expected to be the most active users of online electronic commerce and represent a target market that is actively pursued by online sales organizations.

Each evaluator was asked to assess his/her comfort level with web sites requesting personal information after reading the privacy statement associated with that web site and completing a common privacy statement evaluation questionnaire. Each evaluator was instructed in the use of a standard measurement instrument. The evaluator then completed the evaluation instrument by examining the contents of the privacy statement. In this study, the comfort level is measured on a 5 point ordinal scale ranging from a low to high comfort level in using the web site. Potential evaluator bias was examined by performing an analysis of variance on the comfort level scores. The identity of the evaluator was found not to be significantly related to the comfort level rating. Table 1 presents the distribution of outcomes for the sites in terms of the comfort level ratings.

Table 1. Web Site Comfort Management Results

Comfort Level Rating	Definition of Comfort Level with Web Site	Responses
1	Low comfort	3 (1.9%)
2	Low to average comfort	32 (20.7%)
3	Average comfort	62 (40.00%)
4	Average to high comfort	52 (33.6%)
5	High comfort	6 (3.9%)

It is clear that there is a normative effect in the rating and that extreme values are fairly rare among these web site ratings. A test for normality of the results table leads to the conclusion that a hypothesis that the comfort ratings are normally distributed cannot be rejected ($\text{Chi}^2=2.43$, Probability=.296). While this suggests that there is a significant degree of conformity in privacy statements, other data provide evidence that this is not the case.

The privacy statements for each web site were evaluated in terms of a set of specific characteristics and the location of the privacy statement on the web site. All of the privacy statement characteristics except one are measured on a binary scale (True or False) indicating the presence or absence of each specific characteristic of the privacy statement being evaluated in this study. One characteristic (the number of clicks to the privacy statement) is not binary. The characteristics used in the analysis of the web sites are shown in Table 2.

Table 2 presents the percentage of times that each of the characteristics is present in the sites used in this study except for the one characteristic (the number of clicks to the privacy statement) for which the mean value is given. A comparative examination reveals that, while many of the privacy statement characteristics are very commonly found in the privacy statements, other characteristics are considerably less common. The widespread use of privacy statements for a period of years could be expected to have resulted in a very high degree of conformity in privacy statements with the emergence of a typical or standard privacy statement ensuing.

However, these data reveal that there is considerable diversity in the content of the privacy statements examined in this study even though there are a number of organizations and trade groups promoting standardization of web site privacy statements. In particular, there is no single characteristic that is found on all privacy statements. If the normative values suggested by the results shown in Table 2 were used to construct a privacy statement, the resulting privacy statement would still omit three key privacy statement characteristics. These data reveal that privacy statements have not become so standardized that Internet users can necessarily take them for granted and ignore their specific elements.

It is noteworthy that a large percentage of these web sites do not provide OptOut options or explain exactly personal information is collected or used. It is also noteworthy that a minority of these sites state that they are a member of a privacy advocacy group and who are the 3^d party users of collected personal information. These three privacy statement characteristics represent some of the most important information concerning privacy that can be found in a privacy statement. One conclusion that might be drawn from this fact is that the web site owners are not convinced that privacy is not as great a concern among consumers as some suggest that it is. Alternatively, it may be that web site owners are not convinced that users really are swayed by the specific characteristics of privacy statements.

Table 2. Privacy Statement Explanatory Variables

Variable	Privacy Statement Characteristic	Occurrence/Mean Value
P1	Link to privacy statement from home page	87.7%
P2	Link to privacy statement from all pages	61.9%
P3	Link to privacy statement from information entry	52.3%
P4	Number of clicks to the privacy statement	1.13 clicks
P5	States that site collects personal data	93.5%
P6	Site is a member of a privacy advocacy group	40.1%
P7	Specifies what information is collected	86.5%
P8	Specifies how information is collected	87.1%
P9	Specifies what type of technology is used	85.2%
P10	Specifies nature of possible future contact	77.4%
P11	Specifies how collected information is used	90.3%
P12	Warns of 3 rd party links	72.9%
P13	Specifies if individual data is used	74.8%
P14	Specifies if aggregate data is used	67.7%
P15	Specifies type of 3 rd party disclosure	68.4%
P16	Specifies 3 rd party information users	38.1%
P17	Provides OptOut option for internal information use	59.4%
P18	Provides OptOut option for 3 rd party information use	51.0%
P19	Specifies how the user can review or change personal information	42.6%
P20	Specifies safeguard policy	63.2%
P21	Specifies how cookies or beacons are used	58.8%

2.1 Analysis Methodology

The research model that is employed is based on the assumption that the comfort level of a web site user is dependent upon the characteristics of the privacy statement associated with the web site. Assuming that the combined effects of the privacy statement characteristics can be expressed as a linear combination, the following model is appropriate

$$R_i = \sum B_j P_{ij} + e_i$$

where R_i is the privacy statement comfort level rating for a particular web site, P_{ij} represents a privacy statement characteristic for that web site, B_j is the model parameter associated with a particular privacy statement characteristic, and e_i is the error term for that web site relative to the model.

Various methods have been used to examine data of this type in which the dependent variable is measured on an ordinal scale. These methods include regression analysis, ordinal probit analysis, and ordinal logit analysis [Long, 1997]. Since the ordinal logit and ordinal probit model do not assume that the ordinal response variable (the comfort level in this case) is linear, these methods are more appropriate for the data. The primary difference in these two ordinal models is in the assumptions concerning the distribution of the

error terms with the ordinal probit model based on a normal distribution and the ordinal logit model based on a logistic distribution. In many cases, the maximum likelihood estimators of the two models can yield very similar results except that the logit model parameters are generally larger [Long, 2001]. In the study, the data are analyzed with both methods since it is not clear on a pre-analysis basis which is the more appropriate model assumption. The use of both models also provides confirmatory evidence of the analysis since the two models would normally be expected to produce generally consistent results in terms of relative model parameters, goodness-of-fit criteria, and explanatory variable significance.

If the assumptions regarding the ordinal probit and logit models are valid, the distribution of model parameters is approximately normal and can be tested using the estimated standard error. In this study, the fit of the both overall models can be tested using a standard goodness-of-fit test. The model fit can also be further described through various forms of residual analysis if the specific pattern of residual behavior is important or the effectiveness of the model in predicting specific outcomes is of interest. In this study, the analysis is done in two stages. In the first stage the models are estimated with all measured web site characteristics used as explanatory variables. In the second stage, only explanatory variables that were found to be significant (with a type 1 error of .10 or less) in the first stage are used.

2.2 Results

The initial phase of the data which used both models and all of the potential explanatory variables resulted in statistically significant fits for both models but with only some of the explanatory variables statistically significant. The initial results are shown in Table 3 for both models for the variables which were found to be significant (at the 10% level) in either model. None of the other explanatory variable were close to being significant and are thus excluded from the Table.

It is interesting to speculate as to why some of the omitted variables are not significant. The lack of visibility of the privacy statement on the home page does not show a significant effect. Since the evaluators were already reading the privacy statement, a this location effect may have been minimized and it may be that the privacy statement when available on a page that leads to a business transaction. There also appears to be less evaluator sensitivity to the nature of the information that is collected on the web sites as specified in the privacy statement than might be anticipated. However, since each of the evaluators was an experienced user of electronic commerce web sites, they may have already overcome any reluctance or concern with the concept of information sharing over web sites. It is also somewhat surprising that the evaluators were somewhat of a mixed mind about third party information sharing.

Table 3. Model Analysis with All Explanatory Variables

Model Fit	Ordinal Logit: $\chi^2=187.24$ Prob.=0.0000, Psuedo $R^2=.4790$		Ordinal Probit: $\chi^2=169.03$ Prob.=0.0000, Psuedo $R^2=.4324$	
Significant Variable	Estimated Coefficient	Probability	Estimated Coefficient	Probability
P2	1.185	.020	.500	.064
P4	-1.698	.003	-.647	.016
P5	3.578	.013	.936	.127
P6	1.791	.005	1.023	.002
P12	1.208	.022	.537	.060
P14	1.247	.016	.463	.076
P15	1.277	.038	.335	.279
P17	1.480	.006	.823	.005
P20	1.134	.060	.763	.013

Both models are similar in terms of the set significant variables and overall model fit except that variables P5 and P15 were only significant in the ordinal logit model. In the second phase of the analysis, a revised model was used which contained only the explanatory variables which were found in the first phase to be significant in at least one of the two models. These results are shown in Table 4.

Table 4. Model Analysis with Reduced Set of Explanatory Variables

Model Fit	Ordinal Logit: Chi ² =168.21 Prob.=0.0000, Psuedo R ² =.4304		Ordinal Probit: Chi ² =148.47 Prob.=0.0000, Psuedo R ² =.3798	
Significant Variable	Estimated Coefficient	Probability	Estimated Coefficient	Probability
P2	1.451	.000	.666	.003
P4	-1.417	.001	-.636	.003
P5	4.122	.000	1.610	.002
P7	1.960	.001	1.019	.000
P12	1.388	.003	.653	.010
P14	1.260	.004	.585	.011
P15	1.165	.028	.422	.130
P17	.872	.056	.560	.027
P20	1.587	.002	.907	.001

A comparison of the results of the first and second analysis reveals that the set of variables used in the second analysis captured most of the explanatory power of the full set of explanatory variables since there was only a drop of about 5% in the Psuedo R² and that the fit of the functions remain highly significant. While there were some changes in the exact size of the model parameters, there were no changes of sign. The estimated individual model parameters generally were more significant and only variable P15 in the ordinal probit model was not significant.

These results suggest that the initial visibility and the accessibility of the privacy statement is an important consideration in determining the comfort level. This conclusion is supported by the statistical significance of the characteristics of P2 (link to privacy statement from all pages) and P4 (number of clicks to the privacy statement). The implication of this is that a web site can inspire greater confidence by making a privacy statement highly visible and easy to reach.

Several other significant characteristics relate to the general area of clarifying for the user of the web site what information is collected and how it used. The significance of P5 (states that the site collects personal data) and P7 (specifies what information is collected) is noteworthy since these are present on the vast majority of sites. Consequently, it appears that users expect for these to be part of privacy statements and do not feel as comfortable when they are not included in a privacy statement. This may, in fact, reflect a developing normative expectation among users concerning the contents of a privacy statement.

The significance of variables P12 (warns of 3rd party links), P14 (specifies if aggregate data is used), and P15 (specifies the type of 3rd party disclosure) suggest that users are concerned with issues such as selling user data and sharing user data with business partners. These data suggest that firms which fail to disclose what is done in these areas will experience a lower level of user comfort with the transfer of personal information to their web sites. This appears to suggest that disclosure of information sharing alone has some positive benefits in terms of user comfort while a failure to disclose how information is used can create more apprehension and a lower comfort level.

The significance of variable P17 (provides OptOut option for internal information use) in inspiring greater user comfort is easy to understand since it is presenting the user with an opportunity for to control the

use of personal information. Finally the significance of P20 (specifies safeguard policy) provides an addition element of confidence that is appreciated by web site users.

3. CONCLUSION

This study examines the impact of privacy statement characteristics on user comfort levels for web sites that collect personal information. The results of this study indicate that considerable diversity exists in the specific characteristics of web site privacy statements and that users are sensitive to these privacy statement differences. Web sites that collect personal information can increase the comfort level of the users by increasing the visibility and accessibility of privacy statements. User comfort levels can also be increased by a privacy statement that clarifies what information is collected and describes how it is used. User comfort levels are also increased when the privacy policies include use control features such as an OptOut feature.

These results suggest that privacy statements (and privacy policies) should not be treated casually by owners of web sites that hope to collect personal information. The web site owner may be able to improve the comfort level of the web site user by a careful design of the privacy statement so that it includes the elements that are of most significance to the user. It is also clear that considerable diversity in privacy statements continues to exist and that web site owners may not be convinced that the exact nature of the privacy statement has as much effect as the mere presence of a privacy statement.

In order to develop a more rounded view of the effect of privacy statement elements, the impact of the privacy statement on persons who were not previous electronic commerce users needs to be assessed. In this study the evaluators' personal experience quite possibly resulted in different conclusions than would be the case in which the evaluators were not previous electronic commerce users. Consequently, the overall effect of the privacy statement may be less dramatic than in the case of the inexperienced electronic commerce user for whom the privacy statement could be expected to induce the person to engage in electronic commerce at all. As long as privacy statements remain the main source of information to users about web site privacy policies, their use and differences in privacy statements may remain important aspects of the expansion of electronic commerce.

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YOUR PRIVACY IS ASSURED—OF BEING INVADED: WEB SITES WITH AND WITHOUT PRIVACY SEALS

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ABSTRACT

Concerns about consumer privacy are a leading reason for non-participation in electronic commerce and other on-line activities. Privacy seals were developed as means of addressing those concerns through industry self-regulation. Their purpose is to assure consumers that certain basic privacy standards are being met by the Web sites they visit and two leading seal authorities, TRUSTe and BBBOnLine have emerged. The present research assessed whether the two seal authorities delivered what they promise and compared the privacy protection practices of sites that participate in the two programs with non-participating sites. Privacy policy statements were interpreted as a form of persuasive communication that attempts to minimize the risks of providing personal information while emphasizing the benefits of personal disclosure. Seal bearing sites were compared with a sample of comparable sites to determine if the privacy practices of unsealed sites differed. There were few differences in the privacy practices between seal authorities: TRUSTe and BBBOnLine participants offered about the same degree of privacy protection assurances and were equally invasive with regard to the amount of personal information they requested. However, unsealed sites offered nearly equal privacy assurances and were significantly *less* invasive than the sealed sites with respect to the amount of personal information requested. However, seal program participants did provide superior access to information and assurances of data security. Suggestions for the improvement of voluntary privacy seal programs are offered.

KEYWORDS

Internet, privacy, seals, content analysis

1. INTRODUCTION

Privacy remains an important issue on the Internet. Two-thirds of Internet users are concerned with the confidentiality of the Internet (NTIA, 2002; Cranor, Reagle & Ackerman, 1999; Hoffman, Novak & Peralta, 1999, Pew Research, 2000) and an equal number see the Internet as a threat to their privacy (Cole, 2001). Privacy threats may lower participation in commercial and social activities on line (Pew Research, 2000) and are of particular concern to new users and women (Pew Research, 2000) and to African-Americans (NTIA, 2000). Non-users see the Internet as a privacy threat (Cole, 2001; NTIA, 2002), suggesting that on-line privacy invasion is a deterrent to non-users as well.

These concerns may be well-founded. A content analysis of leading e-commerce sites by the Federal Trade Commission found that only 20 percent met the agency's standards (FTC, 2000). These guidelines entail disclosure of privacy policies, providing consumers choice and consent, access to their data, and security of the data that is collected. Independent studies have revealed continuing gaps in on-line privacy practices (Culnan, 1999; 2000; Miyazaki & Fernandez, 2000; Miyazaki & Krishnamurthy, 2002).

To address the on-line privacy problem, fair practice standards are sought (FTC, 2000; Milne & Rohm, 2000). For consumers, clear explanations of information practices are a first step toward making a conscious decision to participate in a web site's information practices (Han & Maclaurin, 2002). The on-line public also demands third party verification of those claims (Harris Interactive, 2002). The problem for Web site proprietors is how to inform consumers without losing consumer trust and prompting avoidance behavior.

Elsewhere, notably the European Union (CEC, 1995), there are strong legal protections for consumers. These include the right to control the release of information to third parties and to inspect and correct private information. However, government regulation has not proven to be an effective approach in the United States to date. With the exception of the Child Online Protection Act (COPA) provisions governing the privacy rights of children, efforts to pass consumer privacy legislation have been a failure. The USA Patriot Act, passed in the wave of fear following the September 11, 2001 terror attacks, has significantly "lowered the bar" for privacy protection by undermining basic Fourth Amendment concepts of probable cause and issuance of warrants and effectively gutting the Electronic Communications Privacy Act (EFF, 2001). Now, commercial interests are demanding powers similar to anti-terror agencies, including the right to invade computer hard drives in search of copyright violations (in the Peer to Peer Piracy Prevention Act, H.R. 5211, Section 514). In this climate, consumer privacy is endangered and protective legislation is unlikely.

Instead, consumers, the Federal Trade Commission and industry leaders alike are all hopeful that voluntary third party seal programs will provide a self-regulatory solution. Several alternative seal programs have emerged, including TRUSTe, BBBOnline, and HON. However, the Internet user's desire for convenience or pleasure may overwhelm concerns about privacy. E-commerce sites are laden with features that seem calculated to overwhelm the consumer self-control and trigger impulsive behavior (cf. LaRose, 2001). The complexity and mixed messages (cf. Anton & Earp., 2001) of privacy disclosure statements and unfamiliarity with privacy self-protection techniques are further barriers to the effectiveness of privacy notifications. While users may be concerned about privacy, they may not understand on-line privacy disclosures, be unable to implement their own privacy protections, or be motivated by the blandishments of Web site proprietors to ignore their own privacy concerns. Most Internet users routinely divulge personal information in return for access to "free" information or for the perceived benefits of having information personalized for them (Pastore, 1999a). The rewards of incentive programs, coupons, discounts, and prizes may also motivate disclosures (Pastore, 1999b) and a trade-off between privacy and convenience is thought to be the crux of the on-line privacy issue (O'Neill, 2001). Customer relationship management—the science of building an exchange between proprietor and customer—may also subvert privacy concerns (Luo, 2002).

The purpose of the present paper is to compare sites bearing the seals of the two leading privacy seal authorities with each other and with a comparable control group of sites. It updates and improves upon recent research comparing sealed and unsealed sites (i.e., Miyazaki et al., 2002) by expanding the sample size: the small (n=20) cell sizes in prior research may have lacked the power to detect distinctions between sealed and unsealed sites. In addition to assessing compliance with voluntary privacy guidelines as did past studies (Culnan, 1999; 2000; Miyazaki & Fernandez, 2000; Miyazaki & Krishnamurthy, 2002), the present research examines the consumer communication characteristics of privacy policy statements.

2. A COMPARATIVE ANALYSIS OF WEB SITE PRIVACY POLICIES

2.1 Privacy Policy or Persuasion Attempt?

Thus, the content of privacy policies and the use of privacy seals may be viewed as a persuasion attempt on the part of Web site proprietors. Proprietors may use privacy policy statements to persuade visitors to voluntarily disclose personal information necessary to complete transactions or to ignore involuntary monitoring activities conducted by the proprietor.

This balancing of risks and rewards is consistent with a theory of privacy (Foddy, 1984) that describes competition between the desire to avoid personal disclosures and the desire to set up exchange relationships for mutual benefit (e.g. to complete an e-commerce transaction), to obtain desired stimulation (e.g. to register for an online game), or to compare oneself with others (e.g. to enter a chat room). Generally, the decision to make a disclosure depends upon the closeness of the relationship, the risk to benefit ratio involved in the disclosure, the situation, and reciprocity (Rosenfeld, 2000). Thus, Web site proprietors might influence the

disclosure decision by building a close on-going relationship, minimizing the perceived risks of disclosure with their privacy practices, emphasizing the benefits of disclosure, creating private situations with secure Web links, and reciprocating with additional information, services and completed transactions when personal disclosures are made. In privacy theory, deception (e.g. using false on-line identities), equivocation (e.g. filling in ambiguous address information), and hints (e.g., providing incomplete information) are alternatives to full disclosure, strategies that are mirrored in the on-line context (Sheehan & Hoy, 1999). We site proprietors would like to persuade visitors to avoid these practices.

In this light, privacy seals may be seen as a persuasion tool. For those who are not highly involved in privacy issues, they are an attempt at persuasion through the use of peripheral cues that are easily recognizable, familiar and attractive. The source of the information is of those cues. Familiar sources that are viewed as credible, that is, trustworthy, attractive and with expertise (Petty, Cacioppo & Schumann, 1983; Atkin & Block, 1983) are used heuristically to assess the meaning of the message. Thus, source credibility closely parallels the concept of trust in Internet research (Luo, 2002; Chadwick, 2001) that is predicated on the familiarity of the source (built through repeated transactions or community relationships) and institutional affiliations (i.e. with certification services). If privacy is a high-involvement issue, then the privacy seal links to a detailed policy that elaborates arguments in favor of making personal disclosures.

2.1.1 Privacy Seal Practices

But what do privacy seals actually assure? The two leading seal authorities, TRUSTe and BBBOnline both rely on voluntary compliance with privacy policy standards consistent with the FTC's guidelines (disclosure, choice, and data security). There are differences. TRUSTe emphasizes procedures to assure the accuracy of information. BBBOnline prohibits the release of personal information to third parties for marketing purposes even if consent is obtained and requires "opt in" privacy for health, financial, political preference, religious and other highly personal information. Both engage in ongoing monitoring. TRUSTe conducts periodic privacy policy reviews, CPA audits of privacy policies, and "seeding" of private information to check compliance (TRUSTe, 2002). BBBOnline monitors through random checks. Both offer on-line verification so that consumers can "click through" the seal to verify the legitimacy of the seal.

Both offer consumer complaint resolution although BBBOnline's, modeled on the Better Business Bureau approach, is considered superior by some (PerfectlyPrivate, 2003). BBBOnline posts consumer complaints online and also the follow-ups to those complaints, with the threat of reporting violators to the FTC withdrawing their seal if the complaints are not satisfactorily resolved. TRUSTe requires that the consumer refer the complaint to the site and wait up to 30 days before submitting a complaint to the seal authority. TRUSTe does not publish a record of complaints or their resolution (TRUSTe, 2002).

In practice, the seal assurance programs have been less than perfect (PerfectlyPrivate, 2003). TRUSTe was embarrassed to find it had violated its own standards by using (unwittingly, it claimed) a third party to track identifiable information on its own site. Two TRUSTe seal holders were found to be forwarding personal information to a marketing company and while TRUSTe vowed to investigate and the transfer was eventually terminated, the authority never published the result of its investigation. TRUSTe also failed to pursue complaints against Microsoft and RealNetworks on the premise that software glitches had inadvertently caused the breaches. Both authorities have been criticized for granting seals to companies who were under investigation by the FTC (GeoCities in the case of TRUSTe, Equifax in the case of BBBOnline).

2.1.2 Examining Privacy Policies

Prior content analysis research (Culnan, 1999; 2000; Miyazaki & Fernandez, 2000; Miyazaki & Krishnamurthy, 2002) examined privacy seals from the perspective of the FTC guidelines and found gradual improvement in complying with those guidelines. However, compliance with the letter of the code authorities and FTC guidelines does not necessarily mean compliance with the spirit of consumer protection. The context in which the seals are presented and the text of privacy policies might present mixed messages to the consumer, on the one hand warning about the dangers of yielding private information, on the other hand arguing that these concerns are unimportant or offset by other factors. The purpose of the present study is to examine the seals as an act of persuasive communication as well as an artifact of voluntary self-regulation. That is, we examine how privacy seals may be part of a persuasive exchange process in which they serve as inducements to make disclosures of personal information.

From this perspective, it is important to consider the context in which the seals appear. For example, when seals appear prominently on the home page, next to the text of the privacy policy, and again on pages where personal information is requested, that could represent an invitation to forego reading of the text of the privacy policy and rely on the presence of the seal alone to assure privacy. In so doing, is the Web site proprietor “arguing” to low involvement visitors that they needn’t delve into privacy policies too deeply? Overall, is the appearance of the seal a “smoke screen” to obscure privacy intrusion?

And if visitors delve more deeply, are revelations about privacy intrusions countermanded by verbal arguments that stress the trustworthiness of the site? Or do they remind visitors of the rewards for compliance, or the negative consequences of failure to comply. For example, statements affirming the proprietor’s concern for the visitor’s privacy might be a verbalization of the same superficial trustworthiness “argument” that the seals themselves represent. Reminders of the additional services available when personal information is provided – or the ones that will be withheld if the information is not forthcoming—are attempts to convince the visitor of the benefits of supplying personal information.

In analyzing privacy policies from the consumer’s perspective, distinctions between differing dimensions of privacy should be recognized. Lee and LaRose (1994) synthesized previous studies of privacy dimensions: Physical privacy, or solitude, is the freedom from the undesired observation and intrusion on one’s senses or person. Informational privacy, or anonymity, is control over the release of personal data. Reserve, or psychological privacy, is control over personal information to protect one’s thoughts and emotions. Intimacy, or interactional privacy, is relevant to small group relationships as it preserves meaningful communication among group members. The first two are especially pertinent here. Informational privacy relates to voluntary disclosures of personal information, the types of disclosures routinely requested during Web site registration procedures. Conventionally, physical privacy relates to intrusions on one’s person by unwanted sights and sounds or unwanted observation, such as the ring of a doorbell or telephone. In the information age that extends to intrusion upon one’s computer, including unwanted files, including cookies and unsolicited email.

2.1.3 Research Questions

We formulate these issues into the following research questions: 1. Is there a difference between sealed and unsealed Web sites in their degree of information disclosures they request and their intrusiveness? 2. Do sealed and unsealed sites vary with respect to their privacy practices? 3. Are there differences in requested disclosures, intrusiveness, and privacy practices between seal authorities? 4. Are disclosures and invasions related to the presence of verbal arguments in favor of disclosure?

2.2 Research Methods

A content analysis of 200 Web sites was conducted to compare sites with TRUSTe and BBBOnline seals with similar sites that did not participate in the leading privacy seal programs.

2.2.1 Sampling

Fifty sites each were drawn at random from among the 1389 TRUSTe (www.truste.org) sites and the 747 BBBOnline (www.bbbonline.org) sites listed at the time of the study. Comparison sites were drawn randomly from a list of the 4449 most visited Web sites supplied courtesy of NetRatings (www.netratings.com). BBBOnline and TRUSTe sites drawn from the NetRatings sample were replaced. Adult sites and business-to-business web sites were excluded from the samples.

2.2.2 Operational Definitions

Content categories were built from prior studies (e.g., Culnan, 1999; 2000; Miyazaki & Fernandez, 2000; Miyazaki & Krishnamurthy, 2002) to reflect the basic FTC guidelines of notice, choice, access and security. Notice included statements about general privacy assurances, what information was collected, how information was collected, how the information would be used, and child protection. Choice entailed statements about conditions under which consumers could be recontacted or have their information shared with third parties. Suggestions for privacy protection were also noted. Access included provisions for consumers to review or correct the information the site collected and to file a complaint. Security related to protecting information during transmission and subsequent storage and whether an admission about the basic insecurity of Internet communication was present.

Consistent with the objectives of the present study, additional items relating to consumer communication and persuasion, such as the location and prominence of seal icons and the inclusion of statements about the benefits of information disclosure were added. The position of the link to the privacy policy page, whether the link is tagged with the word “privacy”, its font size relative to the remainder of the home page, and whether the privacy seal was visible on the main page was coded. On the privacy policy page the position of privacy seal, the presence of site navigation and advertisements was noted.

The types of information requested of the consumer were recorded, including user name, personal password, last name, e-mail address, street address, telephone number, fax number, credit card number, social security number, demographics, and personal interests. A disclosure index was computed by counting the number of items of personal information requested by each site for voluntary disclosure (mean = 4.47, S.D. = 2.39, range 0-9). For this purpose, demographic and personal interest requests were treated as a single item even if multiple requests were made in those categories.

An intrusiveness index was computed by totaling the number of involuntary privacy invasions (e.g. leaving cookies, recording IP information, sending email) each site admitted to in its privacy policy (mean= 4.48, S.D. = 2.52, range= 0-10). Likewise, a benefits index was computed by totaling the number of benefits of information disclosure mentioned in the privacy statement (mean= 1.31, S.D. = 1.16, range 0-4).

2.2.3 Procedure

The coding guide was pretested and modified to improve reliability and coders were trained in its use. Coders were provided with a spreadsheet containing the categories shown in Table 1 and a codebook describing the definitions of each. Keywords were suggested (e.g. “children” when seeking policy statements about child protection policies). Ten coders were divided into teams of two, and each team member reviewed all of the Web sites assigned to their team. Any responses that differed between the two were then reviewed by the coders as a team and a mutually agreed upon code was determined by referring back to the coding guide.

2.2.4 Data Analysis

The results of content analysis were entered into the Statistical Package for the Social Sciences, version 10.1 (SPSS, 2000) for statistical analysis. Comparisons between sites registered with the two seal authorities and between sealed and unsealed sites were performed using chi-square analysis. The attributes analyzed at each site (e.g. the presence or absence of a privacy seal on the page containing the privacy policy statement) were dichotomized, resulting in a series of 2x2 tables. Two sets of chi-squares were computed, one contrasted BBBOOnline registered sites with TRUSTe sites. The other compared unsealed sites with those bearing seals, combining sites from the two seal authorities. On items where attributes of privacy policies were compared, only those sites that had policies posted were included (n=183). Fifteen of the “control group” sites but also one each of the BBBOOnline and TRUSTe sites had no privacy policies available. Pearson product-moment correlations were computed between indices of intrusiveness, invasiveness, and stated benefits.

2.2 Results

The results of content analysis are shown in Table 1. With respect to the amount of information requested (intrusiveness), unsealed sites were significantly *less* likely to request last names (65% of unsealed sites vs 78% for sealed sites), e-mail addresses (75% vs 87%), or credit card numbers (27% vs 49%). There was only one significant difference between sites participating in privacy seal programs and those not participating with respect to the privacy violations that were acknowledged: nonparticipating (unsealed) sites were more likely (77.6%) to acknowledge the placement of cookies than sealed sites, taken as a group (64.2%).

Regarding the communication characteristics of privacy policies, unsealed sites were far less likely to include their privacy statement as an option on their main navigation bar (10.6%) than were sites with privacy seals (20.4%). The presence of a link tagged with the word “privacy” was highly likely at both sealed (83.5%) and unsealed (91.8%) sites that had privacy policies. About three-fifths of all sites used smaller than normal fonts for the privacy links, however. Participants in seal programs usually displayed their seals on their front pages (73.5% of BBBOOnline sites, 63.3% of TRUSTe sites) or on the privacy policy page (73.5% and 93.8%, note that two of the control group sites participated in seal programs other than the two leading ones). However, potential distractions were also present. About three-fourths (72.7%) of sites with privacy policies had their main navigation bars on the privacy page and a fourth (24.6%) carried ads on those pages.

Table 1. Content Analysis Results

Item	No Seal N=100	BBBOnLine N=50	TRUSTe N=50
1. INFORMATION REQUESTED:			
User Name/Screen Name	31.0	34.0	50.0
Personal Password	47.0	46.0	68.0*
Last Name	65.0**	82.0	74.0
E-mail address	75.0**	88.0	86.0
Street Address	53.0	70.0	58.0
Telephone Number	37.0	56.0	44.0
Fax Number	1.0	8.0	2.0
Credit Card Number	27.0**	50.0	48.0
Social Security Number	7.0	6.0	10.0
Demographics	26.0	28.0	32.0
Interests	3.0	4.0	2.0
2. OPTIONS FOR USING INFORMATION			
For alerts	36.0	36.0	34.0
For market research	7.0	2.0	4.0
For third Parties	11.0	10.0	12.0
3. PRIVACY POLICY PRESENTATION			
Privacy policy linked from main menu	10.6**	22.4	18.4
Link tagged with "Privacy"	83.5	91.8	91.8
Normal font size used	39.3	38.8	40.8
Privacy seal visible on front page	1.2**	73.5	63.3
<i>Privacy Page Appearance</i>			
Seal visible on policy page	2.4**	73.5	93.8
Site Navigation Visible	74.1	65.3	77.6
Ads Visible	27.1	16.3	28.6
4. NOTICE			
Notice of Types of Information Collected	80.0**	98.0	98.0
Notice of How Collected:	71.8**	83.7	87.8
IP Information	45.9	20.4	59.2*
Site Registration	68.2	67.3	83.7
Leaves Own Cookies	77.6**	57.1	71.4
Tracks In-Site Navigation	32.9	18.4	24.5
Uses Web Beacons	11.8	16.3	8.2
Third party cookies	37.6	24.5	30.6
Specifies Use of Data...			
To Send email	69.4	83.7	67.3
For Marketing	56.4	51.0	46.9
Target ads	35.3	30.6	30.6
5. BENEFITS OF DISCLOSURES DESCRIBED?			
General Assurance	47.1	63.3	53.1
Service Access	74.1	93.9	67.3
Saves time	36.5	34.7	46.9
Customization	15.3	24.5	24.5
Alerts Offered	21.2	28.6	36.7
Alerts Offered	43.5	44.9	46.9

Child Protection	43.5	49.0	36.7
6. ARE CHOICES OFFERED?			
Recontact Choice	41.2	55.1	51.0
Privacy Protection Suggestions Offered:	17.6**	28.6	36.7
Cookie control	28.2	28.6	46.9
Choose to refuse	20.0	28.6	16.3
Protection Information Links Shown	9.4**	30.6	20.4
Third Party Disclosure Options	57.6	61.2	63.3
Aggregate Only	34.1	38.8	46.9
Disclosure Choice	35.3	40.8	36.7
Review Policy	32.9**	73.5	59.2
Corrections Policy	41.2**	85.7	87.8
Complaint Procedure	57.6**	87.8	85.7
7. SITE SECURITY			
Transmission Security	31.8**	73.5	49.0*
Site Security	41.2**	77.6	71.4
Insecurity Statement	20.0	8.2	24.5*

Note: Table entries are percents based on the number of sites in each category.

* Indicates significant differences between BBBOnLine and TRUSTe sites Pearson chi-square $p < .05$.

**Indicates significant differences between sealed and unsealed sites, Pearson chi-square, $p < .05$.

Comparing the content of privacy policies, unsealed sites and were less likely to include statements about the types (80% vs 98%) and methods (7.18% vs 85.8%) of information collection. Consumer protection information was also somewhat lacking, the unsealed sites were less likely (17.6% vs 32.6%) to offer specific suggestions about how consumers could protect their own privacy and seldom posted links to privacy protection links compared to sites participating in the two leading seal programs (9.4% vs 25.4%). The non-participating Web sites were also far less likely to state policies for reviewing (32.9% vs 66.3%) and correcting erroneous information (41.2% vs 86.8%), provided fewer assurances of security of data during transmission (31.8% vs 66.2%) and after (41.2% vs 79.5%) receipt of the information by the site's proprietor, and were less likely to have a formal complaint procedure (57.6% vs 86.8%).

Substantial numbers of sites used privacy policies to point out the benefits of providing personal information or ignoring the consequences of privacy invasion, and here there were no significant differences between sealed and unsealed sites. Over three-fourths (77.6%) of all sites with privacy policies offered comforting general assurances that the proprietor is concerned about consumer privacy (and many of these are prominently displayed in the opening paragraph of the policy). About half (47%) of all sites with privacy policies made reference to the benefits of information disclosure, including access to service (38.8%), time savings (20.2%), customization (27.3%), and the alerts about new products or services (44.8%).

Comparing TRUSTe sites and BBBOnLine sites, there were few differences. TRUSTe sites were more likely (68%) than BBBOnLine sites (46%) to request personal passwords, or to acknowledge that they recorded IP information (59.2% vs 20.4%). Sites with TRUSTe seals were less likely (49% vs 73.5%) to assure security during transmission and were more likely (24.5% vs 8.2%) to issue "insecurity statements" to the effect that no transaction completed over the Internet could be regarded as completely secure.

Comparing the occurrence of statements about the benefits of information disclosure, the number of arguments made favoring disclosure were unrelated to the amount of personal information requested (intrusiveness, $r = -.098$), but was moderately correlated to intrusiveness, as indicated by the number of different ways in which privacy was invaded (invasiveness, $r = .506, p < .001$).

2.3 Discussion

It is perhaps ironic that the Web sites that seek to publicize their concern for consumer privacy by displaying privacy seals were actually more likely to intrude on privacy, at least in terms of the amount of personal

information that they requested from consumers. And, aside from a greater tendency to deposit cookies, the unsealed sites were no more likely to invade users' physical privacy through involuntary intrusions on their computers. Naïve consumers who view seals as a form of privacy protection may thus be disappointed.

From the perspective of compliance with FTC guidelines, both sealed and unsealed sites were about equal in their assurances, with two key exceptions: sites participating in privacy seal programs were more likely to offer assurances about the security of information both as it is collected and after it is collected. And, unsealed sites were less likely to reveal how data is collected.

How effective were the seal authorities in encouraging compliance with FTC guidelines for notice, choice, access, and security? BBBOnLine sites were more likely to make assurances about secure transmission of information than TRUSTe sites. However, compliance with the guidelines was less than perfect in all key aspects. While almost all of the seal program participants provided notice of the types of information collected, about an eighth did not reveal how information is collected, offer to correct errors, or maintain a complaint procedure. And, while most sealed (but also unsealed) sites informed consumers of their choices, many did not really offer any choice other than leaving the site or foregoing service.

Of course, the seal authorities themselves make no promises about the levels of privacy offered by the sites bearing their seals. They only promise that disclosures about privacy practices will be monitored for accuracy and consumer complaints about privacy practices will be responded to. Judged on these, their own terms, the seal authorities were effective in that nearly all the sites bearing their seals of approval provided expected information about notice, choices, access, and security. Compliance was not perfect in any of these key respects, but this perhaps points to the complexity, ambiguity, and lack of standardization in privacy statements as much as the effectiveness of their enforcement. For example, a site that makes no explicit reference to a consumer complaint policy might point out that it collects no personal information and therefore needs no such policy or that its customer service policy covers the requirement.

Are the FTC guidelines sufficient? Judged against the stricter standards of the European Community's privacy directive (CEC, 1995), for example, neither seal program participants nor non-participants offer adequate protections. Only a tenth offered an option to restrict release of personal information to third parties on the information collection forms themselves and a sixth of the sites analyzed (16.5%) stated that they reserved the right to pass consumer information to third parties for marketing purposes. Future research should assess the impact of government-sponsored approaches compared to voluntary industry compliance.

Moreover, it appears that certain Web site proprietors are pursuing something of a hidden agenda in their privacy policy statements as well as the manifest agenda of the FTC. While complying with the guidelines in "confessing" their privacy invasions, many Web site proprietors use the opportunity to convince consumers to make voluntary disclosures and to submit to involuntary forms of privacy invasion. The present study found a sizable correlation between the intrusiveness of Web sites, defined in terms of the number of different ways they obtained and re-used consumer information, and the number of persuasive arguments about the benefits of disclosure that were offered (e.g., to obtain free or customized information) to justify the privacy invasion. This could mean that Web proprietors are trying to diminish the perception of privacy risks by offering counterarguments about the benefits of personal disclosures. Distraction is another issue, the majority of sites with privacy policies had the main site navigation bar visible along side the policy statement and about a quarter carried ads on their privacy policy pages.

Assuming that the statements made by sealed sites are true, and that the silence of unsealed sites on certain issues at unsealed sites leaves consumers vulnerable, what comfort is offered to the consumer by a privacy seal? Visitors to sealed sites receive superior assurances mainly in handling privacy complaints, including the ability to review and correct erroneous information and having an established complaint procedure. Sites with seals also take greater note of data security, both during the transaction and after.

The present results fall short of a definitive evaluation of privacy seals, of course. We also need to know whether the information is in fact more accurate at sealed than unsealed sites, whether they are more responsive to consumer complaints, and whether consumers are persuaded by the seals or even take much note of them. However, based on the current research we might begin to question whether the seal programs as currently constituted are useful for the consumer. Perhaps motivated by the same Federal Trade Commission guidelines that underlie the recommended practices of the privacy seal programs, the unsealed sites generally follow the same practices and offer the same assurances as the sealed ones do.

The seal programs might improve their utility for the consumer by standardizing the ways in which the information is presented. For example, advertising and distracting graphics might be banished from pages containing privacy statements. Terms might be standardized and a glossary offered by the seal authorities.

The content and sequence of sections of privacy statements might also be further specified. In our content analyses we found wide variations in the organization of privacy statements, making it difficult to locate and compare policies. Consumers are often referred to corporate or “property-level” policy statements that are not specific to the information that they have been asked to supply. It is often difficult to determine which aspects of the policies apply to which portions of the site in question. In other cases, visitors were referred to third party sites that may have differing, and unmonitored, privacy policies. Above all, the practice of “counter arguing,” using the privacy statements to convince consumers to yield personal information, should be evaluated. If the personal benefits of supplying information are mentioned, perhaps the negative consequences (e.g., “your identity could be stolen”) should also be spelled out.

Future research should attempt to examine the perception of seals by consumers. Are they being (mis)interpreted as signals that privacy is protected, rather than assurances that privacy invasion practices are what they appear to be? Does the counterarguing, distraction, and obfuscation evident in privacy statements affect consumer behavior? Do government-mandated privacy policies such as the European Commission’s inspire greater trust? These questions should be answered in making the Internet a safer place.

3. CONCLUSION

Web sites continue to make progress toward compliance with Federal Trade Commission guidelines for consumer notice, access, choice, and security. The presence of a privacy seal from either one of the two leading seal authorities indicates that the consumer will find statements about access to information and data security more so than at sites without seals. Otherwise, there are minimal differences between the policy statements of sealed and unsealed sites. However, sites participating in seal programs are more likely to request personal information from the consumer than non-participating sites. Across both sealed and unsealed sites, Web site proprietors are taking advantage of privacy policies to present persuasive arguments in favor of yielding personal information and the more invasive the site, the more persuasive messages that are presented. In addition to specifying the topics that should be covered in privacy policy statement, additional standards governing the format and presentation of privacy information might be considered.

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ACCEPTABLE INTERNET USAGE: POLICIES AND PRACTICES

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ABSTRACT

Surveillance in the workplace is a growing issue in organizational theory with the new practices brought by employees' usage of the Internet in the workplace. However, news bulletins abounds of anecdotes reporting employee caught on non professional behaviors instead of as a productivity tool and sometimes on the verge or beyond the legal limit. Software solutions of blocking, filtering and monitoring of the traffic within and outside of the corporative network exist indeed. They are used by the more careful firms. Few recent investigations are available to assess this new phenomenon. This communication reports the results of a study aimed at a better knowledge of the extent of Acceptable Internet Usage Policies (IAUP) coverage in enterprises. A survey by internet has been conducted with a sample of enterprises and results indicate that managers should be more concerned with the actual use, as it reveals that a great majority of firms do not have formal policies relating to Internet resources usage. The size of the firms does not seem to be a factor in the decision to adopt or not an acceptable internet usage policy. Moreover, 60 % of the respondents do not plan to adopt such policy in the next few years. Conclusion are drawn.

KEYWORDS

internet abuse, internet misuse, internet policy, employee monitoring

1. INTRODUCTION

Surveillance in the workplace is a growing issue in organizational theory. It is becoming the focus of a bigger attention especially with the new practices brought by employees' usage of the Internet in the workplace. Because of the emergence of the digital economy era, the Internet has become an important resource in businesses as more and more employers are providing access privileges to their personnel. A Management Recruiters International research indicates that 80% of respondents are grating Internet access to their

employees from the workplace as implementation costs dramatically dropped. It now poses problems of abusive and improper usages more than ever. A research based on the responses of 400 company leaders indicates that 80% of the employees of management had access to the Internet (Verespej, 1998). Another research indicates that one Canadian worker out of 3 connects to the Internet at the office during a 2 hours average per week (Worklife Report, 2000).

Software solutions of blocking, filtering and monitoring of the traffic within and outside of the corporate network exist indeed. However, news bulletins abounds of anecdotes reporting employee caught on non professional behaviors. This established fact exposes these firms to dangerous consequences. Providing an Internet access to employees must be thought as a whole set of complementary measures in the scope of a long term viable strategy. Before connecting employees to the Internet, firms must understand that online employees tend to be more productive (Holtz, 2001) even if they make private incursions on the Internet. As the line between privacy and work has blurred (Soëtard, 2001), employees must be treated as adults to get an adult behavior in return. Blocking is not the best solution.

In contradiction, trends are quite different. Currently, less than a firm out of four has a formal Internet usage policy (Overly, 1999). However, more than half respondents (54%) admit monitoring their employees. Consequently, more than 80% of employees admit using the Internet in work time for personal purposes. A recent research evaluates total online workforce to 100 millions worldwide. Only 27% of this population is monitored. Trends are roughly the same for the United States (35% on a 40 millions population) (Schulman, 2001). Spot checks (66%) are used more than systematic surveillance (Schulman, 2001). That means monitoring happens most times after an incident happens, or in a random suspicion-less frequency. However, there is a growing trend of suspicious surveillance where the entire workforce is monitored. This is partly explained by the fear of security breaches like insiders or legal liability. The monitoring software industry is a growing business worth about \$140 million a year (Schulman, 2001). This represents only a return of about \$5.25 per monitored employee per year. The Internet can be at the same time a benediction and a curse for firms who decided to provide access to employees. Control solutions do exist but they are habitually deployed after damage is done. These control solutions are insufficient themselves if not accompanied with the right policies.

Firms are often as guilty as their employees whom are abusing the Internet resources. This guilt is a consequence of the firms' incapacity of dealing right with the traffic in and out of their systems and to deploy the policies in a way to make it acceptable to the personnel. Internet resources in the workplace are supposed to be dedicated no more than for productivity. This fact has diluted over daily practices. A research (Soëtard, 2001) has shown that the edge between private and professional activities in the workplace has blurred. The misuses of the Internet in the workplace are numerous, many researches have classified them. The Angus Reid Report (2001) states that 86% of employees surveyed admit sending personal e-mails in office hours, 75% check out news or sports headlines and 17% view adult web sites. Actually, employees are using the Internet for much the same reasons they use it at home. This usage is illegal, unproductive but and may the viability of the firm. A research has shown that no less than 31% of all e-mails are potential threats to firms' assets, 8% are in violation of corporative communication policies and 2% contain viruses.

This study aims at a better knowledge of the extent of Acceptable Internet Usage Policies (IAUP) coverage in enterprises.

2. FOUNDATIONS

2.1 A brief history of surveillance

Jeremy Bentham created in 1787 the concept of Panopticon. This concept is still of central importance in all writings on surveillance and monitoring. Actually, the Panopticon is a proposition of an architectural design for a prison. This prison would have a circular shape and prisoner would be parked in individual cells placed in the exterior perimeter of the circle. All the cells would be placed in the view range of an inspector placed at the center. Using a complex set of mirrors, conduits and openings, the prisoner would be aware of a permanent surveillance and the inspector can observe any cell at any time. Prisoners' behavior is visible permanently to the inspector, but prisoners cannot see neither inspector's eyes nor his face: they just can see a silhouette which reminds them permanently his presence. The concept of Panopticon is based on an

objective of discipline by conditioning. As prisoners fear being continually watched and punished if they fault, they interiorize rules and behave. The prison of Bentham never was and probably never would be a realistic project but it illustrates strongly the power of surveillance. There is a strong religious parallel between the social mission of Bentham's project and the idea of an almighty God invisible and omnipresent. The inspector can see without being seen. Thus, prisoners are not locked in their cells but also in their own bodies they cannot shield from the inspector "permanent" stare (Whitaker, 2001). In reality the Panopticon is no more than an illusion but according to Bentham, it creates a no choice context for the subjects. The panoptical monitoring is based on an illusion of permanent surveillance which induces self-discipline. The interest of the concept is that it can avoid a rough use of punishment as a last option.

2.2 Privacy considerations

When questions about surveillance are defined as questions of privacy, the questions become part of a long debate about social importance of privacy to the individual. Privacy is deeply rooted in liberal thinking and is considered primordial to self-development of individuals. Warren and Brandeis (1890) define the right to privacy as the "right to be left alone". It is very much an individual right and a protection from social intrusion. This definition of privacy is considered as a negative value of privacy as it draws attention to the reasons an individual might want to be let alone. The reason often offered is to hide things he does not want known. Corollaries of this negative value are that one who has nothing to hide places no value in privacy and if one has something to hide, should it remain private as others might need to know about it? Monitoring in itself is not inherently evil or oppressive. Like any technology, it is neutral. The real issue is how companies use it (Picard, 1994): how they gather information, what they do with it and most important how they communicate this to employees. Generally, employees' most legitimate objection about being monitored is that employer treats them as a cheat. Monitoring must deal with workers morale. Thus, communication is very important in the process of implementing surveillance. Findings of a research on the effects of computer surveillance on employees (Alge, 2001) have shown that monitoring job-related activities and allowing employees to participate to the process reduced the sentiment of invasion of privacy. Also, monitoring job non-related activities reduced the effect of participation.

2.3 'Policing the employees' Internet usage

As mentioned above, job-satisfaction is a very important aspect when dealing with Privacy and surveillance issues. Pro-panoptical surveillance authors set the tone for all subsequent discussion regarding surveillance on the workplace. Yet, the central shortcoming of this objectivist work is to neglect the subjective dimension of the labor process as reflected in the attitudes of workers. It is incorrect to argue that managerial control is not problematic. Important factors in understanding the process. A study, concerned with American automobile workers, found that automation was supported by workers who have a sense of job security, are satisfied with the quality of working conditions and perceive the management style as open. Job satisfaction is greatly correlated to consultations and other forms of participation into a democratic workplace. However, literature underlined that policies are aimed at ameliorating the effects not the process: most system designers admit little or no consultation of the employees (Rothwell, 1984). Consultation must be extensive to overcome resistances. In the case of personnel access to the Internet in the workplace, although not legally required for employers (Crowley and Aviza, 2002), it is important to design an Internet acceptable usage policy. However, it is more important to follow a process in which policies are materializations of the firm's real needs in respect of a multi-department evaluation and multi hierarchical level consultation. Implementing an employee Internet policy takes consensus and dynamic cooperation amongst departments, along with top management involvement. They must precisely status on cost of disturbance to IT and operational departments. Legal advice is important to evaluate costs of law suits or settlements if firing abusing employees. Cooperation between Information Technology Management (IT) and Human Resources (HR) is crucial as HR must become informed about technology issues. They must find out how filtering and/or blocking work and all available solutions. Reporting also is an important issue: IT must check with Operational departments if managers have time to check the Internet usage. They must also review the current policies. IT then is enabled to decide on the monitoring product to adopt, hire an administrator or a

network manager. IT, operations and HR settle in a last step, final details like deciding what is appropriate and what is not. Interaction with employees is not a bad idea in this step.

2.4 Legal aspects of personnel monitoring

Surveillance implicates many activities of observation and information gathering. It is not unusual for employers to read internal and external mails addressed or sent by employees or listen to telephone calls made on the company telephone system. Regulation and law is on the side of employer when it comes to monitoring activities under some conditions. Employers are not bound to get employees permission to control their activities in the workplace. In fact, law is giving employers considerable scope to monitor employees without having to ask for their permission first. In a legal point of view, privacy on the workplace is a more complex issue. This appears obviously when considering the three consecutive failures in adopting the U.S. Privacy for consumers and workers Act (Senate S984, House of Representatives HR1900) that would have limited electronic monitoring in several ways (Picard, 1994). The 1974 American Privacy Act that covers the public administration has never been extended to the private sector because jurisprudence is stating that video surveillance for instance cannot be considered as an offense to the privacy of employees as they are only supposed to act in a professional manner in the workplace (Duclos, 1999). The 1986 Electronic Communications Privacy Act enacted by U.S. Congress brought electronic communications within the Federal Wiretapping Statute (Doherty, 2001). The FWS prohibits intentional interception of oral and electronic communication. However, as long as a firm is providing communication services in its ordinary course of business it is not under the legislation of the FWS. Consequently, employees should assume no privacy in the workplace when it comes to using work resources. More recently, the Regulation of Investigatory Powers Act 2000 (RIPA) makes the interception of telecommunications –including telephone and e-mail – an offense, unless certain conditions are met. In particular, the consent of the individual monitored. However, employers still have a very large scope to monitor employees without their explicit agreement. Purposes vary from establishing facts relevant to the business, ensuring quality standards, preventing or detecting criminal activities. Recent cases, in Massachusetts and California reveal that the courts are not willing to provide employees with the defense of privacy as a means of shielding their use or misuse of company provided computer or facility (Crowley and Aviza, 2002). For a global perspective, we must also consider the European legislation which is far more protective to employees. The 1995 European Union Data Protection Directive enacted processing of personal data might be used only for the legitimate purposes for which it was collected. Processing must also be processed with the consent of the data subject. However all in all, monitoring is permitted and used whatever the legislation. The debate of privacy in the workplace is taking more room in the extent of the surveillance field than on the principle itself of monitoring or not.

3. OBJECTIVE

The research has been oriented toward establishing a portrait of the current coverage of policies and practices of Internet Acceptable Usage. More specifically, the research aimed at getting a first look at the existence of such policies, their date of adoption or planned adoption in regard of firm's size and date of implementation of internet, the current coverage of policies when they exist, and finally the usage improvement due to the policies

4. METHODOLOGY AND DATA ANALYSIS

Considering our objectives of research that aim to study the organizational behavior of enterprises facing the introduction of the Internet on the workplace, as well as variables influencing this behavior, our approach will be merely descriptive, by means of a survey distributed via e-mail and the questionnaire has been hosted on a website. The questionnaire counted 10 questions on Internet acceptable usage policies and 5 questions to categorize respondent's profiles. The received data has been analyzed with the SPSS 11.0 software.

The following table presents the results of the data collection.

Table 1. Data collection results

Initial sample	Returned questionnaires	Completed questionnaires	Non legible or non exploitable	Retained questionnaires	Response rate
775	577	201	112	89	15%

Table 2 presents the results by company size of the existence of policy.

Table 2. Existence of an Internet acceptable usage policy

	Total Sample N = 89		Small Companies N1 = 34		Middle Companies N2 = 28		Big Companies N3 = 27	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
		44,5000	6,3640	17,0000	2,8284	14,0000	4,2426	13,5000
Yes	44,9%		44,1%		39,3%		51,9%	
No	55,1%		55,9%		60,7%		48,1%	

Internet acceptable usage policies (IAUP) exist mainly in the greatest companies (1 company out of 2). This proportion is slightly less important in small and middle enterprises (respectively 44% and 39%). However, we can affirm that globally the size of the enterprise doesn't influence to a big extent, the existence or not of an IAUP as there is not a significant difference between data of big and smaller companies.

Table 3. Date of adoption of the IAUP

	Total Sample N = 40		Small Companies N1 = 15		Middle Companies N2 = 11		Big Companies N3 = 14	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
		13,3333	8,5049	5,0000	4,5826	3,6667	1,1547	4,6667
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
More than 3 years	10	25,0%	1	6,7%	5	45,5%	4	28,6%
1 to 2 years	23	57,5%	10	66,7%	3	27,3%	10	71,4%
Less than 1 year	7	17,5%	4	26,7%	3	27,3%	0	0,0%

Table 3 illustrates that a big majority of IAUP have been adopted most recently, in fact less than two years in about two thirds of cases. Middle companies appears to have a different distribution than others.

A Crosstab analysis between the date of implementation of the Internet and the date of the adoption of an IAUP (table 4) shows that companies where the Internet is implanted for a longer period of time (3 years and more) adopt IAUP very lately.

Table 4. Cross tab Analysis between date of implementation of the Internet and date of adoption of an IAUP

		IUAP date of implementantion=>		
		More than 3 years	1 to 2 years	Less than 1 year
Internet	More than 3 years	23,3%	27,9%	48,8%
	1 to 2 years		26,8%	73,2%
	Less than 1 year			100,0%

We conclude that the implementation of IAUP often comes in reaction to the apparition of bad uses of the Internet by the personnel. The adoption of IAUP is rarely proactive.

Table 5. Enterprises planning a short term adoption of an IAUP

	Total Sample N = 49		Small Companies N1 = 19		Middle Companies N2 = 17		Big Companies N3 = 13	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
	24,5000	6,3640	9,5000	2,1213	8,5000	7,7782	6,5000	0,7071
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	20	40,8%	11	57,9%	3	17,6%	6	46,2%
No	29	59,2%	8	42,1%	14	82,4%	7	53,8%

Table 6. Date when adoption of an IAUP is planned

3.3	Total Sample N = 20		Small Companies N1 = 11		Middle Companies N2 = 3		Big Companies N3 = 6	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
	6,6667	6,4291	3,6667	2,0817	1,0000	1,0000	2,0000	3,4641
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Less than a year	2	10,0%	2	18,2%	0	0,0%	0	0,0%
1 to 2 years	14	70,0%	6	54,5%	2	66,7%	6	100,0%
More than 2 years	4	20,0%	3	27,3%	1	33,3%	0	0,0%
Total	20		11		3		6	

Among enterprises having indicated not to possess any IAUP at the time of the administration of the questionnaire and whom are planning to adopt one, an immense majority plans to do it in a horizon of one to two years. It is necessary to underline that 60% of enterprises who have not an IAUP currently say they do not know or do not want to adopt it. It is also interesting to emphasize that 65% of the respondents of this category say they never have observed any abusive uses of the Internet by their staff.

Tables 7 and 8 report roughly the same tendencies. The IAUP foresee mainly the good uses concerning surfing on the World Wide Web (98%) and e-mail exchanging (98%). Downloads are also the subject of instructions and prohibitions in the IAUP of the respondent but to a least degree (60%). These distributions are practically identical for the three sub samples. The only considerable difference in the range of action of the IAUP is at the level of Instant Messaging programs. If the IAUP of small enterprises do not mention them at all (0%), those of the big enterprises seem to rake larger to a 42% extent.

Table 7. IAUP coverage when adopted

	Total Sample N = 20		Small Companies N1 = 11		Middle Companies N2 = 3		Big Companies N3 = 6	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
The World Wide Web	17	85,0%	10	90,9%	3	100,0%	4	66,7%
E-mails	15	75,0%	8	72,7%	3	100,0%	4	66,7%
Instant messaging	6	30,0%	3	27,3%	2	66,7%	1	16,7%
Downloads	10	50,0%	5	45,5%	3	100,0%	2	33,3%
Total	20		11		3		6	

Table 8. Current IAUP coverage

	Total Sample N = 40		Small Companies N1 = 15		Middle Companies N2 = 11		Big Companies N3 = 14	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
The World Wide Web	39	97,5%	15	100,0%	10	90,9%	14	100,0%
E-mails	39	97,5%	14	93,3%	11	100,0%	14	100,0%
Instant messaging	10	25,0%	0	0,0%	4	36,4%	6	42,9%
Downloads	24	60,0%	9	60,0%	6	54,5%	9	64,3%
Other	3	7,5%	1	6,7%	0	0,0%	2	14,3%

A very small minority of enterprises estimates that the existence of an IAUP within the enterprise must be implicitly known by employees. However, the proportion of businesses that does not communicate formally or even orally the content of their IAUP to employees is higher among the small enterprises. It is also important to notice that the small and middle enterprises are more numerous to communicate the details of their IAUP using more than one mode of communication (45 and 50% vs. 40%). However, the big enterprises are more numerous to ask the employee a formal acknowledgement of the content of the IAUP.

5. LIMITS AND CONCLUSION

The first observation to be made out of the descriptive analysis is that the size of the companies is not a strong factor when talking about Internet policies. We found very little variation between the policing attitudes of the respondents excepts for the range of the IAUP coverages. Bigger companies seem to possess wider policies. The coverage includes downloads and chat services when small and middle companies put the emphasize more on the "classic" and most known services: the World Wide Web and e-mails. If bigger companies adopts more explicit Internet policies, the assumption that they adopt policies in a bigger proportion than smaller companies have not been confirmed. The proportion of adoption of IAUP in big companies is slightly but not significantly higher than in small and middle firms. We also illustrated the reactive attitude of the managers towards Internet access policing. The two thirds of the respondents have adopted an IAUP over a short period of time, mostly within the last 2 years. Moreover, a cross analysis between ancientness of the implementation of the Internet and the ancientness of adoption of an IAUP, shows a gap of one to two years in 70% of cases. Moreover, we succeeded to show that IAUP is not the next best thing in our respondents' companies. 60% of the firms whom did not have an IAUP at the time of completion of the questionnaire say they do not know or do not plan to adopt an Internet policy in the short term.

Like all other exploratory studies of this nature, this one had some important limitations. Any conclusions or interpretations drawn from this study should recognize these attendant limitations. The study sample was drawn from companies listed in the CRIQ directory which is over representing manufacturing companies. For this reason, findings must be limited to a more manufacturing study population. We also failed to guarantee that the subjects of the study really possessed the information we sought for, as some of the respondents were not the IT managers. Another limit of the study resides in the accuracy of the dependant variable. As we could not precise the proper coefficient for each of the 5 sets of variables composing the index, we assigned an arbitrary equal coefficient for every component (20% each). Fisher (1967) states that in the absence of available weights we are sometimes forced to use simple or equal weighting. We must then assume that the weighting we used in the creation of our index contains unknown errors.

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CHARACTERIZING DDoS ATTACKS WITH TRAFFIC RATE ANALYSIS*

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ABSTRACT

As the complexity of Internet is scaled up, it is likely for Internet resources to be exposed to Distributed Denial of Service (DDoS) attacks. To characterize the pattern of the DDoS network attacks on TCP-based servers, in this paper, we present a network traffic analysis mechanism, called Traffic Rate Analysis (TRA), which computes TCP flag rates and protocol rates under various types of the DDoS attacks. We experiment with the metrics of various ratios of types of packets going in and out of a host. The experimental results showed that the features of the DDoS attacks were distinctive and predictive. We wish the experimental results could be used to detect and prevent a variety of network flooding attacks.

KEYWORDS

Distributed Denial of Service Attacks, Network Security, Network Traffic Analysis

1. INTRODUCTION

As the complexity of Internet is scaled up, it is likely for Internet resources to be exposed to Distributed Denial of Service (DDoS) attacks. It was reported that the DDoS attacks against network servers such as Yahoo, e-Bay, and E-Trade caused serious damages to system stability [3, 11]. Since the attacks could be made on any system of the Internet, a tapestry of approaches to prevent the attacks or to minimize damages has been proposed in many Internet applications [1, 3, 5, 6, 7, 13, 17].

Regarding the analysis of various patterns of the DDoS network attacks, many researchers have investigated the randomness and the distribution of source IP addresses. From this perspective, if the randomness of source IP addresses is getting higher than usual one, alarms are set upon the detection of the DDoS attacks. Gil and Poletto [4] examined traffic flows in one direction vs. flows in opposite direction over IP packets by using their own data-structure, MULTOPS. Their network monitoring device using the MULTOPS detects flooding attacks by “the difference between packet rates going to and coming from the

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victim.” Their assumption for the detection is based on the disproportional difference between the packet rates, which is caused by randomness of ‘malicious’ packets. Kulkarni et al. [8] traced the source IP addresses and construct Kolmogorov Complexity Metrics [10] for identifying their randomness. Kolmogorov Complexity Metrics change according to the degree of randomness of spoofed source IP addresses. Actually, the randomness of source IP addresses is very low without any DDoS attacks but it is very high under the DDoS attacks. However, these approaches are not applicable when attackers reduce the level of randomness of the source IP addresses or when they use the actual IP addresses instead of the spoofed ones.

In another approach to detection mechanism, Wang et al. [18] examined the protocol behavior of TCP SYN-FIN (RST) pairs. If there are no DDoS attacks against a TCP-based server, the rate of SYNs for TCP connection establishment and the rate of FINs for TCP connection termination are the same value, or rarely different in case of retransmission. In case of SYN flooding attack, for example, the rate of SYNs clearly differs from the one of FINs. The metrics of SYN-FIN (RST) pairs could be useful to detect the SYN flooding attack against web servers. This approach is somewhat similar to our approach in that both of them take into account TCP flags to detect the DDoS attacks (or flooding attacks). However, their method can be applicable only to SYN Flooding attacks. On the other hand, our approach is more general so that our mechanism can be applicable to all types of the DDoS attacks, i.e., SYN Flooding attacks, UDP Flooding attacks, ICMP Flooding attacks, and so on.

It is crucial to identify the network traffic characteristics of flooding attacks in protecting Internet resources from them. To understand the features of DDoS attacks, we introduce a network traffic analysis mechanism in two settings: web server without any attack and web server with the DDoS attacks. In these settings, we measure TCP flag rates, which are expressed in terms of the ratios of the number of the TCP flags to the total number of TCP packets. For example, the number of SYNs drastically increases in case of the SYN flooding attack, which is one of the most common DDoS attacks. In consequence, the increasing number of SYNs indicates the possibility of the DDoS attacks. In addition to the flag rates, we also measure protocol rates, which are the ratios of the number of packets belonging to specific protocols (TCP, UDP, or ICMP) to the total number of packets on the IP network. The in-depth analysis of simulation results shows that we can efficiently detect the symptoms of the DDoS attacks using two sets of the rates, namely, flag rates and protocol rates. To be more generally applicable in realistic settings, therefore, this paper presents a new approach to identify the features of the DDoS network attacks using all of the flags, i.e., *SYN*, *FIN*, *RST*, *ACK*, etc., within Transmission Control Protocol (TCP) header, and taking into account the relationship between the flags and network packets.

In the following section, we will discuss how we analyze network traffic characteristics, and define two network traffic rates. Section three describes a simulated network environment, and shows clear factors that indicate the symptoms of various flooding attacks. In conclusion, we summarize our results and further research issues.

2. NETWORK TRAFFIC ANALYSIS

We rely on the dynamics of differences between the rates of TCP flag and protocol to analyze the features of DDoS attacks. Due to the burstiness of TCP flags, the ratio of the number of a specific TCP flag within TCP header, for example, *SYN*, *FIN*, *RST*, *ACK*, etc., to the total number of TCP packets, during normal operations without DDoS attacks, clearly differs from the ones under the attacks. With the flag and the protocol rates for both inbound and outbound network traffic, we characterize the symptoms of the DDoS attacks.

We present a network traffic analysis mechanism, Traffic Rate Analysis (TRA). This mechanism calculates two measuring factors: TCP flag rate and protocol rate. The traffic rate analysis uses the traffic flowing into a victim (a host) as inbound, and the traffic flowing from the victim as outbound. A packet collecting agent captures IP packets and classifies them into *TCP*, *UDP*, or *ICMP* packets. In case of the TCP packet, further, the classification procedure separates the packet into TCP header and payload. From the TCP header containing *SYN*, *FIN*, *RST*, *ACK*, *PSH*, and *URG* flags, the flags are tested to determine whether or not they are set. If any flag of six TCP flags turns on, the agent counts it and sums it up. The packet collecting agents also count the total number of TCP packets during a specific observation period t_d (sec). Our alarming agents then compute two metrics TCP flag rates and protocol rates. A flag rate is expressed in terms of the ratio of the number of a TCP flag to the total number of TCP packets as follows:

$$R_{td}[Ki] = \frac{\text{total number of a flag } (K) \text{ in a TCP header}}{\text{total number of TCP packets}} \quad (\text{inbound})$$

$$R_{td}[Ko] = \frac{\text{total number of a flag } (K) \text{ in a TCP header}}{\text{total number of TCP packets}} \quad (\text{outbound})$$
(1)

Here, t_d means the sampling period. In the equation 1, K stands for one of six flags: *SIN*, *FIN*, *RST*, *ACK*, *PSH*, and *URG* flags, denoted as S , F , R , A , P , and U , for either inbound (i) or outbound (o) network traffic. For example, $R_I[Ai]$ represents the *ACK* flag rate of inbound traffic when the sampling period is one second.

A protocol rate is also defined by the ratio of the number of *TCP*, *UDP*, or *ICMP* packets to the total number of IP packets as follows:

$$R_w[[TCP|UDP|ICMP]i] = \frac{\text{total number of } [TCP|UDP|ICMP] \text{ packets}}{\text{total number of IP packets}} \quad (\text{inbound})$$

$$R_w[[TCP|UDP|ICMP]o] = \frac{\text{total number of } [TCP|UDP|ICMP] \text{ packets}}{\text{total number of IP packets}} \quad (\text{outbound})$$
(2)

Similarly, for example, $R_2[UDPo]$ stands for the *UDP* protocol rate of outbound network traffic during the sampling period two seconds.

Since the traffic rate analysis utilizes a rate scheme, our mechanism can be applicable even to scaled-up network settings. This enables us to examine the various traffic patterns and to identify the features of the DDoS attacks in various network environments.

3. SIMULATIONS AND RESULTS

We have implemented a simulated network environment using SPECweb99 [16], Tribe Flood Network 2000 (TFN2K) [15], and libpcap [9]. In the simulated, Web-based environment, the SPECweb99 located in Web clients generates web traffic, the TFN2K on DDoS attackers simulates DDoS attacks, and the libpcap used by a packet collecting agent captures the stream of network traffic. While the web clients request of the web server that they should be serviced, the DDoS attackers make various flooding attacks towards the web server.

We construct the simulated network environment on LINUX machines, which consist of a web server using Apache, web clients, DDoS attackers, a network monitoring device including a packet collecting agent and an alarming agent (700 MHz Pentium III, 256 MB memory), and the network bandwidth of 100 Mbps. Figure 1 presents the simulated network setting, and our agents working on the network monitoring device.

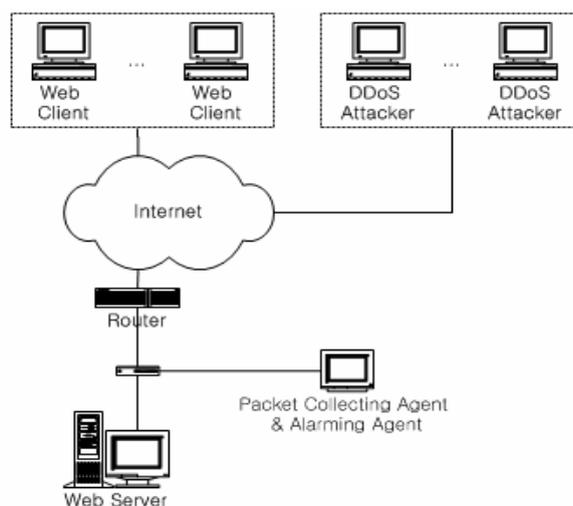


Figure 1. A simulated network environment

The packet collecting agent, sitting on the network monitoring device, captures IP packets and classifies them into TCP, UDP, or ICMP packets. The agent looks into TCP packets in detail and separates the packet into header and payload. The alarming agent then calculates the traffic rates (flag rates and protocol rates) and generates reports.

We measured two types of network traffic rates in the simulated network environment, as depicted in figure 1. The network traffic models were generated in two settings: normal web server without any attack and the web server with DDoS flooding attacks. For each network traffic setting, we changed two factors, *simultaneous connections (SC)* and *requests per connection (R/C)*, to simulate different web traffic patterns. The *SC* indicates the number of HTTP connections at a given time, which approximates the number of users in real networks. The *R/C* represents the number of requests to be issued in a HTTP connection. In the experiment, we used 5, 10, 50, 100, 150, and 200 for the *SC* and 1, 2, 5, and 10 for the *R/C*. The sampling period t_d (sec) was one second for all of the experiments.

3.1 Flag rates without any attack

The experimental results of normal web traffic (without DDoS attack) are depicted in figure 2. Even if *SC* ranges from 5 to 200, the results of all TCP flag rates¹ are almost identical.

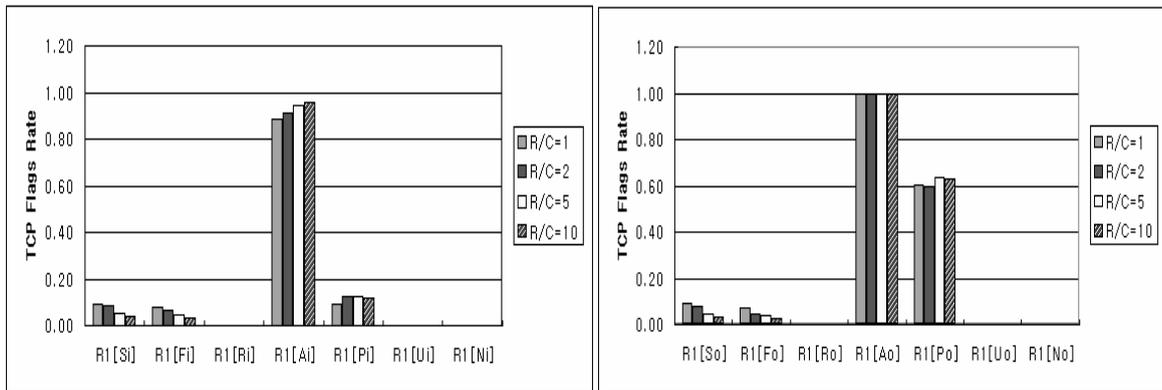


Figure 2. TCP flag rates in normal web service when SC=200

We measured TCP flag rates for inbound and outbound network traffic, respectively. In both of inbound and outbound TCP flag rates, the rates of SYN and FIN were less than 0.1. On the other hand, the rate of an ACK flag was close to 1.0. This revealed the fact that most of the TCP packets set an ACK flag bit in their header for the purpose of sending an acknowledgement as a notification of receipt.

3.2 Traffic rates with various DDoS attacks

TCP flag rates and protocol rates are measured and analyzed under several well-known DDoS attacks: SYN flooding, UDP flooding, ICMP flooding, and other miscellaneous attacks. For simulating the attacks, TFN2K [15] is utilized. For *SC* and *R/C*, we use 100 and 2, respectively.

3.2.1 SYN flooding attack

Figure 3 presents the inbound and outbound TCP flag rates when a SYN flooding attack occurs. The attack is done with random ports between 30 and 70 seconds.

¹ In figure 2, for instance, $R_i[Si]$ means the ratio of the number of SYN flags to the number of total TCP packets for inbound network traffic with the sampling period, 1 sec. We similarly define $R_i[Ni]$ as the TCP flag rate with no flags set. In this case, N stands for null.

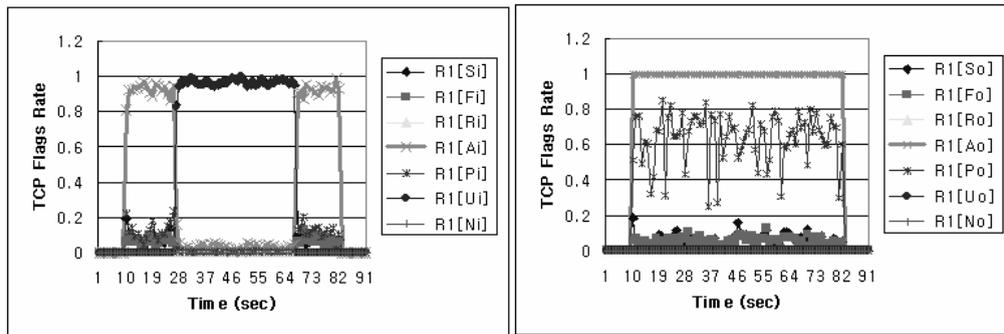


Figure 3. TCP flag rates under SYN flooding attack

$R_I[A_i]$ goes down to about 0.0, due to the SYN's burst during the attack. This indicates that web traffic flow is blocked by enormous amount of SYN packets. On the other hand, $R_I[S_i]$ and $R_I[U_i]$ in the inbound flag rates drastically change and go up to almost 1.0. The outbound TCP flag rates except $R_I[S_o]$ are not affected by the attack at all. Since a victim follows the TCP three-way handshaking protocol, it replies to all SYN packets with SYN flags, if the SYN flooding attack is made on open ports. That's the reason why $R_I[S_o]$ increases.

3.2.2 UDP flooding attack

Figure 4 shows the inbound and outbound TCP flag rates and protocol rates under the UDP flooding attack. The UDP flooding attack is made between 20 and 60 seconds. Right after the attack, $R_I[UDPi]$ drastically increases while $R_I[TCPi]$ decreases as much. The TCP flag rates don't change at all even though the amount of TCP network traffic decreases, since the UDP flooding attack is done with UDP packets. Unlike $R_I[UDPi]$, the UDP protocol rate - $R_I[UDPo]$ - in the outbound network traffic doesn't change significantly and remains in normal data flow because the incoming UDP packets do not require any response.

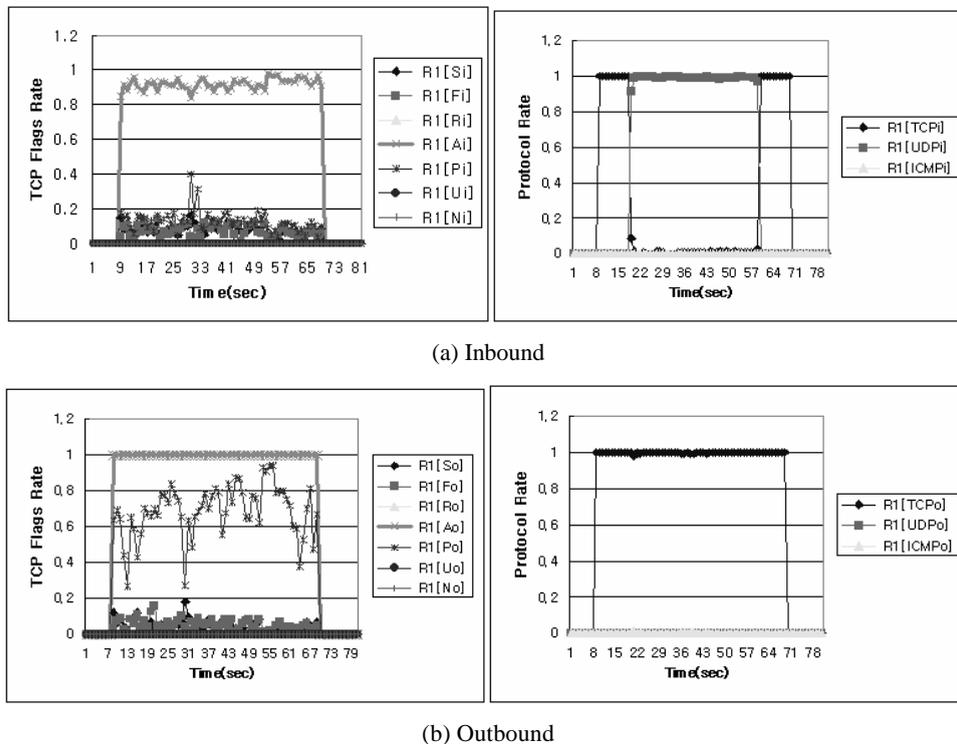


Figure 4. TCP flag rates and protocol rates under UDP flooding attack

3.2.3 ICMP flooding attack

Figure 5 shows the inbound and the outbound TCP flag rates and protocol rates under the ICMP flooding attack, which is performed between 20 and 60 seconds. The ICMP protocol rate for inbound traffic, $R_I[ICMP_i]$, increases from nearly zero to one. Like $R_I[UDPi]$ under the UDP flooding attack, the increase of $R_I[ICMP_i]$ under the ICMP flooding attack is obvious. One different thing is that $R_I[ICMP_o]$ sharply goes up and down, as depicted in the right diagram of figure 5 (b), since all of the inbound ICMP ping requesting packets ask for a Web server (victim) to reply with ICMP ping acknowledging packets. That is, in case of the ICMP flooding attack, the victim is not able to continuously send any packet due to the flooding of ICMP packets.

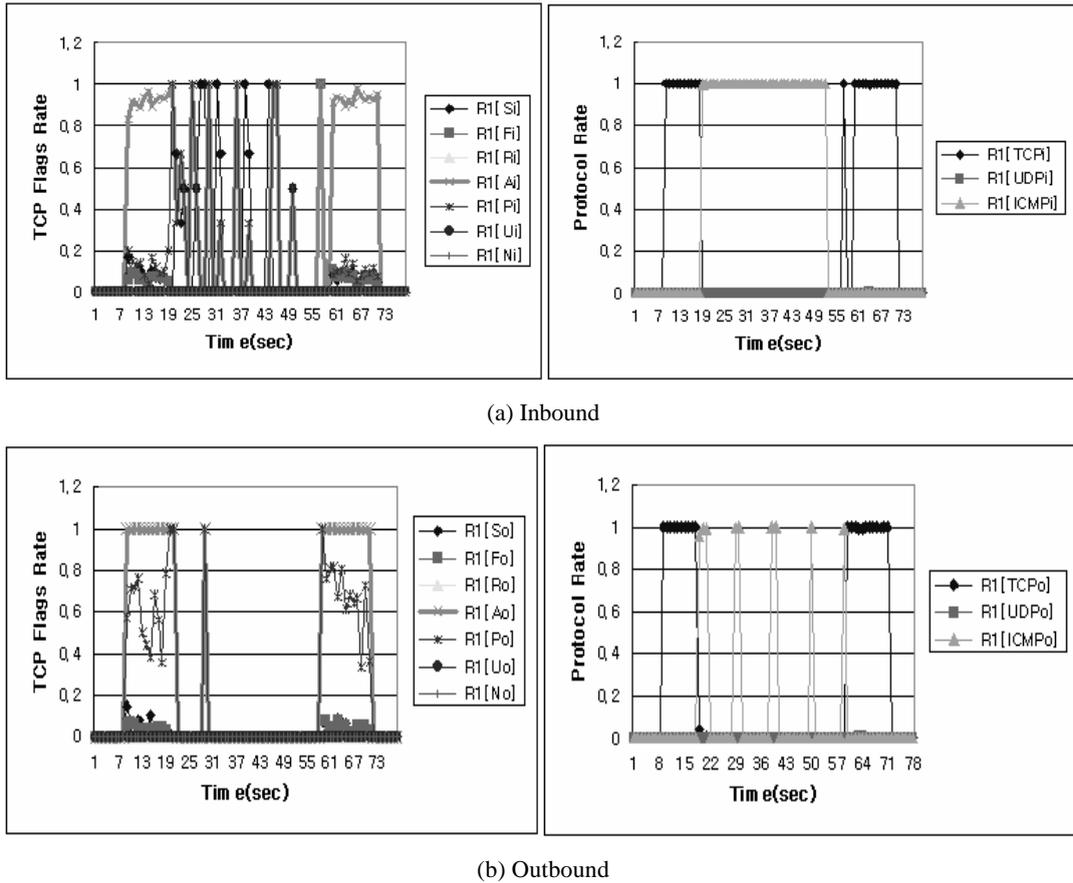


Figure 5. TCP flag rates and protocol rates under ICMP flooding attack

3.2.4 Other miscellaneous attacks

The MIX flooding attack combines TCP, UDP, and ICMP flooding attacks [2]. Figure 6 shows the inbound and the outbound TCP flag rates and protocol rates under the MIX flooding attack, being done between 20 and 58 seconds. During the SYN attack, the ACK flag rate for inbound network traffic $R_I[A_i]$ decreases nearly zero but $R_I[S_i]$ and $R_I[U_i]$ go up to almost one because of the flooding of SYN flags. In the protocol rates, $R_I[TCPI]$, $R_I[UDPi]$, and $R_I[ICMPi]$ are the same because the MIX flooding attack uses the protocols in the same proportion.

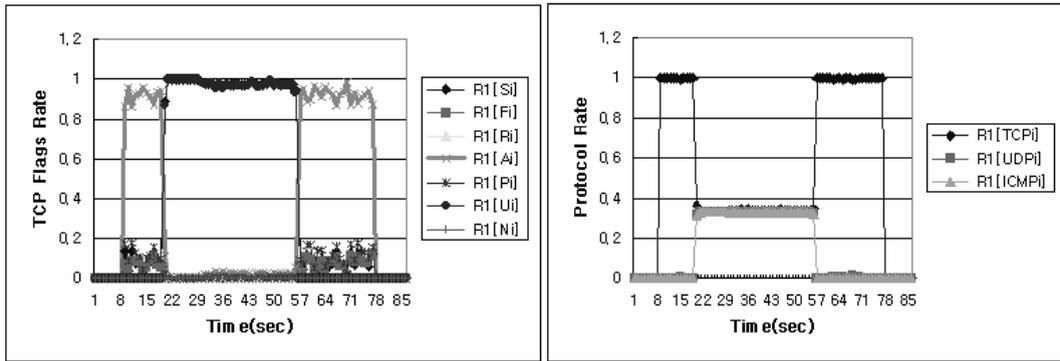


Figure 6. TCP flag rates and protocol rates under MIX flooding attack

The TARGA3 flooding attack generated by TFN2K combines the MIX flooding attack and the XMAS flooding attack. The distribution of flag and protocol rates is depicted in figure 7.

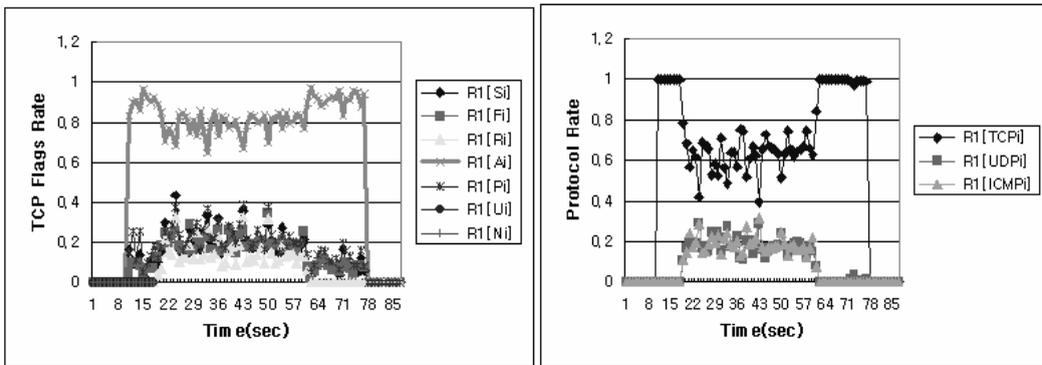


Figure 7. TCP flag rates and protocol rates under TARGA3 flooding attack

The above figures imply that alarming agents need to calculate all four traffic rates together, to clearly characterize the symptoms of various DDoS attacks, which are flag rates and protocol rates for inbound and outbound network traffic, respectively. In summary of table 1, we conclude that the traffic rate analysis mechanism could be used to represent the features of network traffic under a variety of the DDoS attacks.

Table 1. Network traffic rates with significant changes

Types of attacks	Inbound		Outbound	
	Flag rates	Protocol rates	Flag rates	Protocol rates
SYN	R[Si] ↑, R[Ui] ↑, R[Ai] ↓			
UDP		R[UDPi] ↑, R[TCPi] ↓		
ICMP		R[ICMPi] ↑, R[TCPi] ↓		R[ICMPo] ↑, R[TCPo] ↓
MIX	R[Ai] ↓	R[TCPi] ≈, R[UDPi] ≈, R[ICMPi] ≈		
TARGA3	R[Si] ≈, R[Ui] ≈, R[Fo] ≈, R[Pi] ≈, R[Ui] ≈			

In the table 1, \uparrow indicates a rate close to nearly one, \downarrow nearly zero, and \gg presents a stable rate. To determine whether or not SYN and TARGA3 flooding attacks, our alarming agents need to watch the fluctuation of flag rates; for UDP and ICMP flooding attacks, they need to check protocol rates; for the MIX flooding attacks, they need to examine flag as well as protocol rates. For the cases such as SYN, UDP, MIX, and TARGA3 flooding attacks, the inbound traffic rates are crucial to detect the DDoS flooding attacks. However, the alarming agents might watch both inbound and outbound traffic rates for the purpose of detecting ICMP flooding attacks.

4. CONCLUSIONS

We investigated the characteristics of network traffic of DDoS attacks on TCP-based servers. To efficiently present the characteristics, we suggested a traffic rate analysis (TRA) mechanism, which calculates flag rates and protocol rates for inbound and outbound network traffic. With the in-depth simulation, we found that the rates could be used to represent the features of network traffic under various types of flooding attacks. In our future research, to determine the reliability of our method, we will continuously test the TRA in different network settings, for example, SMTP and FTP servers. Further, we will consider learning algorithms [14] to compile a pair of traffic rates and presence (or absence) of flooding attacks into state-action rules. The alarming agents will be equipped with the compiled rules to be adaptive in dynamic network settings.

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COOPERATIVE THEME AND TOOL COMPETENCE FOR LEARNING IN LARGE CLASSROOM SETTINGS

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ABSTRACT

For a more intensive presentation and an active involvement of students, in particular in large classes, we present a novel approach termed Cooperative Theme and Tool Competence For Learning (CoTTCoL). One of the novelties of our multi-step CSCL method is that it utilizes (and advertises) a *congruence* between objects and operational structures in the *theme area* and the *learning process*. To this end combined educational tool and subject area competence are needed. We explain our approach in the example of a new undergraduate class “Operating Systems and Networking”. We report on results, experiences, and project extensions in the works that reach into a large variety of topic areas for teaching.

KEYWORDS

Computer supported cooperative learning, computer-mediated communication, autonomous processes, process interaction, theme and learning tool competence.

1. MOTIVATION

At the University of Dortmund, the School of Computer Science has recently introduced a new (compulsory) class “Operating Systems and Networking” into its undergraduate curriculum. The idea behind was to give students a thorough experience in a few core areas such as operating systems, networks, information systems, and software technology even if they decided not to pursue any of these topics during their graduate studies (where courses are mostly selective). Due to tight limits regarding the total number of credits required these classes had to be squeezed into a program which was already rich enough. As a result “Operating Systems and Networking” combines 2 major areas into one course where students would meet in class once a week for 90 minutes, and once a week for 45 minutes of homework discussions. This class stretches over a full year (2 terms). In total, this comprises half of the credit hours compared to a “regular” undergraduate class format.

The unusual format poses a number of challenging questions:

1. How to make students really understand, experience, and work with, the core concepts and contents in the topic areas?
2. How to pursue any teaching or learning method in a class setting of 400 – 800 students? This is the number in our CS sophomore year.
3. How to compress the material to fit into the extremely narrow time frame?
4. How to make sure that despite the low frequency of class sessions (once a week) students would engage intensely enough to keep in close touch with the themes?

While answers for one or another question are conceivable, or are being practiced, we had to deal with the combined problems. As the traditional classroom teaching method is very hard to realize even in a regular session schedule we were led easily to think about a style which would at the same time be more demonstrative and involve students actively, in other words: we were looking for cooperative teaching and learning approaches.

While this may cover questions 1 and 2, problems 3 and 4 are not yet addressed. *Also, to the best of our knowledge the existing CSCL methods are not really scalable to work in large classes such as mentioned, even the technological hardware basis is not yet available.* In this situation we decided to design and develop an innovative CSCL concept by establishing a **principle of congruence** of themes, paradigms, tools of the

topic area, and forms of cooperative learning and teaching. Due to the lack of models and experience we started a comprehensive research and development project **Cooperative Theme and Tool Competence for Learning (CoTTCoL)** by focusing on the mentioned new class “Operating Systems and Networking”. Clearly we meant to contribute to questions 3 and 4 with our modeling principle. Several initial ideas have already been presented in [WBF02].

This paper is a case study on behalf of developing CoTTCoL, and of using it in a large classroom setting. In the case study, as much as in our CoTTCoL project, we do not advertise an exclusive use of computer-supported CL tools although the emphasis in this presentation suggests this (dealing with questions 1-4 above). Indeed, our major research theme is to embed CSCL methods into traditional role-based cooperative processes, and also to draw a line between the two. While it makes no sense to do any kind of brainstorming with 600 students without a (sophisticated) software support system it is certainly more efficient for a group of up to 20 students gathered in one room, to play a role game with all perspectives of an unprecedented and spontaneous discussion, as part of a *direct* communication. In this paper we will present 2 steps of an innovative multi-step CSCL teaching / learning approach that will be complemented by a role-based group play in homework discussions. This will be done in section 2. The last section concludes our results and gives perspectives of future work.

Previous and Related Work. As mentioned above we are not aware of any CSCL concept or tool that would work, or is at least targeted at working, under the constraints listed above. On the other hand, our findings and experience are equally relevant for revising multimedia and CSCL methodologies in Life-Long Learning programs as well as in Distance Teaching [BD01, Ko96, RCFK99, Pa93, BLG98, GE99].

2. THE NEW COURSE „OPERATING SYSTEMS AND NETWORKS“

According to question 3 (see section I) we identified “*Cooperation / Collaboration and Synchronization of (Conceptually) Autonomous Processes*” as the core theme for the course “Operating Systems and Networking”. Indeed, this is even true in uniprocessor operating systems where system functions like memory management, CPU and disk scheduling **are designed as if they would interact as autonomous entities**. (Otherwise both the complexity of the service structure and the efficiency of the services would be infeasible.) While equally characteristic e.g. for database systems and other complex application systems this aspect is most prominent in operating systems and networking, and for undergraduate students in the US and in several European countries such a course is the first occasion for undergraduate students to be exposed to interacting autonomous processes.

As a matter of a decades-long experience it turns out that autonomy of processes while not difficult to define as an abstract concept, is certainly very difficult to understand. At the same time it is possible to experience the nature of autonomy (*learning by doing*). Without further reference or discussion we simply mention here that one of the key problems in operating system design, more specifically in memory management, is the well-known **Dining Philosophers’ Problem** (see e. g. [Win81]). It was formulated in the early 1960’s when distributed systems and explicitly autonomous processes were really not a practical issue. (It was “invented” by E. W. Dijkstra, one of the visionary pioneers in computers, in order to illustrate the claim stated in the previous paragraph.) The problem is as follows.

The Dining Philosophers’ Problem. Five Dutch philosophers are seated around a table (see fig.1). On the table there is a big pot with an arbitrary supply of Italian spaghetti cooked and maintained “*al dente*”. (For the purpose of simplicity we omit it in the picture.) There is a fork placed on the table between any two neighbors. Since the philosophers are Dutch – and not Italian – each of them needs 2 forks for eating the pasta, hence if a philosopher eats none of his neighbors can eat. The philosophers have thus to cooperate for the purpose of eating once they become hungry. Let us assume that their relevant activities are combined into: **Thinking, becoming hungry, picking up left/ right fork, eating, cleaning the forks, dropping left/ right fork**. The autonomy is to be realized by requiring that *any distributed solution procedure must not make use of any assumption on (relative) speeds, static priorities, or preference of any philosopher process. No central management will be accepted.* In order to understand the problem adequately, or to find a solution, it is imperative to understand or manage the autonomy of the philosophers.

After more than 30 years of professional practice of one of the authors it can be stated here that this is very difficult even for professionals in the field. Therefore it not too surprising that it took more than 20 years

until a “correct” solution was found which guarantees that *no philosopher could starve, neither accidentally or as a result of a bad coalition.*

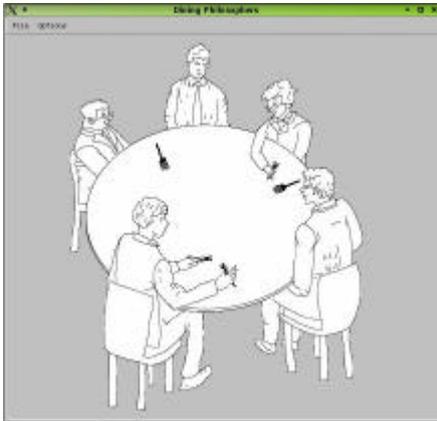


Figure 1. The dining philosophers



Figure 2: Local view of a philosopher

Step 1. Active CSCL experience of autonomous interaction (simple). In a large classroom setting it is therefore inadequate to expect an understanding of a formal definition of the problem, or of the solution strategy. Rather our approach is to **experience the problem nature through experimental, interactive and cooperative activities of the students.** This is meant as a basis to result in creating “reasonable” solution ideas. This process may then lead to an understanding of the problem. We have designed and pursued the following approach:

We started with a distributed implementation of the following small loops at each of a LAN of laptops. Each of the loops represents the relevant steps of the philosophers’ behavior (see above).

```
DO THINK;
  Get hungry;
  Grab left fork;
  Grab right fork;
  EAT;
  Clean forks;
  Drop left fork;
  Drop right fork;
OD
```

Students operating the laptops assume the role of a philosopher. They have each a local view of their state as represented in fig.2. They may interactively grab one of the needed forks, by pushing one of the buttons “GRAB left” or GRAB right”. Once the left neighbor has picked up his right fork (like the left fork displayed in fig.2) this symbol disappears. As long as this has not happened the player may still drop his right fork, by pushing the button “DROP right”. This makes him inactive yet allows his right neighbor to pick up this fork (and, hopefully, to eat).

Despite hiding technical details from the players the global situations and developments may be very complex. The local information is collected by a central process (running on an additional laptop) and combined into a global picture which is displayed on a screen. This information is visible to the rest of the audience. Since essential details about the process ID’s is hidden and the players turn their backs to this screen it makes no sense for them to turn around while playing: The high amount of concurrency does not really allow them to find out about the impact of any of their actions, and while peeping they may put in a disadvantage by other players.

Accidentally a situation may be reached where each philosopher holds his right fork and does not want to drop it (see fig. 3). (This will happen frequently.)

The local view for each philosopher (and thus for each student playing this role) is to be found in fig. 4. Since the left fork is gone in this example the “DROP right” button is disabled. No player can continue from this point although the grabbing left hand indicates his interest. This situation is called a *deadlock*.

In order to break the tie one could change the game by allowing a deadlocked player to drop his right fork. While the students may appreciate the change since they could proceed further this leads into a similar problem where no philosopher may be able to eat while still being active. In any case the players do not even know whether they are in a deadlock situation or not. Once this experience gains ground it will appear reasonable to extend the role of the philosophers, to make them more intelligent and at the same more responsible players.

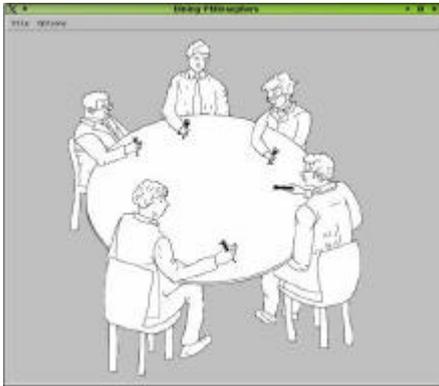


Figure 3. Deadlocked philosophers

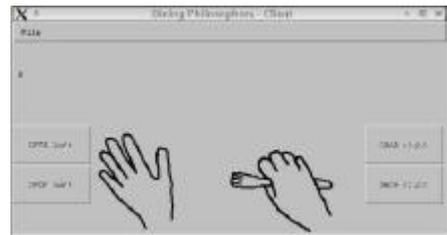


Figure 4. Local View of deadlocked philosopher

Step 2. Active CSCL experience of autonomous interaction (extended). For this purpose we have provided, as a second step, an extension of the previous algorithm by providing a more explicit information structure which in turn yields a better decision basis. This is realized by referring to Winkowski's Algorithm [Win81]. Here fork managers have been introduced who would queue requests for "their" fork into lists Q_j , depending on, and according to, *dynamic local* priorities between the philosophers P_i who need fork f_j . f_j in turn maintains lists L_j displaying these priorities. This extended scenario is to be found in fig.5.



Figure 5. Messages und synchronisation structures

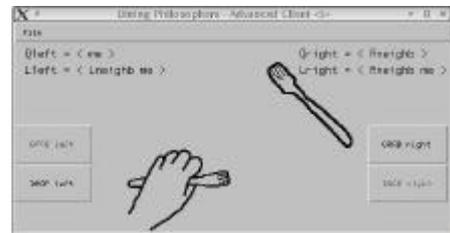


Figure 6. Structured user information

The players, again, see just a local section of this global scenario (see fig.6). All they learn about the new rules of the game is that the right or left fork manager, respectively, will accept a request only (and enqueue it in a FCFS manner into Q_{left} or Q_{right} , respectively) as long as no request of a higher priority had been enqueued or the fork is in use by a neighbor, i.e. it has disappeared from the display. Also, if a request by P_i has been denied any other request by P_i that had already been enqueued would have to be removed as well from the according Q_j .

In fact it can be *proven* that with these refinements deadlocks can no longer occur. However, it needs quite an effort on behalf of the students to digest this. While playing only the absence of a blocking situation could be sensed (from the local perspectives) yet in discussions among the remainder audience some ideas would occasionally flare up about the cause. In any case the players have, in this refined procedure, an improved insight about the effect of their actions: In the situation displayed in fig.6 the player might press the "GRAB right" button.

When the request would be rejected (the right fork symbol would flash for a short while) he would have to drop the left fork (by pressing "DROP left"). Based on the new information available he may now consider not to send a request for the right fork as long as the right neighbor holds this fork (content of Q_{right}) and, in

addition, has a higher local priority than the player (content of L_{right}): In this situation he would run into the risk of losing hold of his right fork without any guarantee to get it back in due time. In the same style further strategies could be based on questions like: “Is my strategy advantageous in the given (local) situation?”, “Am I treated ‘fairly’?”, “Do I risk to run into a deadlock?”

In the sequel the players, or students from the audience, come up at times with the conjecture that despite the absence of deadlocks one of the philosophers may still *starve*. This documents for everybody a deepened understanding of the problem.

The roles are successively assumed by different students from the audience, ideally everybody (or at least a large group) plays both roles. In this way both the creativity and sensitivity for finding and investigating solution approaches are considerably increased.

Observations:

- The 2-step procedure described so far could only be successful with computer support since the systematic hiding of information in both steps is at the same time instrumental for introducing into the problem.
- Of course, a “correct” algorithm could be implemented from the beginning but then the participants would not be aware of inherent deadlocks, and they would not be guided into their own, or cooperative, ideas for solution strategies.
- In a traditional classroom setting the problem would be formally defined, treated, analyzed, including formal proofs but this leaves only a few specialists with a reasonable understanding.

Step 3. Role-based elaboration of autonomous interaction. After a classroom session featuring the cooperative procedures described we did both intensify and deepen the experiences in a third step: In homework discussion sections (held with groups of up to 20 participants) the two distributed algorithms discussed (even the second one is not perfect since philosophers may starve!) have been transformed into role games, without computer support. Here the direct oral and visual communication yielded deeper insights even resulting in real solution ideas and their implementation.

Evaluative Observations:

- In this way a full (and operational) understanding of the original problem was achieved out of collaborative activities.
- The acceptance of the role games – computer-supported or traditional – was throughout very good. Clearly the motivation for an active participation was higher than in a traditional teaching format, let alone the creativity.
- Given the class size (465 students) the two previous results could not have been achieved otherwise.
- Out of the 465 students, 269, i.e. 59% of the enrolled students, and 70% of the regularly participating students passed successfully. Except for satisfying rigid criteria for active participation in the homework discussions, a mid-term and a final exam had to be passed, each contributing to the grade with 35%.
- One year ago a sophomore class on “Computer Architecture” had been taught by one of the authors in the traditional format and presentational style. Out of the 1100 participants (the class was taught in 2 sections at 550 each) only 140 passed.

3. CONCLUSION AND FUTURE WORK

We have presented a 3-step CSCL procedure meant for coping with a highly unusual and difficult course and classroom situation (the new CS course “Operating Systems and Networking”). The particular format was needed because of the large class size, and interactive distributed computer support was indispensable in class. Since the core theme of the course was cooperation of (conceptually) autonomous processes and autonomy is not easy to grasp our approach was to shape the learning / teaching method in accordance with the (operational) process structures in the theme area, in other words: We established a congruence between the theme area and the learning process, thus at the same time an understanding of the nature of distributed processes could be built as much as it was experienced and made operational.

In this particular context we were led to CSCL methods as natural computer support paradigm. Our theme-based approach was designed to involve students through a both intensifying and compacting collaborative process ending up in individual active understanding. This objective is certainly independent of the particular class context and restrictions. However for the purpose not only educational tool competence (CSCL in particular) is needed but also competence in the subject area to be taught. This explains immedi-

ately why interactive distributed CSCL software is very difficult to develop but even more why there is so little of it available yet.

With the experience of the one-year course we are currently in the process of utilizing our insights for completing, evaluating, and extending our CSCL software tools, by participating in a novel distributed lab environment which was established with state funds supporting university-wide efforts for improving the teaching and learning situation (WIS funds and InWiDA initiative, respectively). The research reported here was generously supported by the state of North Rhine-Westphalia under the WIS program.

Our approach is readily applicable not only to different Computer Science courses but also to courses in Journalism, Sociology, Logistics, Production Planning, Urban / Regional Planning etc. It may be very useful even if the number of participants is not large: Imagine a in-depth analysis and report situation for a newspaper like for the "New York Times", say around September 11 or under the tense circumstances of a potential war against Iraq. Thoroughly researched reports from correspondents around the world would be needed but their compilation into an article for page 2 or 3 (and no more space available!) would need a direct collaborations of the expert correspondents. Based on phone or fax/ e-mail connections this takes currently about a week for a particular expert team in New York City whereas in a hot situation like in the examples mentioned the work should be completed overnight. This would be a scenario for graduate class or seminar in Journalism. As mentioned in section 1 our approach is well suited to revising multimedia and CSCL methodologies in Life-Long Learning programs as well as in Distance Teaching.

Over the past 20 years an increasing affinity of High School and University students towards CSCW and CSCL methods can be observed. It could be described psychologically as *a transition from encyclopedic to cooperative forms of thinking and acting*. This means that in the near future there will be a rapidly increasing demand for tailored, i.e. theme and tool based CSCL software.

We have implemented our system on the EWS platform (Electronic Work Space) which was developed in Dortmund and is currently used in quite a number of universities, Middle and High schools, and research institutes for supporting different cooperative tasks and programs. We have written our software in Java both for better portability and for keeping the programming job manageable. In particular we are in the process of generating a test environment for different classes of distributed algorithms (like the ones described here) and combine them into a Java library. Animation and visualization of communication are on our current work list as much as multi-step guidance into internal states for distributed processes. On a mid-range basis we are planning for developing comprehensive interactive tools for cooperative design and simulation of distributed processes. This is part of project work to be performed within the cEVU and ECIU initiative, and also through EU funding as we also participate in the DICTUM project.

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REVS – A ROBUST ELECTRONIC VOTING SYSTEM

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ABSTRACT

There are many protocols proposed for electronic voting, but only a few of them have prototypes implemented. Usually the prototypes are focused in the characteristics of the protocol and do not handle properly some real world issues, such as fault tolerance. This paper presents REVS, a robust electronic voting system designed for distributed and faulty environments, namely the Internet. The goal of REVS is to be an electronic voting system that accomplishes the desired characteristics of traditional voting systems, such as accuracy, democracy, privacy and verifiability. In addition, REVS deals with failures in real world scenarios, such as machine or communication failures, which can lead to protocol interruptions. REVS robustness has consequences at three levels: (i) the voting process can be interrupted and recovered without weakening the voting protocol; (ii) it allows a certain degree of failures, with server replication; and (iii) none of the servers conducting the election, by its own or to a certain level of collusion, can corrupt the election outcome.

KEYWORDS

Electronic voting, Fault-Tolerance, Robustness, Blind signatures.

1. INTRODUCTION

In the last few years several experiences have been conducted in order to facilitate elections. The facilitations were introduced by new ways of expressing votes besides the traditional paper-based. Examples of new voting interfaces and systems are touch screens, SMS messages from cellular phones and distributed voting systems using the Internet (Monteiro 2001, UK-eDemocracy 2003).

Internet voting systems are appealing for several reasons: (i) people are getting more used to work with computers to do all sort of things, namely sensitive operations such as shopping and home banking; (ii) they allow people to vote far from where they usually live, helping to reduce abstention rates; and (iii) they may support arbitrary voting ballots and check their correct fulfillment during the voting process.

However, Internet voting systems face several problems that prevent their widespread use today (CIVTF 2000, CALTECH-MIT 2001, Cranor 2001, IPI 2001, Rivest 2001, Rubin 2002). The problems can be broadly divided in three main classes.

The first class includes security and fault tolerance problems inherited from the current Internet architecture. Vital services, such as DNS name resolution, can be tampered in order to mislead users into spoofing servers (Lioy et al. 2000). IP routing mechanisms and protocols, managed by many different organizations, should deal with partial communication outages, however communication problems may arise.

The second class includes problems that are specific to voting protocols. These problems derive from the assumptions of the protocols about the execution environment, namely:

- Client machines used by voters must be trusted, in order to act as “trusted agents”, which is hard to ensure in personal or multi-user computers with general-purpose commercial operation systems.
- Servers controlling the voting process cannot (i) fail, (ii) become unreachable or (iii) pervert the voting protocol. The protocol perversion can be done either by not reacting properly to client requests or by trying to influence the election acting as a voter.
- The voting protocol is not disturbed by communication problems or machine failures.

The third class includes problems that may be created by specific attacks against a voting protocol or a running election. Such attacks may try to get some useful outcome, by subverting the voting protocol, or

simply ruin an election using DoS (Denial of Service) attacks against the participating machines or applications. Another kind of attack is the coercion of voters, which can happen if they can vote anywhere without supervision of electoral committees.

REVS is an Internet voting system designed to tackle some of these problems. In particular, the REVS voting protocol, involving several participating machines, supports some types of communication and machine failures by keeping a distributed loosely-coupled state. Each voter keeps a local state, in mobile non-volatile storage, allowing him to stop and resume the election anytime and anywhere. Servers are replicated and only a subset of them needs to be contacted by each voter. Each server keeps a distinct state regarding the participation of each voter in the election, allowing voters to get many times the same answer from each server. Each server alone is not able to act as any voter and cannot provide false replies to voters without being noticed. The collusion of servers in order to interfere with the election (e.g. voting for absentees) is prevented to a certain degree of collusion.

REVS is a blind signature electronic voting system based in DuRette's (1999) work, which improved the EVOX system (Herschberg 1997). DuRette improved EVOX in order to eliminate single entities capable of corrupting the election (the EVOX Managed Administrator). Both DuRette's system and EVOX are very sensible to failures in communication or servers, a problem that we solved with REVS. Furthermore, the DuRette's system has problems concerning the authentication of voters, allowing an easy impersonation of voters by the servers running the election. In REVS we solved this problem redesigning the voters' authentication algorithm.

A first prototype of REVS is being implemented in the Instituto Superior Técnico (Technical Univ. of Lisbon) to support elections, namely quality surveys. To this particular scenario, REVS servers are deployed and managed by separate entities, namely central computer services, several departments and students' organizations, in order to reduce collusion. A set of trusted machines are made available to voters, but they can use any machine to participate in the elections. Voting ballots are signed Java scripts downloaded into voters' machines. These scripts are able to check the correct fulfillment of ballots and to contact the correct REVS servers to submit them.

This document is structured as follows. Section 2 presents an overview of previous work stressing the work in which REVS is based on. Section 3 describes the protocol used and how it achieves robustness. In Section 4 we describe the implementation details of REVS. Section 5 presents an evaluation of the system and finally in Section 6 we draw some conclusions.

2. RELATED WORK

Researchers have been working in the electronic voting research area mainly after 1980, with an emphasis in the last decade. Currently there is a consolidated taxonomy for classifying electronic voting systems and well-defined sets of protocols for implementing them. We will start with a brief presentation of the taxonomy and the alternative protocols, and then we will describe the DuRette's system, the EVOX Managed Administrator, upon which we designed REVS.

Researchers in the electronic voting field have already reached a consensus pack of four core properties that an electronic voting system should have (Cranor and Cytron 1997):

Accuracy: (1) it is not possible for a vote to be altered, (2) it is not possible for a validated vote to be eliminated from the final tally, and (3) it is not possible for an invalid vote to be counted in the final tally.

Democracy: (1) it permits only eligible voters to vote and, (2) it ensures that eligible voters vote only once.

Privacy: (1) neither authorities nor anyone else can link any ballot to the voter who cast it and (2) no voter can prove that he voted in a particular way.

Verifiability: anyone can independently verify that all votes have been counted correctly.

Accuracy, democracy and verifiability are, in most cases of today's electoral systems, assured by the presence of representatives of opposite parties. The privacy property is currently assured by the existence of private voting booths, allowing voters to cast their votes in secrecy.

The particular nature of the Internet environment requires robust Internet voting systems. We define robustness as the join of the following three characteristics:

Collusion Resistance: no electoral entity (any server participating in the election) or group of entities, running the election can work in a conspiracy to introduce votes or to prevent voters from voting. If all

entities conspire this property isn't achieved. So, this characteristic should be measured in terms of the total number of entities that must conspire to guarantee a successful interference in the election.

Availability: (1) the system works properly as long as the poll stands and (2) any voter can have access to it from the beginning to the end of the poll.

Resume Ability: the system allows any voter who had interrupted his/her voting process to resume it or restart it while the poll stands.

The electronic voting protocols proposed so far are mainly divided in three different approaches: protocols based in blind signatures¹ (Fujioka et al. 1992, Sako 1994, Cranor and Cytron 1997, Herschberg 1997, Okamoto 1997 and DuRette 1999), protocols based in mix-nets (Chaum 1981, Park et al. 1993, Sako and Kilian 1995, Ogata et al. 1997 and Jakobsson 1998), and protocols based in homomorphic encryption (Benaloh and Fischer 1985, Benaloh and Yung 1986, Benaloh 1987, Benaloh and Tuinstra 1994, Sako and Kilian 1994, Cramer et al. 1996, Cramer et al. 1997, Hirt and Sako 2000 and Baundron et al. 2001).

Each approach has pros and cons, but the ones based in blind signatures are more flexible. The blind signature systems are open to all kind of ballot formats, and have less computational complexity than mix-nets and homomorphic-based systems. Therefore, we chose this type of system for REVS.

Fujioka et al. proposed in 1992 a blind signature protocol, known as FOO, which became the reference in blind signature voting protocols. Later, Cranor and Cytron (1997) with Sensus, and Herschberg (1997) with EVOX, proposed their voting protocols and systems based on FOO. But both of them don't control the power of the Administrator. In 1999, DuRette proposed the EVOX Managed Administrator protocol, an evolution of EVOX reducing the power of the Administrator. REVS is based in DuRette's work, but we modified the system in order to be fault tolerant, thus assuring availability. Furthermore, we modified the algorithm for authenticating users because the one proposed by DuRette has personification problems.

2.1 The EVOX Managed Administrator

DuRette's (1999) work tackles a common problem in voting protocols based in blind signatures: preventing the Administrator from introducing ballots in the election. The idea is to ensure accuracy by sharing the power of the election Administrator among several servers: there are n Administrators and it is required t signatures of them to make a ballot valid. An additional signature from the Manager ensures democracy.

Here's an overview of the protocol (c.f. Figure 1): the voter contacts the Manager and obtains a ballot (1), fills it and contacts $t \geq n$ Administrators for signing his ballot (2). Then the voter gets the Manager's signature over all the signatures previously obtained from the Administrators (3) and, finally, he submits his vote to the Counter through an Anonymizer, which protects the voter's privacy from the Counter (4).

If the Manager is not trusted than $t \geq n/2 + 1$. However, this threshold is not enough because DuRette's system uses one password per voter for all Administrators and for the Manager. None of these entities know the password in advance, because a UNIX-like validation is used. However, a small set of Administrators, colluded with the Manager, can generate false votes using a voter's password once they get it. The fraud may work like this: x colluded Administrators use a voter's password to get signatures

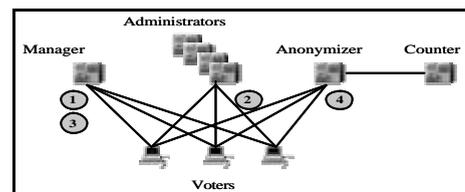


Figure 1. EVOX Managed Administrator

from all the Administrators not contacted by the voter and send to the Manager a signed vote that it could accept and send to the Counter. With n Administrators and $n/2 + D$ required signatures, x is equal to $2D$. If, for improving performance, D is a low value (1 or 2), the possibility of attack is not negligible. If t is less than $n/2$ the Manager, it self, can introduce votes without the participation of any other entity.

This kind of fraud can be discovered using the servers logs. But if the Manager is also part of the collusion, he can refuse to sign some votes saying that some error occurred or just refusing the connection (too busy). In this case the introduction of votes for those refused voters will pass undetected.

¹ Blind signatures are a class of digital signatures, consisting in getting a message digitally signed without giving any knowledge about the message to the signer. This is like putting a document and a sheet of carbon paper in a sealed envelope that somebody signs on the outside. After removing the envelope we get the signed document.

The authentication method in REVS is also username/password based, but uses a different password for each server, preventing voter's impersonation by less than t colluded Administrators. The details about the authentication scheme are presented in Section 4.

Another problem, but now respecting the robustness of the system, is the existence of a single Manager (the replication of the Anonymizer and Counter is taken into account in DuRette's proposal). The Manager must sign all ballots and is also responsible for ballot distribution. Any malfunction on this server leads to an interruption of the election, as it is a single point of failure. Thus, the system does not ensure availability. Furthermore, the Manager is a performance bottleneck when considering large-scale elections.

Single points of failure should be avoided to increase availability, one of the properties that a robust electronic system must have (c.f. Section 2). Therefore, in REVS there are no single points of failure.

3. REVS VOTING PROTOCOL

In REVS we have five types of servers: Commissioner, Ballot Distributor, Administrator, Anonymizer and Counter. There is also a module that is used by voters to support their participation in elections, performing all the proper interactions with election servers (get the ballot, get it signed by election servers, submit the ballot, etc.).

Commissioner: Similarly to EVOX and DuRette's systems, in REVS we also have a Commissioner. In all three systems the Commissioner is the election supervisor, receiving complains made by any voter or electoral server. If the received complains raise any suspicion, an investigation is made to find out the causes.

The Commissioner in REVS has also the responsibility of preparing the election, generating and keeping secret the election's keys, signing the ballot questions and defining the operational configuration for the election (addresses and public keys of servers, number of required signatures, etc.).

Ballot Distributor: The Ballot Distributor is responsible for the distribution, for the voters, of the data set up by the Commissioner for the election: ballots and operational configuration. This procedure is expensive in terms of data exchange, so we decided to introduce this dedicated server in REVS.

All the information distributed by a Ballot Distributor must be signed by the Commissioner, in which all voters trust. Thus, there may be several Ballot Distributors. This replication, besides reducing the work load on each Ballot Distributor, improving efficiency in large-scale elections, provides protection to communication or machine failures affecting Distributors, bringing robustness to the distribution process.

Administrators: The Administrators are the electoral entities that have the power to decide upon the acceptability of a ballot from a voter. A ballot is acceptable for the final tally of the election only if it has a minimum set of signatures from different Administrators. If n is the total number of Administrators a voter must get $t > n/2$ valid signatures from different Administrators to make its ballot acceptable. This makes impossible for any voter to get two valid votes.

A voter uses a different password to get a signature from each Administrator. And because one Administrator cannot derive any other passwords from the one it knows, as we will show in Section 4.1, it cannot alone impersonate a voter.

Anonymizer: The Anonymizer server provides anonymity to the voter's machine, preventing a Counter from associating a ballot to the machine owner. A voter can choose any number of Anonymizers from the ones participating in the election. The Anonymizer hides the voter's location and randomly delays and shuffles several submitted ballots before sending them to Counters. The randomization of ballot submissions prevents time analysis trying to discover voters' ballots from the hour that have voted.

Counter: The Counter is the server who verifies the validity of the ballots, verifying that all required signatures are on the ballot. Then the Counter removes the repeated ballots verifying a bit commitment (made by the voter in the ballot signing phase (see, c.f. Section 3.1) and performs the tally.

Voters send their final ballots to Counters through Anonymizers encrypted with the public key of the election preventing Anonymizers and Counters from watching votes during the election. Counters can only analyze the votes when the election ends and the Commissioner releases the election key (private key).

REVS allows configurations with no single points of failure. So, in those configurations there must be several Counters, each one of them reachable through an independent Anonymizer.

In the case of the existence of several Counters the voters can send their ballots to any Counter (or, more correctly, to any Anonymizer), or even to several Counters. This means that different Counters will get

different sets of votes at the end of the election, and those sets may even contain repeated votes. A selected master Counter obtains the final tally after gathering all the valid votes from the several Counters and discarding the repeated ones. Like in EVOX, any person with access to the ballots collected by all Counters can act as a master Counter. This increases the confidence in the election outcome.

3.1 The Protocol

The REVS protocol allows a flexible replication of all servers involved in the election process. With the introduction of Ballot Distributors we separated every logical function into a different server, leading to a more modular system than EVOX. The only restriction made is to the number of required signatures to make a ballot valid, t , which must be greater than $n/2$, where n is the number of Administrators.

From the voters' point of view, the REVS protocol is divided in three steps (see Figure 2, detailed messages in Figure 3):

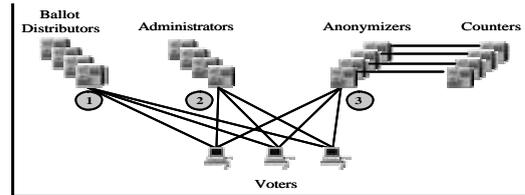


Figure 2. REVS protocol

I. Ballot distribution: The voter contacts a Ballot Distributor to get a blank ballot for a given election. The Ballot Distributor returns the requested ballot, the election public key and the election's operational configuration, all signed by the election's Commissioner. This is done in two phases. First the voter contacts a Ballot Distributor and provides a voter ID to receive the list of election in which he can participate. Then the voter chooses the election and requests a ballot for it from a Ballot Distributor.

II. Ballot signing: After expressing his will on the ballot, the voter commits to the ballot digest with a random bit string and blinds the committed digest with a random blinding factor. Then the voter sends his blinded committed ballot digest to the Administrators for signing.

The voter's module saves the answers, the bit commitment and the blinding factor into a non-volatile storage, preferably provided by a mobile media, before using them. This enables the voter to stop and later resume its participation in the election, but affects the voter's privacy.

The Administrator, after receiving a request for signing, verifies if it had already signed for the requesting voter. If not, he signs and saves the signature; if he had signed before, the Administrator returns the previously saved data, i.e. the signature of the blinded committed ballot digest.

After receiving a signature the voter updates it using the blinding factor and verifies its correctness using the original ballot digest and the Administrator's public key. This process is repeated until all required t signatures are collected. Note that Administrators cannot link the signatures they provided to the vote with the signatures that the voter gets after applying the blinding factor.

III. Ballot submission: in this step the voter constructs the ballot submission package, joining the ballot, its signatures and the bit commitment. At this time the voter can save this data into secure storage. This is an optional step, because it helps improving accuracy but affects privacy. Then he submits this package, ciphered with a hybrid cryptosystem using a random symmetric session key and the election's public key, through the Anonymizer, concluding the voting protocol. The voter can submit the same package to any Counter as many times as he feels necessary to be sure that the ballot as reach its destination.

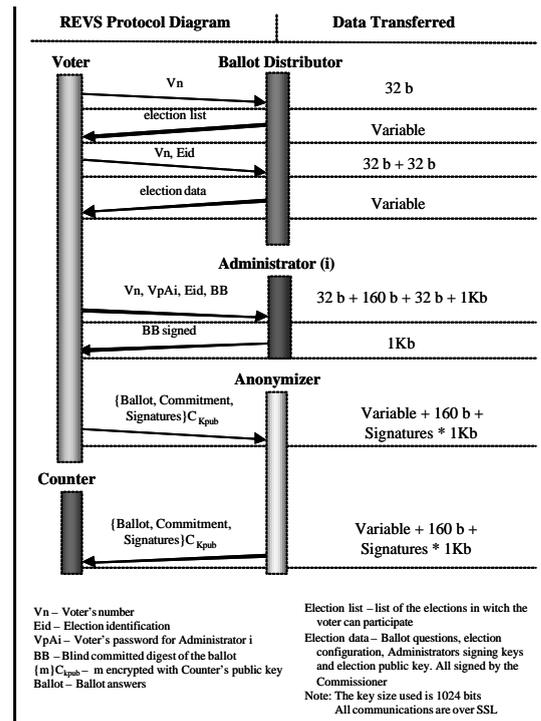


Figure 3. REVS protocol details

After the end of the election the Commissioner publishes the election private key. Then the counting process is performed by the Counters and involves the following steps:

- 1) Decipher the submission package with election's private key.
- 2) Verifying that all required t signatures from Administrators are present.
- 3) Removing repeated votes, which are the ones with the same bit commitment. If the length of the bit commitment is large enough (160 bits in REVS) the danger of collisions is negligible.
- 4) Tallying the remaining votes.
- 5) When using multiple Counters, the master Counter collects all previous verified votes. Then checks for repeated votes using the bit commitment, and proceeds with the final tally.

All the Counters publish the contents of all received submission packages, and the Administrators publish all the blindly signed ballots.

After this publication the voter can verify if his vote was counted. If the vote isn't present at the tally he can reclaim presenting anonymously the previous saved vote. Also, everybody can verify the relation between the total number of votes and the total possible valid votes signed by the Administrators.

4. IMPLEMENTATION

REVS was fully implemented in Java, enabling it to be installed and executed on any computational platform. For encryption we used the logi.crypt 1.1.2 crypto package. We also used a database back-end in REVS servers, namely the 3.23.53-max version of MySQL.

Election preparation: Before we can start using REVS an election must be prepared. This preparation consists in generating the election key pair, registration of voters and configuration of the servers. The registration of voters consists in defining their identification (username) and collecting their passwords for all Administrators (this is secure because the passwords are recorded in an Unix-like method).

The configuration of the servers consists in installing the servers (this includes the generation of their public and private keys), and setting up their databases with the election and voter's information.

The voter's module can be distributed to the voters in the registration process or can be downloaded later from the election official site or from some Ballot Distribution server. The voter's module comes with the Commissioner public key.

4.1 System security

In EVOX and EVOX Managed Administrator systems it is possible to run several elections simultaneously. This possibility is controlled distributing the right ballots to voters, but nothing was done to prevent the voters from exchanging ballots, or even to use ballots stealed from other voters. Thus, it is possible for voters to participate in elections for which they are not authorized to.

In REVS every Administrator has an asymmetric key pair for each election, so even if the voters manage to exchange the ballots the signatures will not match and the ballot will be discarded.

The voter's module represents the voter, so it's important that the voter trusts it. In REVS the Commissioner signs the voter's module, ensuring its integrity.

When implementing a secure application, aspects such as intervenient authentication and security in communications must be taken into account.

In REVS we use RMI over SSL to provide security in the communications. When establishing a connection with a server the voter uses the server public key to authenticate the server.

For authenticating voters we used the well-known username/password method. The voter must use a different password for each different Administrator for preventing impersonation. But for keeping the authentication user-friendly we should not force the voter to memorize all passwords. Thus, we designed an algorithm for generating all necessary passwords from a small set of secrets.

Our algorithm uses two secrets (see Figure 4): a strong password (non trivial password, like a large random alphabetical string) and an activation PIN that should be memorized by the voter. The voter introduces these two passwords in the voter's module and it computes all required passwords, one for each Administrator. Because the algorithm uses digest functions, an Administrator A_i knowing a voter's password P_i , cannot compute any other password P_j , $j \neq i$, known by Administrator A_j .

For improved security both passwords should be chosen by the voter. At a registration phase the voter should give the actual passwords, in an Unix like method, that will be used to authenticate itself to the Managers. Another possibility is to give the passwords to the voters and allow them to choose new ones.

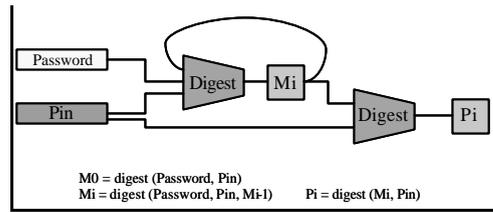


Figure 4. Password generation

5. EVALUATION OF THE FUNCTIONALITY OF REVS

The evaluation of the functionality of REVS is made under several assumptions. First we will clarify those assumptions, and then evaluate REVS considering the characteristics presented in Section 2.1 and also considering its usability and scalability. The assumptions are:

- The cryptographic algorithms used are hard to break. In REVS there are three cryptographic algorithms used: (i) RSA, for producing and checking blind and non-blind signatures and encrypting the keys used to encrypt the submission packages; (ii) Triple-DES, used to encrypt the submission packages; and (iii) SHA-1, for all required digest computations.
- The communications are secure. All communications in REVS use SSL and servers are authenticated with their public keys.
- The servers, voters’ computers and communication gateways are not vulnerable to attacks, such as DoS or infection by Trojan horses or viruses.
- The Anonymizers used are honest and work correctly.
- The required number of signatures respects $t > n/2$.
- The voter decided to save his data in secure non-volatile storage in steps I and II of the voting protocol.
- The Commissioner only publishes the election private key after the end of the election.

Accuracy: The vote cannot be altered because that would destroy all Administrators’ signatures. A voter can verify if his vote was eliminated from the final tally, examining the list of received votes published by Counters, and can correct this sending his submission package anonymously. The elimination of votes when using several Counters is harder because it implies the elimination of the vote from all Counters. Because the signatures can be verified by anyone and are published with the votes, it is impossible for an invalid vote to be part of the final tally. Therefore, all three aspects of accuracy are respected.

Democracy: Each voter can only vote once in each election because $t > n/2$ (a voter cannot obtain two valid votes). All voters can vote as long as t Administrators and one Anonymizer are available. Therefore, the two aspects of democracy are guaranteed as long as the system works.

Privacy: While the assumptions stand, the first part of privacy is guaranteed. The second part, as in most voting protocols proposed so far, isn’t accomplished, allowing the voter to prove his choice.

Verifiability: The final tally can be made by anyone, verifying the signatures on the votes and summing all votes. Each voter can verify if its own vote is correct, and assumes that the other votes are correct because of the signatures they have.

Collusion Resistance: This characteristic depends on the number of Administrators, n , and required signatures, t . To cast a vote one needs the cooperation of t Administrators (increases as t grows). To prevent a voter from voting $n-t+1$ Administrators must conspire, preventing the voter from obtaining the required t signatures (decreases as t grows). So, it’s obvious that it’s necessary to make a trade-off between the two parts of this property.

Availability: The system is available as long as there is a minimal set of servers running correctly. The minimal set is actually one Ballot Distributor, t Administrators, and one Anonymizer/Counter pair. The two last properties intrinsically depend on the configuration of the system.

Resume Ability: As explained in Section 3.1, the voter can recover from an interruption in the voting protocol as long as the voter keeps its voting data, i.e. the bit commitment and the blinding factor.

Robustness: REVS is a robust system because achieves the last three properties, as defined in Section 2.

5.1 Implementation evaluation

REVS was designed to support large scale elections. In this section we will evaluate the prototype of REVS concerning implementation decisions, time spend in cryptographic functions (in the voter's module and Administrators) and amount of data transferred.

As seen before, REVS can run with no single point of failure, therefore avoiding bottlenecks. All the servers have a database back-end and were implemented in a way that, if necessary, a cluster can be easily implemented to improve performance. With this design and implementation considerations we believe that REVS can easily support large scale elections.

To evaluate the prototype performance we have made some tests using a computer with a Pentium III processor, 384 MB of RAM running Windows XP Professional.

Regarding the voter's module we determined that it would take less than half a second to compute 1000 passwords; the blinding process is done in less than 200 ms; and the verification of the blind signatures is done in less than 30 ms. So, if we use REVS in a configuration requiring 5 signatures, the voter's module would compute all cryptographic functions in about a second.

The Administrator is the other entity that must compute cryptographic functions (signing blinded ballots). In our tests we verified that an Administrator takes less than 200 ms to verify voter's identity and sign the blinded ballot.

Besides servers' performance it's also necessary to analyze the amount of data transferred in the protocol (c.f. Figure 3). Being REVS a ballot independent voting system we must make some assumption before analyzing any data transfers: we assume that the election list is 3 Kb long; the election data is divided in a fixed part with 10 Kb (ballot questions, election configuration and election public key), and a variable part with $n * 1024$ bits long (signing keys of the Administrators running the election), finally we assume that the ballot (the answers) is 256 bits long.

Table 1. Data transferred in REVS with two Anonymizer-Counter chains

	Ballot Distribution	Ballot Signing	Ballot Submission	Total (one voter)	Total (one million voters)
n = 3; t = 2	≈ 16 Kb	≈ 4.4 Kb	≈ 9.6 Kb	≈ 30.0 Kb	≈ 3.6 GB
n = 5; t = 3	≈ 18 Kb	≈ 6.6 Kb	≈ 13.6 Kb	≈ 38.2 Kb	≈ 4.6 GB
n = 7; t = 4	≈ 20 Kb	≈ 8.8 Kb	≈ 17.6 Kb	≈ 46.4 Kb	≈ 5.5 GB

The data presented in Table 1 was obtained for a configuration of REVS with two Anonymizer-Counter chains (and the voter submitting to both Counters). As can be easily seen, REVS offers a good data transfer performance. It also provides a good tradeoff between increased security and data transfer, about 1 GB for each additional signature required. Note that all calculations don't take in account the additional traffic generated by the communications over SSL.

Regarding the required computation and data transfer aspects, the previously presented data allows us to conclude that our prototype of REVS is efficient and can be used in large scale elections.

6. CONCLUSIONS

We have presented REVS, an electronic voting system able to perform well in faulty environments like the Internet. REVS is a robust electronic voting system based on blind signatures that tolerates failures in communications and servers while maintaining all desired properties of a voting system.

Another important characteristic of REVS is the ballot independency; which facilitates its use in any kind of elections or surveys.

The implementation of REVS was carefully designed for assuring scalability and availability in large-scale elections. In particular REVS was fully implemented in Java, and can use replication to avoid bottlenecks and single points of failure.

For future work, REVS can beneficiate from a more sophisticated anonymity mechanism. The authentication mechanism could also be substituted with one based on public keys, but only after this technology becoming largely available to guarantee the usability of the system.

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A NOVEL FLEXIBLE APPROACH TO DOCUMENT ENCRYPTION USING A MATHML EXTENSION TO THE W3C XML DIGITAL CERTIFICATE STANDARD

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ABSTRACT

The growth of electronic communication between governmental offices highlights the need for sensitive information to be transmitted securely. The constant evolution of cryptographic techniques and standards has led to a need for a flexible approach to encryption. This paper describes a framework that allows such a flexible approach and places it in the context of eGovernment.

KEYWORDS

Security, XML, MathML, Public-key Cryptosystems, eHealth, eGovernment

1. INTRODUCTION

The continuing global expansion of various e-mediated forms of human-computer discourse and trading as exemplified by B2C (Business to Consumer) and B2B (Business to Business) e-commerce and the advancement of eGovernment, has raised issues of trust and security. Indeed one of the authors of this work has reported on trust issues as they specifically relate to the human computer interface component (French and Vile 2001). Others have recently attempted to extend this work through the construction of novel conceptual models of trust and security from a user's viewpoint (Egger, 2002) or examined trust and security issues from a cross-cultural perspective (Jarnenpaa and Tractinsky, 1999). Aside from the user interface, where surface level content often engenders (or even perhaps seeks to manipulate) user trust and site credibility (Fogg et al, 2001), there is a need for e-mediated site-user discourse to be built on secure and tangible security platforms which encapsulate known security standards and protocols.

Users undoubtedly have 'rights' in an eSociety to expect 'trustworthy', 'credible' and 'accessible' site content but also to trust that their own privacy is not compromised and that in general, that site content is managed and data exchanged in a secure manner. Tangible security measures help to ensure for example, that on-line purchases as well as real time messaging and data exchange is secure, hence trustworthy, across

heterogeneous platforms. Most recently, W3C has sought to create a number of XML (Extensible Markup Language) led initiatives designed to support tangible security measures that are also inherently interoperable. Indeed, both the US Government and UK Governments have recently explicitly identified XML middleware delivery systems as being the mandatory architecture to be used to implement their ambitious eGovernment and eGIF (Government Interoperability Framework) initiatives; albeit that XML is still seen to be somewhat immature at present (GAO, 2002).

The increasing pervasive and wide influence of XML is clearly evident both within industry and academia in relation to core areas such as data/content management for e-commerce (Cagle, 2000) as well as leading edge areas such as the semantic-web initiative (Veltmann, 2002). Developing areas include, but are not restricted to: meta-data initiatives of various kinds (www.w3.org/TR/rdf-primer), RDBMS interoperability, XHTML for web-authoring, XML security and SET standards (Secure Electronic Transactions) as well as 'web-services' and electronic data-exchanges of all kinds supported by the SOAP (Simple Objects Applications Protocol). Thus XML's role as a common lingua franca for Computing as a discipline area cannot now be seriously ignored or questioned. This success story is due in part to the structural and syntactic simplicity of XML (comprising a hierarchical tree of container and elementary tagged elements) as well as the ease with which new variant dialects can be defined and established by the user community via schema definitions and namespaces. As Cagle (*ibid*) says 'the technology I am writing about today [XML] will be the plumbing for the world tomorrow'. XML, together with associated helper technologies make for an ideal form of 'plumbing' for security applications, where cross-platform support is essential, and where developers are free to self-select optimal transformational methods that are not constrained by specific languages or proprietary system considerations. Indeed, Java, JavaScript, C++, XSLT and DOM (Document Object Model) helper applications are commonly mixed and matched as required to implement XML enabled systems. It is perhaps no exaggeration to suggest that XML 'plumbing' is now central to a vision of a secure and interoperable eSociety.

This paper goes on to present a novel extension to existing XML based security standards and in so doing seeks in a small way to support a trustworthy eSociety as e-mediated forms of discourse become an increasingly ubiquitous and pervasive part of users everyday lives in the 21st century. The kind of trust discussed here centres around tangible and secure cryptosystems designed to offer high levels of intrinsic security (hence trust) for on-line activities of all kinds for which XML is seen to be appropriate. The proposed framework offers greater flexibility in the choice of decryption technique but without requiring a wholesale revision of the entire security standard itself. XML markup is to be used not only (as at present) to specify the 'envelope', message, and digital signature, but also (via MathML) to explicitly detail the decryption method. We go on to suggest and explicate the use of elliptic and hyper-elliptic curves and present a short worked exemplar MathML one way function by means of illustration. In principle, it is clear that *any* one way function may be defined and sent to the recipient of an encrypted message in this manner. However, it is suggested below that elliptic curves may well provide initial fertile territory for those seeking to use newer approaches. This is due to the intrinsically more complex function inversion and multidimensional input fields and solution spaces that elliptic curves offer.

2. CONTEXT OF USE : XML SET DIGITAL CERTIFICATES IN THE NHS

One typical application area now being explored in the UK is eHealth, (<http://www.nhsia.nhs.uk/erdip/pages/default.asp>) where it is self-evident that the privacy and security of electronic and web-mediated patient records is paramount, but where equally, timely and efficient access is needed for key stakeholder groups. These groups typically comprise key healthcare professionals (i.e. General Practitioner Surgeries, NHS Direct and Hospital Trusts) who all need to share this sensitive information across heterogeneous hardware and software environments. Various pilot ERDIP (Electronic Record and Development and Implementation Programme) related projects are now underway in the UK, with the intention for a full national roll at a later date. Similarly, other EU countries have built pilot systems to support eHealth using XML as their core (Blobel, 2001). Furthermore, the latest version of the 'H7' International Healthcare communications standard is currently being implemented using XML as a core component (<http://www.hl7.org>).

Using eHealth as an instance, it can be seen that XML based solutions are increasingly likely to form the basis of many eGovernment and indeed commercial e-mediated systems. It is therefore perhaps both prudent and timely to re-examine the security of existing approaches in the context of our earlier discussion of trust issues within an eSociety. Our paper goes on to suggest ways in which current XML standards could be usefully made more flexible. We stress though that our paper suggests no more than a tentative 'add-on' to the existing W3C XML standard for secure XML data exchange, rather than a wholesale revision. We now proceed to outline the technical basis and rationale for our suggested 'improvement' to current methods.

3. PUBLIC-KEY CRYPTOSYSTEMS

Cryptosystems fall into one of two categories: Private-Key Cryptosystems and Public-Key Cryptosystems. The former is the traditional method that has been in existence for a number of years and is also known as secret-key or symmetric-key, due to the fact that a single key is used for both encryption and decryption. It is vital that this key is kept private as anyone with the key can decrypt any encryption. A major problem, known as the key distribution problem, arises in such cryptosystems. The recipient must have a copy of the key to decrypt and issues arise concerning transmitting the key from the sender to the recipient without interception. A simple analogue of the situation can illustrate the problem. Consider Alice, who wishes to send a private parcel to Bob. She decides to put the parcel in a case locked using the key, for security which she now sends to Bob. In order for Bob to retrieve the parcel from the case he needs the key. Alice now has the problem of how to send Bob the key safely. Public-key cryptography overcomes this problem. Two keys are used in a public-key cryptosystem. One is used to lock the data and a different key used to unlock the data. Returning to Alice and Bob, Bob creates a padlock and matching key. Bob makes a number of padlocks available publicly but keeps the key to himself. Anyone wishing to send Bob a private parcel simply puts the parcel in a case using a copy of this padlock. When Bob receives a parcel, he can unlock it using the key that he has kept. The system relies on the assumption that although anybody can have a copy of the padlock, it would be very difficult to make a key for it.

In their seminal work of 1976, Whitfield Diffie and Martin Hellman (Diffie and Hellman, 1976) introduced the concept of public-key cryptography to the academic community. The concept is the same as explained in the case of Alice and Bob, only there is neither a physical padlock nor key. Rather there is a mathematical function that acts as a padlock. A number of systems have been developed that build upon this work. Any system relies on establishing an appropriate one-way function, a function easy to perform but difficult to invert. These public-key cryptosystems are generally only used to transmit secret keys for a private-key cryptosystem. That is, they provide a secure medium for key distribution.

There are essentially two bases for public-key cryptography. There is a class of one-way functions that rely on the discrete logarithm problem for the security of the private key and a class that relies on the difficulty in factoring large primes. We discuss three major cryptosystems before establishing common features and presenting the proposed framework in the next section.

3.1 The Diffie-Hellman Exchange Protocol

Diffie and Hellman presented a two way exchange that results in both parties having a secret key without risk of the message being read by an eavesdropper. The method utilises two public parameters a prime number p and a so-called generator $g < p$ such that for all $i, i = 1, \dots, p-1$ there exists k such that $g^k = i \pmod p$. If Alice and Bob wish to exchange a message using the Diffie-Hellman method, they each need a public key. Alice and Bob generate a random private values a and b in $\{1, \dots, p-2\}$ respectively, and public values $e_A = g^a \pmod p$ and $e_B = g^b \pmod p$ respectively. Then Bob can receive a message $m = g^{ab}$ without Alice ever sending a (she merely sends e_A) and therefore protecting the message from being interpreted by anyone without either a or b . All that is known to any eavesdropper is $g^a \pmod p$ and $g^b \pmod p$ but not $g^{ab} \pmod p$. The security of the system is based upon the assumption that when the prime p is sufficiently large, it is difficult to find the secret key $k = g^{ab} \pmod p$ from only $g^a \pmod p$ and $g^b \pmod p$. This is a variation on the discrete logarithm problem (DLP) and provides Diffie-Hellman with its one-way function. The DLP can be expressed as given an element g in a finite group G and another element k in G , it is hard to find an integer x such that $g^x = k$.

3.2 The RSA Algorithm

Rivest, Shamir and Adelman (Rivest et al, 1978) developed the RSA algorithm using an effective so-called one-way function, a function easy to perform but difficult to invert. It should be noted that recently British Intelligence revealed that the function had been found 5 years earlier by Clifford Cocks (Cocks, 1973) at GCHQ and indeed that his senior, Ellis, thought of the concept in 1970, some 6 years earlier than Diffie and Hellman (Ellis, 1970).

The RSA algorithm requires a modulus, $n = pq$, the product of two primes p and q . A public exponent, e , that is less than n and has no factors in common with $(p - 1)(q - 1)$ other than 1. The private exponent, d , is a number such that $(ed - 1)$ is divisible by $(p - 1)(q - 1)$. The public key is then the pair (n, e) and the pair (n, d) is the private key. As required by Alice and Bob, it is currently difficult to obtain the private key from the public key. If one could factor n into p and q , then obtaining the private key would be a very simple matter and hence the assumption that factoring large primes is difficult is central to RSA. Much research has been undertaken in this field and "number sieves" have been found (see for example, Buhler et al, 1994, or Buchmann et al, 1994) that make the task easier but no significant breakthrough has considerably weakened RSA.

If Alice wants to communicate a plaintext message, m , to Bob, she creates ciphertext, c , by performing the operation $c = m^e \bmod n$, where (n, e) is Bob's public key, and sends that to Bob. Bob retrieves m by performing the operation $m = c^d \bmod n$.

3.3 The ElGamal Algorithm

In 1985 an algorithm was proposed by ElGamal (ElGamal, 1985). It, like Diffie-Hellman, is based upon the discrete logarithm problem. The (public) parameters required for the ElGamal cryptosystem are a prime p and an integer g . The powers of g modulo p should generate a large number of elements (though not necessary all). Alice has a private key a and a public key e , where $e = g^a \bmod p$, which is where we see the assumption that the private key is difficult to obtain from the public key.

If Bob wants to send a plaintext message, m , to Alice he must first generate a random number $k < p$. He then computes $c_1 = g^k \bmod p$ and $c_2 = e^k m \bmod p$, and sends the pair (c_1, c_2) to Alice. To decrypt the message, Alice computes $c_1^{-a} c_2 \bmod p$. This is equal to m , since $c_1^{-a} c_2 = g^{-ak} e^k m = e^{-k} e^k m = m \bmod p$.

4. THE PROPOSED FRAMEWORK

We have highlighted three different public-key cryptosystems: Diffie-Hellman, RSA and ElGamal. We notice that each of these as presented are based on modular exponentiation in a ring. Each is well established and used widely in this form. There has been lately a move away from exponentiation in a ring to multiplication on an elliptic curve. Elliptic curve cryptosystems were first proposed by Victor Miller (Miller, 1986) and (independently) by Neal Koblitz a year later (Koblitz, 1987). Instead of calculating g^x , as in the three systems mentioned, the operation here is $xg = g + g + \dots + g$ where the addition is performed on a curve (see Menezes, 1995 or Blake et al., 1999). This addition is not as simple as modular exponentiation, but using this group gives the same security for a much shorter key-length. That is, it is even harder to invert modular exponentiation (at present anyhow). There exist implementations of analogues of each of the three cryptosystems of the previous section using elliptic curves instead of the modular ring.

It is inevitable that advances in hardware and algorithms will eventually lead to a reduction in the level of confidence in the security of algorithms for encryption. Many changes in government policy and acceptance of protocols have occurred over the last three decades. In the US, for example, the National Institute for Standards and Technology has in 2000 approved the use of certain elliptic curves for use with the Digital Signature Standard (NIST, 2000), a standard based upon the Diffie-Hellman protocol. In all there are 15 elliptic curves approved for use by NIST (Cipra, 2002).

Many cases are being made to advance the use of genus 2 hyperelliptic curves for the underlying group of computation (AREHCC, 2001). If this becomes the next standard to be used we can see that we will have three (major) systems, each with implementations using any of three different groups. Currently we might expect to see RSA encryption and ECRSA encryption, in time one can expect HECSRSA, and then what is

beyond this? We see that we can represent cryptosystems as a protocol (RSA, DH, etc.) along with some appropriate operation in a suitable finite abelian group (such as multiplication on an elliptic curve).

MathML is a XML specification for describing mathematics for machine to machine communication. The current version, MathML 2.0, to which we refer has been adopted by W3C in February 2001 (2nd edition December 2002). The MathML specification defines two types of elements (tags). Presentation elements are used for encoding mathematical notation and content elements used for encoding structural information. For the application in cryptography described here we use content elements as the aim is to express formulas which are evaluated by the encryption/decryption software.

Example 4.1:

The semantics of the formula $y = x^2 - 2$ using MathML content elements is as follows:

```

<apply>
  <eq/>
  <ci>y</ci>
  <apply>
    <minus/>
    <apply>
      <power/>
      <ci>x</ci>
      <cn>2</cn>
    </apply>
    <cn>2</cn>
  </apply>
</apply>

```

Note that the MathML expression is human-readable, however the authors of MathML recommend that equation editors should be used for generating this output. Several such tools exist or are under development (MathML, 2002).

The proposed framework links together the arithmetic of cryptosystems with the ability of MathML to express mathematical content. Figure 4.1 shows how cryptosystems are composed, and the levels that we use to represent encryption.

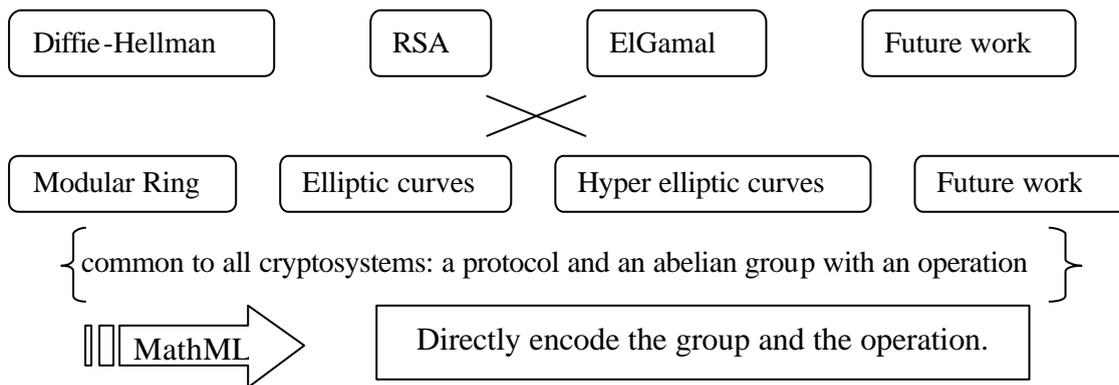


Figure 4.1. The 'layers' of a cryptosystem

Our framework involves using XML with MathML to fully and flexibly describe the cryptosystem used for encryption (and thus to be used for decryption). The current standard of MathML allows specification of mathematical content by using special tags for content markup (as opposed to tags for presentation markup). It should be noted here that using content markup tags in our case allows a wide range of basic mathematical expressions to be encoded into XML, which we can use to define the group and the operation. In the context of cryptography the group elements are vectors over a suitable ring. For instance in RSA the vector is 1-

dimensional, for (elliptic and hyperelliptic) curves it is 2-dimensional. Hence we transmit the decryption process such as $m = c^d \bmod n$ for RSA encryption, rather than sending a tag with value "RSA". We see here that transmitting the equation allows a more meaningful communication and also greater flexibility: we explicitly state that c is "operated on" d times. We would then send the operation and the group over which the operation is performed. For example, we might transmit an elliptic curve along with the set of equations (1) and (2) from section 5 to show how the operation is performed in that group. Essentially the framework uses MathML within an XML envelope to transmit:

- (a) The encryption/decryption process
- (b) The finite abelian group
- (c) The operation in that group

From Example 4.1 it is obvious that we can encode the necessary formulas for modular exponentiation and elliptic curve point addition (Blake, et al. 1999), say for the elliptic curve $y^2 = x^3 + 2x + 3$:

$$\begin{aligned} I &= (y_2 - y_1)/(x_2 - x_1) \\ x_3 &= I^2 - x_1 - x_2 && \text{for } y_1 \neq y_2 \\ y_3 &= (x_1 - x_3) I - x_3 - y_1 && (1) \\ I &= (3x_1^2 + 2)/2y_1 \\ x_3 &= I^2 - 2x_1 && \text{for } y_1 = y_2 \\ y_3 &= (x_1 - x_3) I - x_3 - y_1 && (2) \end{aligned}$$

Similarly we can express the rules for hyperelliptic curves using the explicit formulae in (Lange, 2002).

While MathML is suitable for expressing formulae it has limitations in expressing the semantics of domains. Especially the construction of a polynomial ring is not supported. However we show that the addition of one single tag, <polynomialring/> is sufficient to express the underlying group where the formulas can be evaluated.

Example 4.2:

If we wish to use the elliptic curve $y^2 = x^3 + 2x + 3$ over the finite field F121 with 121 elements, the mathematical representation is $\{(x,y) \in F121^2; y^2 = x^3 + 2x + 3\}$. We discuss first how to declare the symbol F121. For this purpose, we use a special element <polynomialring/> which constructs a polynomial ring over an already constructed ring. For the ring $Z[t]$, the MathML would be:

```
<apply>
  <polynomialring/>
  <integers/>
  <ci>t</ci>
</apply>
```

The finite field of 121 elements F121 which is isomorphic to $(Z/11Z)[t]/(t^2 - 2)$ would be:

```
<declare>
  <ci>F121</ci>
  <apply><divides/>
    <apply><polynomialring/>
      <apply><divides/>
        <integers/>
        <cn>2</cn>
      </apply>
    <ci>t</ci>
  </apply>
  <apply> <minus/>
    <apply> <power/>
```

```

        <ci> t </ci>
        <cn> 2 </cn>
      </apply>
    <cn> 2 </cn>
  </apply>
</apply>
</declare>

```

Then the set $\{(x,y) \in F_{121}^2; y^2 = x^3 + 2x + 3\}$ is implemented in XML as follows:

```

<set>
  <bvar>
    <vector>
      <ci>x</ci>
      <ci>y</ci>
    </vector>
  </bvar>
  <condition>
    <apply><and/>
      <apply><in/>
        <ci>x</ci>
        <ci>F121</ci>
      </apply>
      <apply><in/>
        <ci>y</ci>
        <ci>F121</ci>
      </apply>
      <apply><eq/>
        <apply><power/>
          <ci>y</ci>
          <cn>2</cn>
        </apply>
        <apply><plus/>
          <apply>
            <power/>
              <ci>x</ci>
              <cn>3</cn>
            </apply>
            <apply><times/>
              <cn>2</cn>
              <ci>x</ci>
            </apply>
          <cn>3</cn>
        </apply>
      </apply>
    </condition>
  </set>

```

Example 4.2 generalizes obviously to other possible domains (usually finite prime fields or finite fields of characteristic 2) over which cryptosystems are defined.

As we have seen, for current and even relatively 'new' cryptographic methods such as elliptic and hyper-elliptic curves the expressive power of existing MathML is more than sufficient. Whilst the methods themselves may be complex, the underlying mathematical expressions are in fact trivial (i.e. both human and machine readable with ease).

It is reasonable to assume that MathML will in any case evolve so as to enable any likely future cryptographic systems to be similarly described. Thus, our solution is potentially inherently upwardly compatible with any foreseeable future evolution of cryptography.

Use of MathML to send one-way functions is likely to lead (as with other XML initiatives) to the construction of suitable support tools and wider public domain support, leading to a greater awareness and

wider adoption of newer cryptographic methods in 'real' deployment environments such as eHealth. Hitherto deployments have been somewhat conservative.

The advantage of adopting the proposed method within the context of the generic framework previously described is briefly, that the sender has a choice of which one way function to be used, unlike existing implementations of the W3C XML X509 security standard. The method and framework encompass both application areas requiring high levels of intrinsic security (but which are not time critical) and those where processing speed constraints imposes lower levels of security. Of course for some this greater flexibility may not be needed or allowed by external constraints (such as standards imposed by eGovernment for example).

5. CONCLUSION

Trust and security are widely regarded pre-requisites for an eSociety, particularly in respect of the types of eGovernment systems now being increasingly deployed, such as eHealth. There is clearly a need for such systems to engender confidence and trust both for the developers and hence ultimately for the end users of such systems. Our approach offers to engender stakeholder trust in such systems by enabling developers to be a little more flexible in their choice of cryptographic system whilst nevertheless remaining in alignment with recent mainstream XML (hence interoperable) security standards. Such flexibility will increasingly be seen to form an important countermeasure to the possibility that the weaknesses that are inherent in existing tried and trusted methods will be eventually exploited. Gradual acceptance and roll-out of novel and theoretically more secure cryptographic systems such as those that consider elliptic and hyper-elliptic curves, and indeed any future ideas, is therefore necessary. This paper has suggested ways in which novel techniques can be safely rolled-out within existing security standards.

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AUTOMATED BUSINESS PROCESS INTEGRATION WITH OPENXCHANGE

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ABSTRACT

In order to meet the requirement of a broad support of inter-organisational business processes, a smooth integration into existing business applications is necessary. Standardisation initiatives such as ebXML promise to provide a framework for flexible process and data interoperability among businesses. This is used as the basis for the development of the openXchange reference architecture described in this paper. It is designed to accomplish smooth business process integration based on ebXML and standardised e-business transactions and reference processes for significant business areas.

OpenXchange will provide an extended framework for demonstration and validation of e-procurement applications within several business domains. The mapping of the ebXML framework on the openXchange Architecture shows the gaps that need to be closed before companies can perform standardised e-business transactions. The components of the openXchange Architecture will be piloted in specific business domains within pilot applications in Germany and The Netherlands.

KEYWORDS

e-Business Integration, E-Collaboration, Business Processes, ebXML, Standardisation, e-Procurement.

1. INTRODUCTION

By the manifold means of e-business the way information is exchanged both within an organisation and across organisations' boundaries is subject to constant change. The Internet enables organisations to easily exchange data, but more important the Internet offers a technology to improve inter-organisational processes.

In order to provide organisations with efficient electronic connectedness, a smooth integration into existing business applications is necessary. Formerly, this problem was solved using transaction formats of the Electronic Data Interchange (EDI) standard with their known limitations. With the pervasiveness of the Internet the XML standard came up promising to overcome the limitations of EDI. The ebXML (e-business XML) initiative promises to provide a basis for flexible process and data interoperability among businesses.

The openXchange concept is a new progressive standardisation idea to smoothen inter-organisational processes. The development of the openXchange concept is undertaken by a European consortium

(consisting of Fraunhofer and TNO among others) within the research and development project openXchange funded by the European Commission (IST-2000-28548). With regard to its implementation the openXchange concept is focusing on the ebXML initiative and the application of existing standards as far as available. In addition the project is dedicated to collaborate with standardisation bodies in order to contribute to their further development.

In section 2 of this paper, e-business is introduced with its basic concepts relevant for the work described here. Because the ebXML framework is of great importance for the developments, its concepts are clarified in a short overview in the third section. The openXchange Reference Architecture is introduced in section 4. The last section contains the conclusion and outlook of the openXchange project and further developments.

2. E-BUSINESS AND BUSINESS PROCESS INTEGRATION

e-business activities mainly aim on realising cost reduction and efficiency effects. Information systems of different organisations and companies need to be connected in order to reduce business process lead times, the failure frequency when processing external information, and the number of communication channels. In former times companies used Electronic Data Interchange (EDI) to achieve these goals. But in the long run EDI applications turned out to be very complex and expensive with the result that only major companies can afford using EDI while small and medium-sized companies are not able to participate in EDI-based communication. Moreover, EDI is not flexible enough to cope with business relationships that change frequently (Stefansson, 2002). The pervasiveness and availability of the Internet promises to overcome these obstacles. However, in order to achieve end-to-end business process integration across company boundaries standards are needed for a common understanding which information must be exchanged between business partners.

In the field of inter-organisational business process integration two areas of standardisation can be identified. Document standards specify sets of documents that are necessary for a business process. Within a procurement process, for example, purchase orders, order acknowledgements, dispatch notifications and invoices are exchanged between a buying and a supplying party. Examples for document standards are xCBL, cXML, RosettaNet Partner Interface Processes (PIPs), and openTRANS (Frank, 2001; Kelkar et al, 2002). Document standards are applications of the Extensible Markup Language (XML) specification. The standard itself is encoded in Document Type Definitions (DTD) or XML schemes. Besides document standards, there are business process frameworks that define the overlying business process that participating companies follow when exchanging business documents. Some of them emphasise the organisational aspect of a business process (e.g. UDDI; Ehnebuske, 2001) while others are clearly process oriented (e.g. BizTalk by Microsoft Corporation (2001), eCo by Adkins, J. et al (2001), and ebXML described by Kotok and Webber (2001)).

ebXML is the most comprehensive business process framework since it does not only cover multiple layers of the communication and information interchange stack but also provides mechanisms for the automation of the integration process itself (Otto, 2001). Therefore, the openXchange architecture is mainly based on ebXML specifications as described as follows.

3. EBXML OVERVIEW

ebXML is a framework standard for the electronic exchange of company data and messages needed for business transactions. It is not limited to a certain industry like many other initiatives. This implies some possible overlap with other initiatives (e.g. Biztalk), however, none of them is as broadly conceptualised.

The project ebXML, started in 1999, is led by the organisations UN/CEFACT and OASIS. Company consortiums, branch organisations, standardising agencies, consultants and world-wide users worked on the creation of a set of specifications and papers first presented in spring 2001 (Kotok and Webber, 2001).

ebXML is positioned as a framework, not as a fixed package. An advantage of a framework is that certain parts can be individually chosen according to the specific needs of a company or consortium. It focuses on interoperability on more than one level, including the messaging level. However, the definition of actual message standards is left to the individual organisations or industry associations.

Within its framework several related facilities are presented for realising an operational cross-company e-business agreement and relationship and for the development of the actual message standard. Although the support of the developments of ebXML are evolving quickly, it is definitely not yet finalised. A lot of work has to be done on the specifications of the parts of the framework. However, independent of ebXML, there is a real need of organisations to standardise and harmonise their business processes and transactions for further processing by IT-systems.

Four activities before business transactions can take place are identified and supported by ebXML (Oude Luttighuis and van Blommestein, 2002). These activities will also be described in more detail in the following sections. The four activities are:

1. Standardising of messaging and processes
2. Recording of company profiles
3. Arranging an e-business agreement
4. Run-time of e-business process

However ebXML also provides input for another period which is supposed to address the implementation of business processes into IT-systems. This aspect is not described in more detail since this idea would impede an automated integration and support of the processes.

The ebXML approach that various industrial consortiums and branch organisations arrange agreements about, first, the operational process for doing e-business and, second, the exchange of messages within this process. Accordingly, these processes should be modelled in UML using the UMM method. Next, the models are translated into the XML-format to make it possible to store them in the so-called repository. An important role within this repository play the so-called core components. These are basic elements of messages that are context-free. This means they can be used in many branches and companies, like address data of a company, unlike the operational business processes that can be context-specific. With the core components and the operational processes in the repository, the aim is to standardise the processes and messaging exchanges as far as possible. The outcome of this first activity are the standardised business processes modelled against the Business Process Specification Schema (BPSS) and stored in the repository.

Besides, individual companies have to define their capabilities with regard to preferred communication channels and interfaces by means of a profile. This profile contains information about the way (processes and messages) they are able to do business and gives a description of the technological aspects of the business processes. This company profile (Collaboration Partner Profile, CPP) is set up in the second and stored in the registry.

Based on the CPP, matching takes place to identify potential collaborative partners. The outcome of this process is a collective agreement (Collaboration Partner Agreement, CPA) about how the identified companies want to do e-business transactions. In an ideal situation, this matching process is a completely automated process. Based on this agreement e-business transactions can actually start and can be executed by serving the related business service interfaces. For this run-time environment ebXML offers some facilities, e.g. an envelope to exchange messages based on SOAP. The agreement finally defines the way in which two (or more) companies actually will perform e-business transactions as a two-party (or multi-party) collaboration.

4. THE OPENXCHANGE REFERENCE ARCHITECTURE

The openXchange project aims on the development of a reference architecture for software applications that support the automation of inter-organisational business processes. These applications are to be seen as instances of the reference. In pilot user sites the applications will be implemented and evaluated. Within the reference a method is developed which is supposed to allow a company the participation in this created environment. The openXchange approach is based on the following premises:

1. Deployment of state-of-the-art e-business standards
2. Combination of the model view and the implementation view of business processes
3. Integration of modelling and transaction time

Therefore, the openXchange project scope is twofold. On the one hand, openXchange specifies business process components for certain industries, and on the other hand, it provides the openXchange Architecture to conduct e-business in an automated manner. In order to accomplish the development task, the overall openXchange Architecture is split into the following ‘times’ (in accordance with the four basic ebXML activities; see also **Erro! A origem da referência não foi encontrada.:**

1. Modelling Time
2. Profiling Time
3. Agreement Time
4. Transaction Time

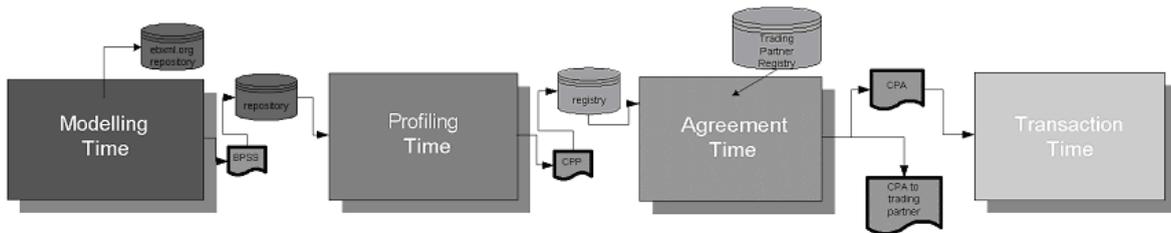


Figure 1. openXchange Reference Architecture

The following sections contain a description and an introduction of the related openXchange Architecture for these four different phases of business process integration.

4.1 The openXchange Modelling Time

The Modelling Time specifies the business process for a certain industry or domain. Due to the fact that a general standardisation of business processes is hardly possible to achieve and, moreover, not desirable, openXchange specifies sectoral sets of business process components. One sector, for example, is ‘Catalogue Based Procurement’ as it is used for indirect procurement by companies independent of their size, industry or location.

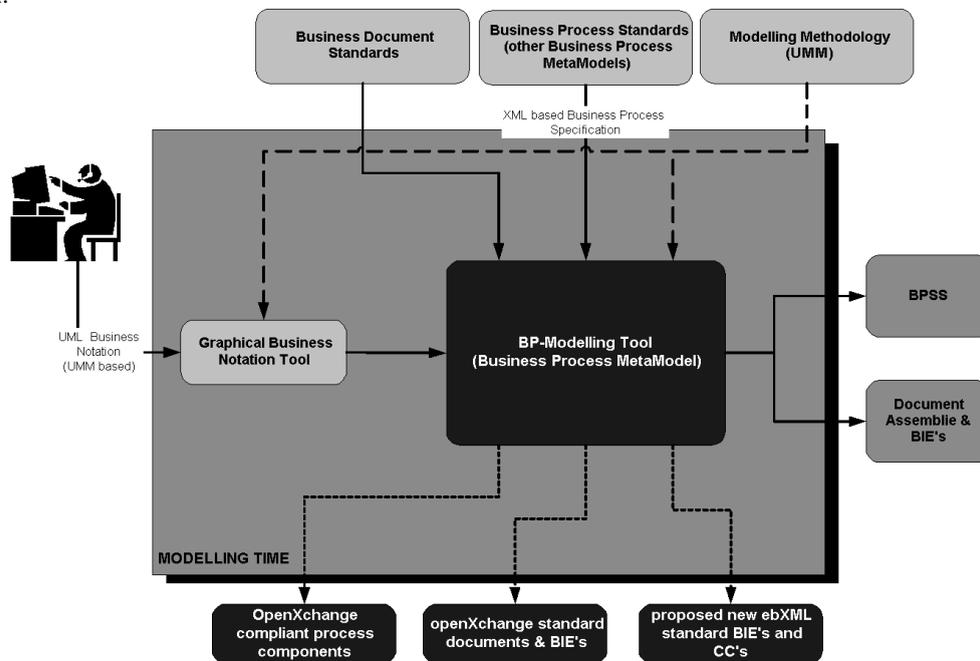


Figure 2. openXchange Modelling Time

The sets of business processes are identified and specified within the user requirements analysis of the openXchange project. The result is then modelled in UML (see Figure 2). The only component necessary for the Modelling Time is the openXchange Process Modeller. However, in this case the openXchange project makes use of existing business process modelling tools. The input for the Modelling Time is graphical, formal, or verbal information about business processes of certain industries or domains. The Modelling Time provides harmonised business process components that serve as an input for the following Profiling Time.

4.2 The openXchange Profiling Time

The main objective of the Profiling Time is the creation of a technical and business related profile of a business partner. Due to the premise that the integration process itself must be automated, i.e. be supported by information systems, the profile must be interpretable by a machine.

The result of the Profiling Time is a machine-readable partner profile (see Figure 3) that contains the following types of information:

1. Technical information about the interfaces and transport protocols the business partner uses to do e-business; this information is defined in an ebXML CPP.
2. Business process information about the number of different variants (out of the set of variants defined during the Modelling Time) the business partner supports and the specific roles of the participants; this information is stored in an 'enhanced' ebXML BPSS.

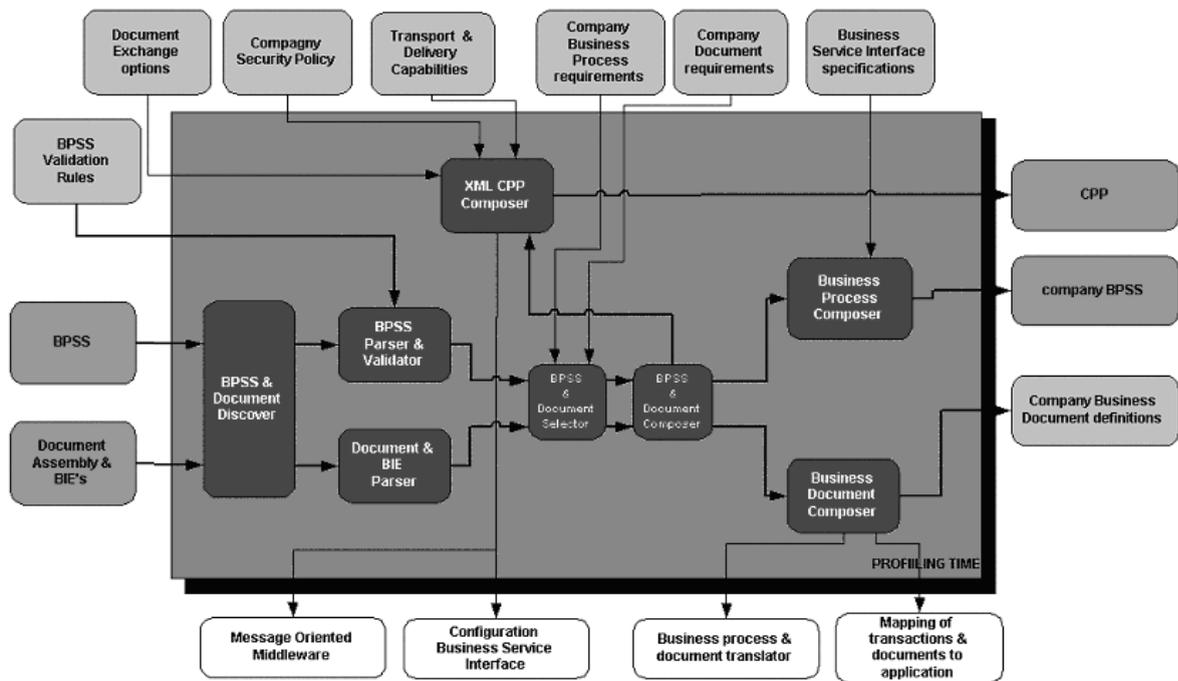


Figure 3. openXchange Profiling Time

These pieces of information take into account, for example, which is the correct HTTPS port to access a company's ERP system, which document standard is used to exchange business information, and in which sequence business documents have to be exchanged. The aim is the creation of XML documents that are in accordance with the partner profile. The system is equipped with a graphical user interface to model the specific process using predefined process components. Moreover, it allows the edition of documents to store technical information that exceeds the business process view.

The partner profile (the specific CPP and 'enhanced' BPSS) forms the basis for the following Agreement Time.

4.3 The openXchange Agreement Time

The objective of the Agreement Time is to match the profiles of two business partners and create an agreement document that describes the common business process and the circumstances under that both partners will follow the process. It is important to notice that the process of matching two profiles is carried out by an information system with a minimised proportion of manual activities. The result of the Agreement Time is a file that contains both an ebXML CPA and a common 'enhanced' ebXML BPSS. In case the two profiles do not allow a successful matching, a log file is produced that contains information about matching details, e.g. statements such as 'transport protocol incompatible'. The Agreement Time architecture, as depicted in Figure 4, consists of three main openXchange components, which are:

MergeValidator & Matchmaker

1. Evaluator & Negotiator
2. CPA Generator

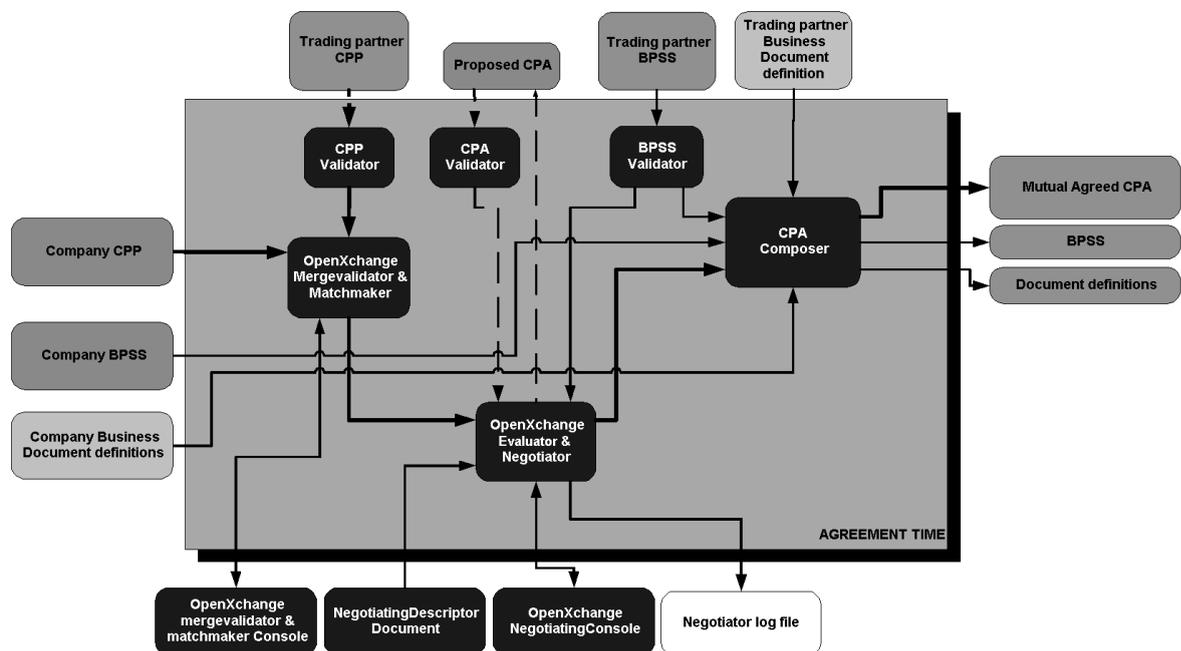


Figure 4. The openXchange Architecture at Agreement Time

After an agreement has been created successfully the information systems of both partners refer to that agreement during transaction time, i.e. when conducting e-business. In case the process was not successful the log file helps to identify the gaps between the two affected companies and therefore enables a strongly reduced customisations of the referenced IT-systems. The openXchange procedure then starts all over again from Modelling Time but then with a great chance of a successful creation of a CPA. By this means, although seen as a side effect, the openXchange Reference Architecture can be of great benefit in future cross-company business process integration projects.

4.4 The openXchange Transaction Time

During Transaction Time actual business is carried out. A triggering event (e.g. the initiation of the output determination of an ERP system) causes the instantiation of a certain business process. Business documents are then exchanged according to the business process specified in the common 'enhanced' BPSS and under the technical restrictions specified in the CPA.

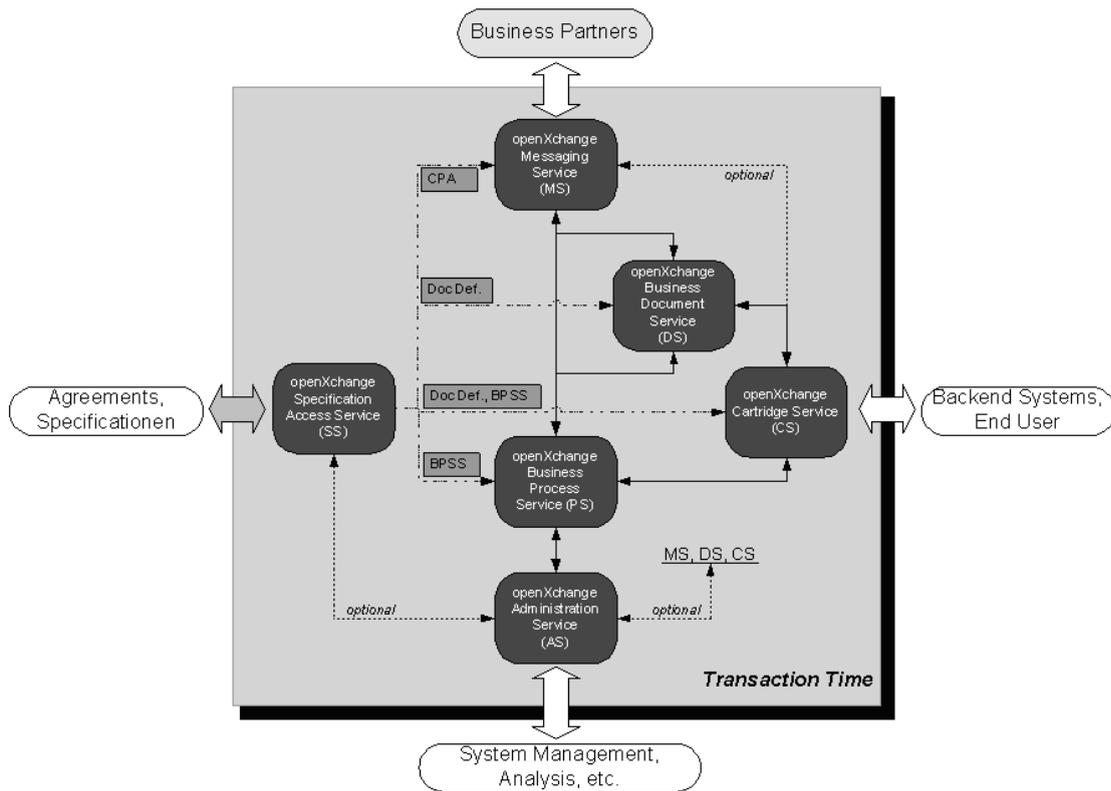


Figure 5. The openXchange Architecture at Transaction Time

At Transaction Time the architecture consists of six main openXchange components (see Figure 5):

1. 'Business Document Service' to validate single documents against specified restrictions
2. 'Business Process Service' to log and control the process execution
3. 'Messaging Service' to send and receive openXchange compliant messages
4. 'Cartridge Service' to provide the connection to existing information systems (e.g. ERP systems)
5. 'Specification Access Services' to provide access to the relevant XML documents
6. 'Administration Service' to allow administration of the environment

In this environment a business process instance is triggered by a certain event, e.g. the receipt of a purchase order in a specified XML based format, by the openXchange Messaging Service. After receipt the openXchange Document Service checks the transmitted information on feasibility and also checks whether the receipt of a purchase order is in line with the commonly agreed process. If so, the data gets posted into the underlying ERP system, which creates a response using the openXchange Cartridge Service again. The response is then formatted according to the specified formats and sent out to the business partner where the business process is continued. Therefore, an instance of the openXchange Architecture is necessary on both sides of the process to make sure that the agreed process is being followed.

5. BUSINESS APPLICATION AND IMPACT

The openXchange reference architecture is being applied at several pilot sites addressing different business areas and partial aspects of the reference in order to show proof of the overall concept. One pilot is located in the catalogue buying domain. It is designed for a flexible integration of business relationships with small and medium enterprises (SME) buying at the site of a manufacturer of electronic equipment. This pilot enables companies to serve business document standards, here e.g. openTrans for requests for quotations, orders,

etc., by on the one hand using a generic web interface to the environment or on the other hand by matching their back-end profiles to the supplier's profile and then executing the processes in an integrated environment.

The architecture allows thereby to create a 'win-win' situation for both buyer and supplier. The main advantage is envisaged to be the ability to easily adapt the profile also for newly business relationships. This will allow to cut down integration and implementation cost. In addition SMEs are enabled to use even complex XML document standards without having to implement all required back-end infrastructure by using web front-ends to the openXchange environment.

6. CONCLUSION

The openXchange project addresses one of the most important aspects of e-business, namely the integration of business processes and underlying systems. Current e-business activities often fail to provide reasonable implementation times and costs. High costs and long realisation times are mainly caused by problems of integration. openXchange provides an architecture that allows the automation of the integration process, thereby helping to reduce costs of ebusiness projects. The automation of the integration process can be achieved by providing not only a solution for the transaction time but also for the preceding phases (modelling, profiling and agreement time). In order to reduce the enormous complexity of the entire approach the openXchange approach does not support totally generic business processes but those that consist of a limited number of business process components for a certain industry or a certain domain. The modelling of the latter is based on the results of previous work of the participating project partners, e.g. the EP.NL project in the Netherlands or the E-START project in Germany. The openXchange Architecture is fully based on the utilisation of business standards such as ebXML as a process framework and document standards such as openTRANS. Continuous work on analysis, modelling and standardisation is necessary in order to meet the requirements of business processes in various other business areas for a later automated execution.

From the business perspective the most positive impact will arise only when the framework ebXML becomes widely accepted in the economy. Only when more and more companies provide their profiles and business processes complying to ebXML specifications a flexible integration of new relationships can take place. A first step into that direction is being taken by the developments of openXchange.

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E-BUSINESS AND CRM: DIRECTIONS FOR THE FUTURE

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ABSTRACT

Customer Relationship Management (CRM) is an important business activity that started in the 1980s to provide business customer interaction tracking, at a time well before the development of any form of B2B or B2C systems. These old-style CRM systems provided a much-needed way of maintaining a permanent record of important data and links with a company's customers, usually via telephone interactions with call and help centers. The emergence of B2C and B2B in the 1990s provided yet another important channel of interaction with customers and companies then had to decide what level of integration was needed between the "old" style CRM and the newly emerging Web interaction systems. The purpose of this paper is to review the current state of development of CRM / Web based Customer Interaction systems and explore what more needs to be done in the future to provide eBusiness support and multichannel solutions that allow organizations to manage, synchronize, and coordinate customer interactions from all sources and across all channels – over the Web, using call centers, and via field sales, and service personnel. A modified Technology-to-Performance Chain model is presented to explore the dynamics of implementing complex IT projects such as CRM and to explain why these systems continue to present problems in their deployment.

KEYWORDS

CRM, Customer Relationship Management, eBusiness, eCommerce

1. INTRODUCTION

Customer Relationship Management (CRM) is an important business activity today, and it has attracted attention from throughout the IT industry. It started in the 1980s to provide customer interaction tracking at a time well before the development of any form of B2B or B2C systems. These old style CRM systems provided a much-needed way of maintaining a permanent record of important data and links with a company's customers, usually via telephone interactions with call and help centers. They allowed companies to treat important customers appropriately and empowered the company's primary contacts with customers to be able to respond to questions by providing all relevant customer data effectively. The emergence of B2C and B2B in the 1990s provided yet another important channel of interaction with customers. It was at that time, that companies had to decide what level of integration was needed between the "old" style CRM and the newly emerging Web interaction systems. One of the leading developers of CRM was the Siebel Company and over the years it has also developed the new CRM-type software to incorporate multichannel capabilities including e-Business applications. Siebel's current corporate web site claims that its new Siebel 7.5 CRM system is "... the only true multichannel solution that allows organizations to manage, synchronize, and coordinate customer interactions at all touch points across all channels – over the Web, using call

centers, by field sales and service personnel, and channel partners. The purpose of this paper is to review the current state of development of these CRM and Web Customer (B2B and B2C) interactions and to explore what more needs to be done in the future to provide such seamless coordination. It also uses the Technology-to-Performance Chain model to explain CRM industry developments.

2. DEVELOPMENT AND USE OF CRM SYSTEMS

Most observers trace the beginnings of modern CRM systems to two books written in the early 1990s (see McKenna 1991; Peppers and Rogers 1993 for a good summary of the origins of CRM). However, even before this era, many companies in the 1980's had realized the need to coordinate the communications with and data collected about its customers. Even though the term CRM was not widely used until the 1990s, many companies had developed home-grown systems to perform similar functions. Several business software developers realized the commercial opportunity of addressing this specific functional need and hence the emergence of CRM packages in the early 1990s. By the year 2002 this young segment of the software industry had delivered mature revenue levels and Dataquest forecasted the 2002 CRM market at over \$25 billion, and Forrester's (www.forrester.com) 2002 estimate reached an even higher level of over \$43 billion. Numerous independent research studies support the vision of CRM Systems as a market worth tens of billions of dollars:

- A 2000 study of 1,500 companies found that 91 percent had or planned to deploy a CRM solution (TDWI 2000).
- According to a report by eMarketer.com, Harte-Hanks Market Intelligence found 45,807 web sites with some sort of CRM and/or ERP.
- Reveries.com reported on a study of US Marketing Executives: if the executives had an unlimited budget they would spend 28% of their marketing dollars on CRM.
- In a survey of 96 global firms, 52% had implemented a CRM solution.

2.1 Emerging Problems with CRM Development and Implementation

By the year 2000, it became clear that all was not well in the CRM world, and there began to be numerous reports of vendor problems that resulted in a downturn in that segment of the IT industry. For example, CRM provider Chordiant reported a 2002 2nd quarter revenue drop to \$15 million from the previous year's \$18 million. E.piphany's second-quarter revenues fell to \$19.4 million from \$32.2 million and Kana software Inc, AskJeeves Inc., Applix Inc. and Aspect Communications Corp. all told similar stories of market segment deterioration (see: Callaghan, 2002 for details of these case situations).

As IT budgets were scaled back, many companies found themselves committed to contracts for major CRM projects that were proving to be very problematic and expensive. Publicized case studies of successful CRM implementations are common. However, the statistics show a much more pessimistic story. The Gartner Group indicates that up to 70 percent of CRM implementations fail to meet basic company goals (Davis 2002). In a March 2001 survey by the Data Warehousing Institute, only 16% of the survey population felt their CRM had exceeded expectations, and 41% considered it a complete flop (Almquist, Heaton et al. 2002). An IDC survey stated that less than 35% of the surveyed companies felt that expectations had been met and in the banking industry (an early adopter of CRM) only 20% of banks felt it had raised their profitability (as reported in: Ebner, Hu et al. 2002).

These high failure rates do not necessarily mean the concept of CRM is flawed as the failure rates for all large IS projects are depressingly similar. McKinsey reports that about 65% of large projects are stopped, and 21% are delayed (Ebner, Hu et al. 2002). CRM projects clearly qualify as large projects as some implementations run over 100 million dollars (Gillies, Rigby et al. 2000; Ebner, Hu et al. 2002). The most commonly reported reasons for CRM failure often are listed as:

- Insufficient senior sponsorship
- Lack of business strategy
- Unclear goals
- Process redesign required
- Poor system design

- Solution requires more than technology
- Focus on key elements
- Cross-organizational support needed
- Need to achieve early successes and build on them
- Lack of a pre-test
- Organizational re-alignment needed

The indication is that the problems reported have as much to do with our inability to manage complex IT projects as they do to the concept of CRM. However, since CRM has proven so important, it is worthwhile to understand CRM-specific concerns regarding these issues. A model of a system's fit and utilization will be used to analyze these events.

3. TECHNOLOGY-TO-PERFORMANCE CHAIN MODEL

The Technology-to-Performance Chain model (presented in: Goodhue and Thompson 1995) provides us with a useful handle on the dynamics of CRM. This TPC model was originally proposed as a merger of two previous models, the Utilization model and the Task-Technology fit model. Figure 1 shows the model as modified for this discussion.

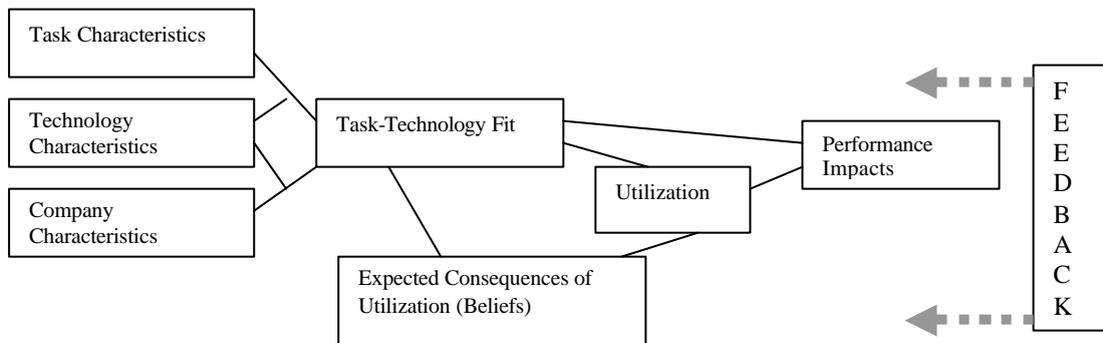


Figure 1. Modified Technology -to-Performance Chain Model

The original model was applied at an individual level, but it will be used here for a company level discussion. The conversion to a company model requires that *Individual Characteristics* be replaced with *Company Characteristics*. Originally, *Individual Characteristics* referred to training, computer experience, and motivation. *Company Characteristics* will refer to the IS environment as it pertains to the CRM decision. The IS environment includes legacy systems, and technology competencies within the company. In addition, external interfaces, such as EDI interfaces and inventory feeds from suppliers, should be considered in the IS environment. The original "individual" characteristic of motivation will be included as it relates to culture, but organizational/political motivation issues are more appropriate to the area of *Expected Consequences of Utilization*, as we will discuss later.

The model identifies three drivers of task-technology fit, namely, Task, Technology, and Company characteristics.

3.1 Task Definition

Arguably, the industry's task definition has not been well developed. At DCI's 2001 CRM conference Mike Cleary, an *Interactive Week* writer stated that the industry had no focus, and Gerhard Gschwandtner, publisher and founder of *SellingPower* magazine stated that there was no industry consensus as to the definition of CRM. The confusion was still evident at DCI in 2002. (Davis 2002). Additionally, Gartner Research shows that 85% of companies that buy CRM software pick the wrong tools because they fail to

define their business objective (Almquist, Heaton et al. 2002). The problem may be that the industry level task definition is so broad that it does not provide sufficient guidance to implementing companies.

An industry's early evangelists will use a broad, inclusive approach to build a critical mass among the press, vendors and adopters. Some analysts have defined CRM as any system that interacts with the customer. Unfortunately, such a broad definition leaves us with an unmanageable situation. Consider the TPC model, and the question: *what is the task we are trying to manage?* Once an industry reaches a critical size the goal needs to shift from nurturing and building to managing and focusing, and at \$25 billion per year in revenue, the CRM industry has clearly reached that stage in its lifecycle. The industry needs to unite behind a definition of the problem it is attempting to solve.

In order to develop this definition we will examine the origins of CRM and we see that two trends launched the industry. One involved the development of individualized marketing, and the other involved the proliferation of sales channels to the customer.

Individualized marketing for each customer gained its focus in the early 1990's under the titles of relationship marketing and one-to-one marketing (McKenna 1991; Peppers and Rogers 1993). These marketing gurus advocated treating each customer uniquely. In the lexicon of Rogers, the focus was narrowing from mass marketing → target marketing → micro-marketing → 1:1 marketing. Products, service levels, and promotional offers could vary for each customer. The key elements of the strategy included the ability to understand each customer's unique needs and the ability to recognize specific customers each time they interacted with the company. It was believed that relational database technology would allow companies to treat customers individually, even if the company had millions of customers.

As the interest in personalized marketing emerged, a contrary trend was impairing the abilities of large companies to relate to their customers, namely the emergence of the business unit. In the 1980's and 1990's companies attempted to break massive functional organizations into smaller, nimbler geographic or product business units. Each business unit had its own sales channel to its customers. The introduction of the Internet in the 1990's created yet another sales channel to customers and this often resulted in a customer's total business being spread over various business units within a company.

The two trends—a desire for relationship marketing versus a proliferation of sales channels—created a conflicting situation. It was difficult to understand a customer's needs and value when the customer interactions were scattered across various channels. These trends formed the building blocks for CRM. Therefore, we find that CRM initiatives have at least one of two requirements: 1) The desire to build ongoing, customer-specific relationships; and/or 2) The desire to consolidate customer activity across sales channels.

Putting these two trends together we can develop an initial task definition for CRM, that is: providing information across all customer/prospect touch points so that the company can recognize the unique needs of each customer/prospect, regardless of the touch point utilized.

3.2 Technology Definition

Let us consider how this task definition was translated into technology via vendor solutions. The technology portion of the task/technology picture focused on data warehousing and management. The goal was to gather customer information across sales channels for the purpose of calculating the customer's total value to the company. This data could also be married with external data sources such as credit reports and geocoding to give a complete picture of the customer. Furthermore, sophisticated database technology allowed companies to easily pull together disparate information types into a unique profile for a given customer. These data warehouses provided analytic tools to help companies determine lifetime customer value. As CRM data warehouses were implemented, the industry realized that something was missing. This realization acted as the feedback loop of the TPC model to trigger a modification of the task/technology definitions.

3.3 Task and Technology

Many companies found themselves with elegant data warehouses, but with existing processes and systems that were unable to use the data. The industry has more recently recognized the need to tie the CRM databases to fulfillment systems using business process reengineering (Almquist, Heaton et al. 2002; Crosby and Johnson 2002; Davis 2002). The modified goal is to ensure that the data collected results in different

experiences for different customers. Evidence of an industry change can be seen in the apparent turmoil among the industry vendors. Earlier we discussed vendor revenue shortfalls of up to 40%. At first glance this might indicate a dissolving market, but a broader investigation reveals that these traditional CRM providers are being replaced with newer entrants. The Enterprise Resource Planning (ERP) powerhouses (SAP, PeopleSoft, and Oracle) all appear to be emerging as new leaders in the CRM marketplace. According to AMR Research, SAP's CRM revenue grew 138 percent last year to \$533 million, and was expected to nearly double to \$998 million in 2002 (Myron 2002). These ERP vendors provide solutions that are pre-integrated into their own respective ERP packages, thus providing integration into back-end processes.

Alternatively *traditional* CRM vendors have worked to increase the interconnectivity of their CRM packages. The Gartner Group (Moaz 2002) forecasts the emergences of web services interfaces in CRM packages and states that these interfaces will allow packages to interface with independent components to enable a best of breed approach to CRM and enterprise solutions. In this vein, Siebel (the leading CRM vendor) and other 'pure play' CRM vendors have championed web services interconnectivity. They expect that the promise of future connectivity via this emerging standard will convince customers of the integrative capability of the CRM solutions.

The evolution of CRM task and technology from broad descriptive systems to process changing solutions has helped the industry focus on its critical success factors. A process focus allows each solution to be tailored to the needs of each implementing company. Our definition of a CRM task now looks like this: *providing tailored experiences to each customer/prospect through all possible touch points*. The key difference is the intent to provide unique experiences for each customer, not just to describe customer differences.

3.4 Task Definition Refinement – Looking Forward

However, this task definition still leaves us with a gap when applying it to a specific company. In order to understand this point, we will use two hypothetical illustrations. In one case consider a grocery store. In the other case, consider a company that sells equipment to electric utilities.

The *grocery store* sells standard commodity items to a mass market in a fixed geographic region as well as via the web to its delivery area. There are millions of customers and prospects in the region. Identical products are sold at competing grocery stores. Repeat customers are common and customers will exhibit certain buying preferences that are maintained over time. Because of the market size and because of employee turnover, personal relationships between employees and customers are not common. The revenue per transaction is relatively small, but repeat purchases can lead to a significant lifetime customer value. The profit margin per sale is small. Most marketing initiatives are funded by suppliers: the suppliers create special offers for consumers, and even supply advertising funds to market those offers. Competitors have access to the exact same offers.

The *equipment manufacturer* serves electric utilities in the United States. All of its customers and prospects can be listed on a few sheets of paper. A handful of sales representatives make personal visits to each customer. Each customer is a company that consists of a network decision makers and influencers. The sales representative for a customer has a personal relationship with all of the key personnel in the purchasing company. Multi-million dollar custom bids are developed for each sales opportunity. A successful sale results in a custom manufactured and installed piece of equipment. Although competitors exist, the company has unique product features vis-à-vis the competition. Product margins are high and significant budgets exist for promotions, incentives, personal sales visits, trade shows and more.

The CRM industry is full of consumer marketing examples such as our grocery store. Business to business implementations have received much less attention. Let's consider the appropriate CRM solution for our equipment manufacturer. Issues for the direct sales company include: 1) ensuring each representative visits the minimum set of people (job titles) at each customer company; 2) determining minimum information gathered about each customer; 3) sharing customer information with support and service personnel; 4) providing information handoff in case of personnel turnover; 5) providing bid/proposal tracking and document management; 6) linking custom manufacturing and installation processes to bid terms for product delivery; and 7) making available *best practices* bid documents as core materials for new custom bids.

Clearly, this CRM system is quite different from that required by the former, consumer-orientated grocery store.

This illustration points to an anomaly in the CRM industry. Most articles begin with a broad definition of CRM applications: from small garages to the largest corporations, everyone needs CRM. However, the articles then focus on consumer marketing companies. In effect, many articles assume a task definition such as this: *providing each consumer a tailored experience through all possible touch points*. The problem is over-generalization. The introduction and discussion of implications assume a global scope, but the conclusions are actually derived from only on a few cases. This consumer versus big-ticket business dichotomy is not the only difference that may exist between companies. Following are company dimensions that may affect the task definition and thus the appropriate technology for CRM:

- **Market Size:** Consumer Market < == > Single Customer
- **Market Composition:** Business < == > Consumer
- **Channel Options:** Direct sales, Internet, 3rd Party Distributors, Retailers, ...
- **Sales Relationships:** Automated < == > Interpersonal
- **Product Profitability:** High < == > Low
- **Product Diversity:** Thousands < == > Single Product
- **Product Customization:** Standardized < == > Customized
- **Sales Frequency:** Reoccurring (Utilities) < == > Infrequent (i.e., Automobile)
- **Delivery Method(s):** Internet, Shipping, Personal Services (Barber, Doctor)
- **Product Sourcing:** Manufacturing, 3rd Party
- **Sales Amount per Purchase:** Millions of dollars < == > Cents
- **Salesforce:** Centralized < == > Distributed
- **Geographic Coverage:** 1 – store < == > worldwide

As this list shows, the characteristics of companies that need CRM can vary significantly. Changing dimensions can even completely reverse a company's CRM activities. Since most current research does not explicitly address these dimensional differences it must either offer overly broad findings, or offer findings that may be misleading to some affected areas. Now that the industry has reached over \$25 billion per year it may be time for research to consider the different market segments that make up the CRM market. Future research may find it useful to define these segments via dimensions similar to those above.

Before we leave this topic, we would like to make one more comment on how these segments fit into the TPC model. As we have modified it, the TPC model is a company level model, not an industry model. The model would be tailored to each company in order to describe its specific situation. Differences between companies can occur at both the Task level and at the Company Characteristics level as well as the Expected Consequences of Utilization in the next section. Company Characteristics include implementation level details of a company: existing hardware; network infrastructure; legacy systems; IS staff size and training; and company culture. However dimensions such as those above are more strategic or structural and they are more appropriately defined at the task level.

4. EXPECTED CONSEQUENCES OF CRM UTILIZATION

Our discussion has concentrated on the first tier of TPC nodes; those that impact the task/technology fit. For the next level we examine the *Expected Consequences of Utilization*. This node encapsulates two types of expectations. On one level are the expected benefits of the CRM implementation while at the other level are the consequences of those benefits. The former issues are well discussed in the literature. The latter issues include some of the most severe problems affecting CRM today. In the CRM situation a problem has occurred because the scope of the effort is larger than initially understood and this can be traced to an initial vision of CRM as a Marketing initiative. CRM was a data mining effort utilizing a marketing-focused data warehouse, and thus, a Marketing emphasis was logical. Many people still see CRM as a marketing-led initiative, and one study revealed that 51% of CRM initiatives were marketing-led efforts (Hapoienu 2002). However, the scope of CRM has spread as the industry has encompassed fulfillment issues and process reengineering. For example, at a consumer marketing company, CRM will eventually affect collections, repair services, distribution, manufacturing, and potentially even external company partnerships. Because of its spreading scope, many experts have suggested CRM cannot be successful without an accompanying

organizational realignment (Gillies, Rigby et al. 2000; Winer 2001; Crosby and Johnson 2002). Industry studies have also referred to problems with a lack of cross-functional planning, leadership gaps, and a lack of business strategy (Davids 1999; Gillies, Rigby et al. 2000; Almquist, Heaton et al. 2002; Davis 2002; Ebner, Hu et al. 2002). It has been shown that systems that change job roles can generate organizational and political resistance. Since CRM changes strategy and organizational structure across functions, assigning its leadership to any one functional group (such as Marketing) is likely to result in resistance from other impacted areas. In order to address these issues, CRM sponsorship should come from senior management at a level above the impacted functional groups.

4.1 Performance Impacts

Reports are that from 20% to 35% of the companies achieve their CRM goals. These reports come from various sources including: The Garner Group (Davis 2002); International Data Corporation (Ebner, Hu et al. 2002), Insight Technologies (Anonymous 2001), and McKinsey (Ebner, Hu et al. 2002). Although individual companies will continue to achieve CRM success, there may be economic bounds limiting the ability of CRM to achieve a greater success rate. The problem is that CRM has been too successful, and it has become a competitive necessity for most companies. According to a 2000 study by The Data Warehousing Institute, 91% of 1,500 companies had CRM or planned to deploy one (Goodhue, Wixom et al. 2002). When an initiative becomes so popular that it is adopted by an entire industry, then its competitive advantage is lost.

One other problem with linking CRM and revenue increases comes in providing evidence of a causal relationship. If 20% of the firms in an industry achieve revenue success with an installation of CRM, the relevant question to be asked is: *are those the same 20% that would have achieved success without CRM?* Some observers use customer satisfaction to track CRM success but it is not clear whether industry-wide CRM adoption will increase customer satisfaction, or whether it will raise expectations without affecting satisfaction. For an example of this second phenomena consider catalog sales versus the internet. For many years, the catalog industry had set expected delivery times at four to six weeks. Internet newcomers set delivery standards at anywhere between one day to one week. Customers now complain if delivery time increases beyond one week, but it is not clear that the shorter delivery times have had any lasting impact on satisfaction. Instead, the increased service has become the normal expectation. Future research studies need to more carefully examine the relationships between CRM, revenue increases, and customer satisfaction levels, and these changes should be tracked over time as new expectations are set.

CRM can also achieve payback through cost reduction. One version of cost saving occurs in reduced customer acquisition costs. Increasing sales to existing customers comes at a lower cost per sales dollar than acquiring new customers. The problem is that this still faces the industry saturation trap. If you continue to acquire customers normally, and you gain greater share of available revenue from existing customers then you are eating into the total market and your success means another's failure. You could switch your marketing strategy to concentrate on focusing on current customers, and reduce your acquisition of new customers, but for this latter strategy to be effective on an industry-wide scale there must be in effect a "gentlemen's agreement" to leave each others' customers alone. Not only is such an agreement illegal in the United States, but game theory would show that these agreements rarely continue without outside constraints.

Another potential cost-saving is in CRM efficiencies. These savings would be primarily due to better information availability in customer service. For example, data entered through the web could be retrieved by a telephone operator, thus reducing the need for the data to be reentered. There is an area where CRM could help out all industry implementers. However, the savings may not be large enough to justify a multi-million dollar expense.

The forgoing discussion does not mean that an individual company should not pursue CRM. In fact, many companies (about 20% of them) will achieve great success with CRM. Arguably, those 20% will be the only profitable ones in their respective industries but to be successful this may be needed to be an industry leader. What this discussion does mean is that it may be difficult for the entire industry to have a high success rate. It also demonstrates that a company cannot guarantee success merely by implementing CRM: each CRM adopter must in essence do a better job than its competitors to achieve higher CRM success. At this time, it is not clear if an adequate CRM implementation has real value and it may be that some type of CRM becomes a competitive necessity, or it may be that the investment in a mediocre implementation never pays off

compared to those who invest their funds in other, non-CRM initiatives. This tradeoff will require further research.

5. CONCLUSION

The CRM industry has leapt rapidly from concept to maturity. In its maturity it is experiencing the same problems that we see in other large software system development initiatives. The Technology-to-Performance Chain model provides an interesting way of analyzing the industry's processes. The industry has found it important to seek senior management sponsorship as CRM has grown from a marketing initiative to a cross-functional effort that interacts with business strategy, and affects the organization structure. In order to provide relevant insight, we need to focus on individual market segments in the CRM industry since the task definition across segments may vary widely. Finally, more research is needed to determine how to measure the success of a CRM system independent of the other activities of a company.

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E-GOVERNMENT THROUGH PROCESS MODELING: A REQUIREMENTS FIELD STUDY

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ABSTRACT

e-Government offers its constituency the hope of engaging in government interaction at any time from any place. This has been slow to materialize. We believe this is due in large part to the complexity of government processes. This paper reports experimental field study evidence that a rigorously defined process modeling language can accurately map this complexity. It introduces Little-JIL, a rigorously defined process modeling language. It then reports experience using this language to capture government processes for an e-Government system to allow online license renewals for the government of Massachusetts. These processes were previously described using Use Case methodology. The errors and shortcomings identified provide opportunities for a more correct and efficient implementation of these processes. The paper concludes with a proposal for improved e-Government development methods.

KEYWORDS

e-Government, Process Modeling, Field Study, Use Cases

1. INTRODUCTION

e-Government offers its constituency the hope of engaging in government interaction at any time from any place. This has been slow to materialize (Fountain 2001). We believe this is due in large part to the complexity of government processes. This paper reports experimental evidence that a rigorously defined process modeling language can accurately map this complexity.

Government processes involve systems of people, organizations, computational systems and legal constraints. Even the most routine processes can be very complex. The driver's license renewal processing may appear simple when the applicant encounters little difficulty, but in actuality the process must allow for dozens of special considerations such as clerical errors, withdrawal and resubmission of the application, and handling issues relating to payment. Hidden from the applicant are the large numbers of activities that take place behind the scenes to ensure accurate processing. Additionally, most existing processes are defined in natural human language, if they are defined at all. This leaves open room for misinterpretation that can lead to process inefficiencies and errors. Because of this, a considerable amount of research has been focused on the development of languages and formalisms to define processes (Katayama 1989; Kaiser et al. 1993). This work has served to emphasize both the difficulty and the importance of research in this area.

We proposed in earlier work that processes are a form of software that is amenable to programming using appropriate languages (Osterweil 1987; Osterweil 1997). We suggested that processes can and must have well-understood requirements, which can then be used as the basis for the design and coding of processes meeting those requirements. Our success within these lines of research has led us to believe that these approaches can be of substantial value in capturing government processes. This work leads us to a hypothesis:

Process Modeling Hypothesis: e-Government processes can be represented clearly, completely, and precisely through rigorously defined modeling formalisms.

The evidence presented in this paper shows the benefits that can be achieved through modeling with an appropriate formalism. We first introduce a rigorously defined process modeling language. We then report our experience using this language in capturing government processes for an e-Government system. The

errors and shortcomings identified provide opportunities for a more correct and efficient implementation of these processes. We end the paper with a proposal for improved e-Government development methods.

2. THE PROCESS PROGRAMMING LANGUAGE

To test our hypothesis, we employed a process modeling language designed to capture the characteristics and properties needed for the effective representation of complex man-machine processes. The importance of explicit process representation has been recognized in such diverse domains as manufacturing, where product quality is commonly attributed to process quality; software development, where there exists a strong emphasis on software development process studies; management, where there has been a strong emphasis on business process reengineering; and, recently, data mining, where there is an effort to define a cross-industry standard process for analyzing large data sets. We contend that process representation is no less central in e-Government.

Many languages and diagrammatic notations (ICSP1 1991; ICSP4 1996) have been evaluated as vehicles for defining complex processes. Osterweil (Osterweil 1986) suggests that processes be defined using a procedural language (Kadia 1992; Sutton Jr. et al. 1995) and be used to specify how tools are to be integrated to support software development. More recently, workflow (Paul et al. 1997; WACC-99 1999) and electronic commerce (Grosf et al. 1999) communities carried out similar research. This work has shown that various types of diagrams aid human understanding of processes, and various types of languages can provide the semantic rigor needed to support the verification and executability of processes to varying degrees of certainty. However, no proposals are sufficient to meet all of the challenges of clear, precise, detailed process definition. The principal failings of these earlier approaches include inadequate specification of exception handling, lack of resource management, limited concurrency control and inadequate support for artifacts.

This work has indicated that the central questions of process representation concern how to build languages that are precise and detailed, while still remaining human-accessible. Central to this is the identification of both high-level, domain-specific abstractions and visual depictions that are clear and intuitive. Osterweil has studied these issues for over 15 years, having produced a sequence of process definition languages (Osterweil 1986; Sutton Jr. et al. 1995; Sutton Jr. and Osterweil 1997). This work led to the Little-JIL process programming language (Cass et al. 2000). We believe that we have in Little-JIL an example of a language that incorporates a promising set of such abstractions and appropriate depictions. Thus, we propose to use Little-JIL as a basis for our study of the properties and characteristics necessary for a language to be an effective vehicle for the definition and analysis of government processes.

Little-JIL was developed to coordinate software development processes (Wise 1998). It has additionally been used to define complex processes in robotics, data mining, ecommerce and complex data analysis processes (Jensen et al. 1999). These process definitions have generally been clear, detailed, and precise. Thus, we will use Little-JIL as the starting point in understanding what is required to effectively specify e-Government processes. The current version of Little-JIL incorporates multiple features that make it well suited for representing such processes. Space limitations prevent presentation of full details about Little-JIL (the details can be found in (Wise 1998)). We instead suggest key language features through presentation of an example.

The process shown in Figure 1 is based on one of the license renewal processes for the Commonwealth of Massachusetts (Sondheimer 2002). Process steps in Little-JIL are represented visually by a step name surrounded by several graphical badges that represent aspects of step semantics. (Note, most data declarations have been omitted from the figure for brevity.) The left-most element in the bar below the step name indicates how substeps are to be executed. In Figure 1, for example, the top-level step, Process License Renewal Application, uses an arrow as a sequential badge, indicating that substeps are executed in order, left to right. In contrast, the Handle Bond Expiration step shows a parallel badge (the two parallel lines), indicating that the substeps may be performed simultaneously.

Each Little-JIL step has an execution agent. By specifying the agent for each step in a process, Little-JIL explicitly identifies the participants in the process, and their responsibilities. This is a key vehicle for specifying the precise ways in which participants are to coordinate their activities. In the process in Figure 1, there are two agents: the licensing authority (specified at the root step and as the default for all its

descendants) and the applicant (explicitly stated). Thus, the only part of the renewal process that the applicant must perform is Review Disclosure.

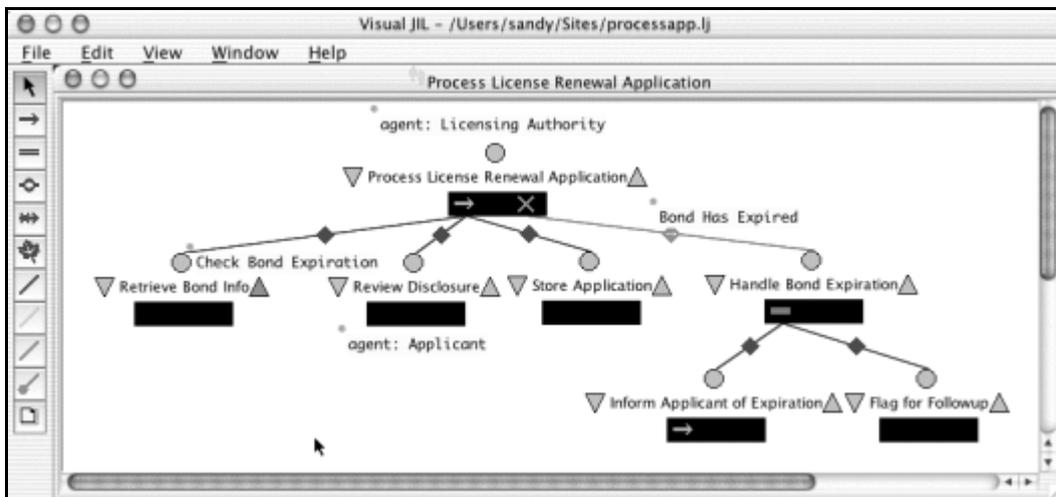


Figure 1. Example of Little-JIL process definition

A Little-JIL step may also have a prerequisite and/or post requisite, represented by triangles on the left and right of the step name, respectively. The body of the requisite is a separately specified step (not shown in our figure) possibly containing multiple substeps. This feature supports the ability to program processes that perform internal runtime checks for the validity of evolving results. When exceptions are thrown, exception handlers may handle them elsewhere in the process. Exception handlers are attached to the right side of a step bar (e.g. Handle Bond Expiration is an exception handler attached to the Process License Renewal Application step.) Exception handlers may be simple or complex subprocesses, represented by additional substeps, and may integrate with the nominal control flow in multiple ways. This affords latitude in responding to unexpected results.

Experience to date suggests that Little-JIL is effective in supporting the definition of executable, verifiable, repeatable, and adaptable man-machine processes. Thus we are comfortable using this language as the initial basis for our exploration of the semantics and features most effective in a language for defining e-Government processes. Documentation, as well as Little-JIL and associated tools, is available for distribution on the Internet at <http://laser.cs.umass.edu/>.

3. THE FIELD STUDY

The United States Commonwealth of Massachusetts Office of Consumer Affairs and Business Regulation (OCA) is responsible for the administration of hundreds of various types of licenses, permits and registrations (henceforth called “licenses”). OCA is chartered to develop an online license renewal (OLR) system.

Hundreds of types of licenses are projected to be regularly renewed in Massachusetts in areas from banking to healthcare. Given the hundreds of licenses expected to be renewed, coupled with the approximately 500,000 current licensees, the potential exists to provide service to a significant number of Commonwealth citizens and businesses through the implementation of an OLR function on the Mass.gov portal. The hundreds of licenses to be implemented also means some substantial challenges in achieving this vision.

The authors acted in a consulting capacity to OCA in reviewing and assessing agency business processes as part of the Commonwealth of Massachusetts’ OLR project requirements gathering phase. OCA chose the UML Use Case formalism as its vehicle for requirements specification. Use Cases use natural language, e.g., English, to list the steps of processes. They attempt to capture the main flow of a process, as well as exceptional behavior and other requirements concerns. They are very flexible and can be easily applied at

different levels of specificity (Kulak et al. 2000). OCA's effort focused on producing Use Cases for the OLR application. They interviewed subject-matter experts and management and went through numerous revisions of material with agency teams and OLR Steering Committee members. These Use Cases documented the many agency business processes. The OCA began forwarding these processes to UMass as they were completed.

We began our part of the project by surveying the Use Cases we received. We then selected a representative set of those Use Cases and translated them into our process modeling language, Little-JIL. This allowed us to utilize Little-JIL's expressive power and its rigorous semantics to reveal any points of concern in the Use Case specifications. It also forced us to examine specific aspects of the Use Case definitions, highlighting possible inconsistencies in the content. We focused on a total of eight Use Cases that described seven licensing processes belonging to two agencies, the Alcoholic Beverages Control Commission (ABCC) and the Board of Registration in Medicine (BORIM). These processes covered a broad range of activities related to license renewal, including committee interaction, management oversight, interaction with outside agencies, and manipulation of real-world artifacts. They represented approximately 20% of the complete set of processes for the two agencies, required 45 pages in Use-Case form, and were translated into a total of 52 Little-JIL diagrams. To achieve a broader sample, we proceeded to identify the general approach we had applied to translate the Use Cases into Little-JIL and applied that approach to the rest of the ABCC and BORIM Use Cases without performing the entire translation. This allowed us to identify and further highlight possible inconsistencies. We then reviewed 19 more of the 43 Use Cases provided and classified the irregularities we found into three groups. The classifications are as follows:

Actor Structure: We found five actor inconsistencies during our experimentation. The omitted actors tended to play a non-central role in the use cases in which they appeared, and their tasks tended to be hidden in the center of the process. The ABCC use case "Process Ship License Renewal" illustrates this problem. It describes the renewal process for a license permitting sale of alcoholic beverages onboard. In the latter parts of the process specification, "interested parties", defined as, "all persons holding a beneficial interest in the applicant's business, including but not limited to: owners, partners, proprietors, officers, directors and stockholders," need to sign off on a document before the process can proceed. These "interested parties" were omitted from the actor definition, which lists the ship owner/operator (i.e., the applicant) as the only actor.

Problems like the one above arise because actor requirements for a particular Use Case are specified in natural language at the beginning of the Use Case. Little-JIL instead binds an actor (called an agent in Little-JIL notation) to each step of the process. In either case, for the process to be useable, an actor must be assigned to do the work of each step. During our experimentation we found that the looser control of actor specification in Use Cases allowed the requirements engineers to omit actors unintentionally. Little-JIL corrected this problem; during the creation of the process, and whenever it was changed (to fix an error or add features), the Little-JIL formalism required an actor binding for each step in the process that was changed or added. This prevented the accidental omission of these actors, no matter how small their role in the process.

As previously noted, we used our experience with Little-JIL when manually analyzing the BORIM and ABCC Use Cases. Methodically investigating each step in a Use Case while considering actor specifications and other required information as Little-JIL demands helped us locate and correct similar situations in which actor definitions were ambiguous or incomplete.

Analyzing the Use Cases in the Little-JIL mindset also revealed an interesting issue in the completeness of the actor specifications across the BORIM Use Cases. The Use Cases each dealt with one actor, and limited the steps they described to those dealing with just that actor. Because of this, they appeared to model the user interface instead of the entire license renewal process. This is a misuse of the Use Case methodology. An example of this problem is as follows: The process requires the submittal of all documents regarding a criminal indictment. The Use Case models a single step with the description, "The User is presented with the message, 'You must arrange for your lawyer or the court officer to submit copies of the indictment, complaint and judgment or other disposition in any criminal proceedings in which you were a defendant.'" A proper Use Case specification would include the court officer as an actor and provide steps for that actor to follow. Actor specification is easier when these extra steps are left out of the process, but one of the goals of the requirements specification is completeness. This is a misuse that is less likely to occur in Little-JIL because unlike Use Cases, Little-JIL contains data flow mechanisms that model the passing of artifacts such as the court documents being submitted by the court officer. This extra expressive power

prompts the requirements engineer to recognize that the artifact needs to flow in from an actor other than the applicant. Adding the court officer to the process and factoring in the related work follows naturally.

Parameter Flow: We found seven errors in Use Cases caused primarily by lack of parameter flow information. These problems resulted because UML Use Cases provide no way to specify the flow of data parameters among their steps. However, the actual Use Cases provided by OCA extended the standard methodology by including a table of data artifacts required by each Use Case. We believe this helped mitigate some of the inadequacies of the methodology, but also highlighted the lack of consistency in their documents.

Little-JIL includes a type-safe parameter flow system. This system requires process programmers to clearly define what data are required for the completion of each step, what data each step produces, and how the data flow among the steps.

In our experimentation, we selected a number of the Use Cases and attempted to fill in all the missing parameter flow information. In the process, we discovered that for each Use Case, some step descriptions implicitly or explicitly referred to data that was not contained in the associated data table. We also observed other, slightly more complex problems in the Use Case that involved collections of data that were inconsistently and at times incorrectly passed or accessed. The rigor that Little-JIL provides helped us to detect data flow errors in the processes we analyzed which may have gone unnoticed otherwise.

Lack of Process Component Reuse: We found three significant redundancy issues in the Use Cases we examined. Since Use Cases are basically lists of steps written in natural language, finding commonalities among them and abstracting the commonalities to a higher level is time consuming and difficult. Similar groups of steps can be easily missed when searching for commonalities because they lie scattered throughout, or placed in different orders in multiple Use Cases. Steps with the same functionality may also have different wordings. Missing these commonalities can lead to errors as the requirements document undergoes changes and result in a confusing document filled with unnecessary redundancies.

Little-JIL solves this problem because it is a hierarchically structured process language. It encourages process programmers to identify logical clusters of related process steps and then group those steps together under one higher-level step. This increases readability and allows for reuse of steps or groups of steps from any level of the process. When the same unit of work is required be performed in another context, the requirements engineer can simply insert a reference to the related step in that context. This reference indicates that the procedure for performing that step in the process has already been detailed elsewhere. Instances in which we added higher-level steps, indicating that several steps from a Use Case could comprise a more general unit of work, are abundant in our Little-JIL requirements documentation.

After a time, performing this identification becomes second nature to a requirements engineer familiar with Little-JIL. It is with this experience that we examined the larger subset of OCA's Use Cases outside of those we translated.

An example of one of these inconsistencies occurred across many of the BORIM Use Cases we reviewed. Each medical license renewal requires the applicant to answer a select set of questions, depending on the type of license being renewed and the applicant's history. For some licenses, the applicant can be expected to answer more than 30 questions, some questions requiring additional information when answered in a certain way. Predictably, there was much redundancy in these questions across Use Cases, with slight ordering or wording differences. In the Use Cases we translated, grouping these questions according to their subject matter (personal information, insurance information, malpractice questions, etc.) was straightforward with Little-JIL. Identifying the redundant questions in the other Use Cases we examined was no worse.

The problems identified and corrected in our experimentation, as shown above, demonstrate that using Little-JIL to specify requirements prevents common errors that the Use Case methodology does not prevent. These results lead us to conclude that Little-JIL, a formalism with richer semantics than the UML Use Case, is useful for crafting clear, precise, and complete e-Government requirements documents. Our experimentation suggests that Little-JIL documents are larger than Use Case documents and take longer to specify. We believe this is because of the increased rigor required, and consider the benefits in clarity and completeness to be adequate compensation.

4. CONCLUSIONS AND NEXT STEPS

Our research supports our Process Modeling Hypothesis. It indicates that complex government processes can be effectively modeled by a rigorous process modeling language. Field studies addressing other types of government processes such as taxation and revenue are currently being planned. The process modeling language will be applied to the later stages of the OCA Systems Development Life Cycle and in other pertinent studies. This represents the technology side of realizing e-Government.

However, the computational issues in modeling government processes are shaped by the organizational dynamics that must be incorporated into e-Government. An example is the conflict between the US Customs Office and the interagency board charged with implementing the International Trade Data system (Fountain 2001). The board could not obtain the cooperation of the Customs Office. This lack of cooperation is common (Wilson 2000). We believe the crucial issue in any e-Government effort is building this cooperation.

Cooperation comes from trust which the Oxford English Dictionary (OED) defines as: “confidence in some quality or attribute of a person or thing”. If the stakeholders can trust that their input is an essential factor in the design of an e-Government system, they are more likely to cooperate. To develop and maintain that trust, methods must be found to obtain stakeholder input and to verify that the input is considered on an ongoing basis as the e-Government system evolves. We refer to these methods as a system for “Trust Resource Management (TRM).” We propose to use explicit process models as the basis for TRM and its use in e-Government.

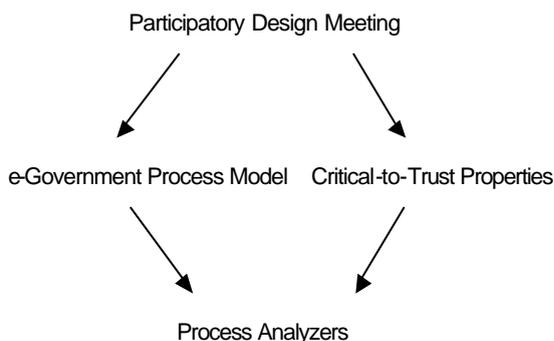


Figure 2. Trust Resource Management Flow

Figure 2 shows our proposed system. Participatory design meetings bring key stakeholders together. They define the e-Government process models and define the properties these processes must meet. Analyzers then determine if the models satisfy the properties. If not, modification of either the e-Government process or the requirements on it must occur. As the e-Government service develops, the model and properties will evolve and the analyzers will be reapplied.

Participatory Design Meetings: Our premise is that much government work can be characterized as the creation, execution, and

modification of processes. In the course of automating government, clarifying these processes and their properties to all stakeholders through the use of appropriately derived formal meetings will increase stakeholder trust, thereby making e-Government more effective.

Sophisticated computational and behavioral work is required to structure these interactions. In the US, a recognized approach to addressing the technical needs of system stakeholders is Joint Application Design (JAD) (Wood and Silver 1995; Yatco 1999). In order to address e-Government organizational design development, our method, Participatory Design Meetings, will extend JAD sessions to focus on modeling and adjusting the behavior of the systems development process to allow for trust-enhancing decision making processes. The heart of our system will be motivated by decision-making rules using a process developed by Victor Vroom (Vroom 1973; Vroom et al. 1998). The key will be to decide how to engage stakeholders in making design decisions.

Analyzers: Participatory Design Meetings will establish proposed e-Government processes and elicit the Critical-to-Trust properties they must meet. Stakeholders must be convinced the processes realize the properties. The clear representation of e-Government processes through rigorously defined modeling formalisms must be combined with analysis tools to achieve this. Our previous research indicates that the definitiveness of analyses must ultimately depend upon the rigor with which the processes are defined. One key reason for the requirement in our proposal to define government processes in a language with formal semantics, which Little-JIL has, is to provide a stronger basis for automated analysis and verification of these processes. In particular we propose to apply a range of analysis and testing techniques to the government

processes that we will define in order to determine how effectively we are able to demonstrate that these processes satisfy the Critical-to-Trust properties specified by stakeholders.

We propose to apply two complementary approaches: dynamic testing and static analysis. In earlier work (Osterweil 1996) we described the specific ways in which these two approaches are complementary. Dynamic testing monitors process execution and is effective in detecting deviations from desired or mandated behaviors. Static analysis is aimed at demonstrating the absence of defects and undesirable behaviors, but only for limited classes of defects. In the next stage of our work, we will study and evaluate both dynamic testing and static analysis approaches to understand their relative effectiveness in enhancing trust.

Our experience has shown that rigorous process modeling isolates errors that inhibit the effectiveness of e-Government. Without process modeling, e-Government struggles to offer to its constituency engagement in government interaction at any time from any place. With it, the foundation exists for a system that can establish and maintain trust among all e-Government stakeholders.

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UBIQUITOUS E-GOVERNMENT

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ABSTRACT

Providing access to government information and services to citizens via the Internet has emerged as a key component of e-Government. Broad objectives of demonstrating leadership in the Information Society and improving citizen access, while restraining or reducing costs, are well understood and have global relevance. However, local implementation with resource constraints, limited experience and limited awareness has challenged policy makers and managers. This paper reviews strategies applied by Australian governments at national and state levels. From a proposed typology of policy approaches, effectiveness of strategies for encouraging participation of government agencies can be examined. It is argued that the objectives of maximum participation and maximum effectiveness, particularly through online integration of services, cannot be dealt with simultaneously.

KEYWORDS

Public Policy, Innovation, e-Government

1. INTRODUCTION

Governments worldwide are adopting policies for the online provision of information and services in their relationships with their citizens – individual and corporate (NAO, 2002). Some reasons for doing this (Sewards, 1998) are external and developmental, with governments taking a leadership position:

- Showing commitment to the Information Society
- Promoting usage of the Information Society by businesses and consumers
- Demonstrating benefits (particularly for businesses) of working online
- Encouraging electronic formats for communication and procurement
- Stimulating consumer usage by having electronic interaction with government services

Other reasons are internal and administrative:

- Cost savings through efficiency gains
- Improved response times
- Ability to make more information available to more people
- A catalyst for the re-engineering of government processes

Some jurisdictions focus on objectives relating to democratic processes. Benefits such as increasing government transparency through access to a wider range of information and promoting citizen engagement have been proposed (UK Parliament, 1998).

While these objectives are widely discussed and generally accepted, in both developed and developing countries, it is not a simple matter to introduce a wide range of online government services. Sewards (1998) also reported barrier issues that included additional short-term expenditure; training public servants in the potential of the new services; seeking consistency across multiple jurisdictions; and matching services to demand. An audit survey of Australian government agencies (ANAO, 1999) identified impediments to increased use of the Internet that included legislative mandates for physical documents, IT skills shortages, and issues of data protection and authentication.

It is difficult to ensure that citizens have access to the necessary hard and soft infrastructure to benefit from available services, particularly those citizens who are disadvantaged through factors such as economic

circumstances, age, physical disability, and regional isolation (Rimmer, 2001). These are at one and the same time the people who are least likely to access the online environment and most likely to benefit from increased access to services, especially in health and education. The risk is that provision of information and services online will exacerbate rather than alleviate the so-called digital divide within society. Taken together, these issues and impediments can significantly delay and deter government agencies from implementing online service delivery (OSD). This paper considers strategies employed by Australian governments to encourage deployment of OSD, and possible directions for the future.

2. ONLINE SERVICE DELIVERY

2.1 Deployment of OSD

In most discussion of technology diffusion, public sector policy decision-makers implicitly are treated as “The Government” – a single entity. Yet most governments are made up of large numbers of autonomous or semi-autonomous agencies, and adoption of new ways of doing things is neither automatic nor instantaneous. This has been exacerbated by “new public managerialism” in many liberal democracies (Dunleavy et al, 2001), which has increased fragmentation and disaggregation. The extent to which adoption of a policy, management or technical innovation can be directed from a central government locus, through political decisions and statements, varies with the political structure and the policy area. In Australia there are three tiers of government – Commonwealth (national), State and Local – and in each jurisdiction a large number of separate agencies with devolved management responsibilities, from several dozen to hundreds.

Deployment of OSD in Australian governments requires a large number of adoption decisions by service delivery agencies, with encouragement and some direction by policy agencies, often called “central” agencies. The willingness and effectiveness of Australian political executives, even to Prime Ministerial level, to direct line agencies in operational and tactical matters is limited (Spencer, 2002a) but in the Information Technology area each government has some central policy group that develops strategies and promotes best practice in the line agencies. For example, the Commonwealth Government has a Department for Communications, Information Technology and the Arts and an Office for Government Online, now part of its National Office for the Information Economy (NOIE). At the State level, Multimedia Victoria (part of the Department of Innovation, Industry and Regional Development) “works with other government bodies to implement the Government’s *Connecting Victoria* policy, which aims to bring the benefits of technology to all Victorians” (MMV, 2002a). Local government involves even more entities – nearly 700 councils through the country (AGLA, 2002). They collaborate through state associations and there is an Australian Local Government Association that addresses strategic issues as well as liaising with the other tiers of government. However, involvement and adoption of an innovation is a council-by-council decision.

No Australian government jurisdiction has implemented OSD directly through a central facility and common infrastructure or by outsourcing, although for a time the South Australian Government proposed an Electronic Services Centre (Information Technology Industry Development Task Force, 1994). Central strategists and decision-makers have applied principles that are consistent with a diffusion perspective, assuming a change agent role (Rogers, 1992) to interest agencies in online service initiatives.

2.2 Quality and Integration of Services

Participation of as many agencies as possible, and for as many applications as possible, is only a starting point for OSD. It represents the *quantity* but not necessarily the *quality* of service to citizens. The Australian Commonwealth’s online strategy proposes that OSD should provide integrated services, helping to overcome structural and jurisdictional barriers (DCITA, 2000). This position is strongly supported by the Auditor General (Barrett, 2002), who supports the UK concept of “joined up government” (Cabinet Office, 1999).

2.2.1 Maturity Stage Models

Several models propose stages of maturity in OSD, reflecting alternative definitions of what constitutes best practice in service delivery. Models cited in the Australian context are based on either information access (a

service provider focus) or customer focus. The information model, used by the Australian National Audit Office (ANAO, 1999) and the Office for Government Online (DCITA, 2000), has four stages:

- Stage 1 – An agency website with information about the agency and its services
- Stage 2 – Internet users can browse, explore and interact with agency databases
- Stage 3 – Users can engage in secure electronic transactions with the agency
- Stage 4 – The agency (with prior user permission) shares information with other agencies

Deloitte Research (2000) has articulated, from a customer-centric view, six stages of e-Government:

- Stage 1 – Information publishing
- Stage 2 – Official two-way interaction between agency and citizen
- Stage 3 – Multi-purpose portals
- Stage 4 – Portal personalisation
- Stage 5 – Clustering of common services
- Stage 6 – Full enterprise transformation

An international review against this framework concluded that “governments have already realised substantial gains in accessibility, service volume and operations data, but have made fewer strides in the overall reduction of administrative costs, customer and employee complaints, signaling potential flaws in their business processes“ (Deloitte Research, 2000, p29)

Stage models postulate low-level participation preceding the development of significant functionality or process change. While they purport to be predictive, they are derived from observation and optimism, based on the premise that technical familiarity and involvement with the Internet environment are necessary and sufficient precursors of wide-spread process change; without explicitly challenging why this should be so.

2.2.2 Single Window Principle

The “single window” approach to OSD, using portals and sophisticated searches, has been part of the model for every Australian government jurisdiction since an early stage in OSD deployment (Information Technology Industry Development Task Force, 1994; OGIT, 1997). Users can access information and services without having to understand government structures (Burn & Robins, 2001) and jurisdictions. Whether proposed through portals, “channels” or “life events” the aim of providing simple, functional access by citizens and business has been part of the statement of objectives in almost every policy presentation.

Portals have been put in place by all Australian governments, with varying degrees of sophistication in the design of website metadata and the use of smart search engines. However, services still are not integrated. Progress to the “single window” objective is limited when the next level of interaction below the portal retains all the variations in style, language and facilities of the individual agencies involved. Portals with the greatest integration, such as the cross-jurisdictional Business Entry Point (<http://www.business.gov.au/>) and Service Tasmania Online (<http://www.service.tas.gov.au/>), have been technically innovative in the use of XML and consistent metadata applications (Service Tasmania Online, 2002). They have not required organisational changes within government and instead have used technology to mask inconsistencies. Such initiatives avoid re-engineering or re-structuring of government as being more difficult than a technical work-around. They are based on first encouraging OSD participation, to increase the volume and scope of services, then finding a practical means of improving accessibility.

3. RESEARCH PROBLEM

Seen from the inside, the central or line agency project level, OSD deployment is a technical project requiring a procedural methodology (Martin & Morton, 2001). However from the “outside”, taking an overview of the whole of government position, it requires that a number of different organisation and individuals develop awareness and make adoption decisions – a process of diffusion over time and throughout the public sector with central agencies acting as change agents. Most research into the diffusion of technology is from the viewpoint of individual consumers or users. For example, Gefen et al (2002) treated citizen adoption of online services – specifically tax filing – as a technology diffusion problem and applied the Technology Acceptance Model (TAM) to questions of service design. The TAM is a simple model, more suited to explaining personal use in a controlled environment than organisational adoption (Karahanna et al, 1999). Kearns (1992) found a complex array of factors influencing computer application

adoption decisions within a sample of local government organisations, and argued for an extension of the classic diffusion of innovation model (Rogers, 1995) rather than a simplification such as TAM.

This paper considers not the *use* of online services by citizens and businesses but the *provision* of the services by government agencies. If indeed Australia is one of the more advanced nations in terms of availability of services and use of services, as it claims (NOIE, 2002), then strategies employed by Australian governments to reach that position should provide lessons in how to establish ubiquitous e-Government. Although governments sometimes carry out evaluations of programs and even identify principles and frameworks, in many instances learning is limited and evaluations remain forever confidential (Spencer, 2002b). Anecdotes are relayed across jurisdictions, and consultants share tacit knowledge in face-to-face discussions, but objective and structured review takes place comparatively rarely and successive government strategists operate in a theory-free zone. The aim of this paper is to tease out some structure from diverse information about the adoption of OSD by government agencies in Australia as a starting point for theory.

4. METHODOLOGY

This research reviewed Australian government policies to develop a typology of the strategies employed. The primary research material comprised policy and strategy statements that had been publicly released by the governments. Some principles for document selection were established:

- Confidential documents are of limited research value, and their status as discussion paper versus agreed strategy can be difficult to ascertain, whereas public statements represent a commitment to the content at political or senior bureaucratic level.
- Public statements tend to fall into two distinct categories – one focuses on the current government's achievements while the other presents a more detailed and objective description. For research into policy content the latter are more useful.
- Recent OSD policy documents are available online, but those that are 6-8 years old usually are available only in hard copy from government departments that may have been restructured several times in the intervening years. Sometimes the existence of an influential paper is highlighted by hyperlinks from later online documents, but the links are usually broken and the document has to be retrieved from archives¹.
- Documentary policy material should be compared across time and in different versions from each government jurisdiction, because public materials at a particular point in time generally reflect the prevailing policy context and the current government ideology. They rarely reflect on the path taken to reach the current status, and may provide a different description and interpretation of the past than contemporary documents did

Detailed public strategy reports originating in the period 1994 to 2002 were obtained from each of the State governments, the Northern Territory and Australian Capital Territory (ACT) and the Commonwealth government. Content of the policy/strategy statements was thematically coded with respect to OSD strategies and issues; then the themes were reviewed to develop a proposed typology of strategies. This is a content analysis rather than hermeneutic analysis, aiming to discern types of strategies ahead of searching for subtle variations in emphasis and interpretation. For example, themes such as “agency commitment”, “selected agencies”, and “innovators” were taken as attributes of a strategy type that I have called “early adopters”.

Table 1 tabulates the early and late strategies for the Commonwealth and each of the States and Territories. “Early” is taken to be about 1996/97 and “late” to be about 2001/02, approximating to a 5-year period beginning around the time of increasing awareness of the Internet. A principle reference for each period is identified. Usually there were several public statements and documents released, but the references provided in the table are seminal documents in each jurisdiction and time frame, containing some reference to the approach employed to encourage or require government agency participation in OSD. Other issues raised also have been included in the table.

¹ Multimedia Victoria has established an eGovernment Resource Centre at <http://www.egov.vic.gov.au/> with many original materials from Victoria and other Australian government jurisdictions. The longevity of this resource, and the inclusion of politically sensitive material in a government resource, remains unproven through the next bureaucratic restructuring.

5. STRATEGIES FOR ONLINE SERVICE DELIVERY

Initially Australian governments, like those in other countries (Kieley et al, 2002), focussed on government-wide requirements for hard and soft infrastructure, with a few key projects undertaken to explore infrastructure requirements. In the mid 1990s, for example, telecommunications infrastructure projects were established by most central government agencies in preparation for an anticipated boom in electronic services (Office of Information Technology, 1999; Government Online Tasmania, 2001). One of the first Australian governments to make significant OSD progress was the State of Victoria, which addressed both infrastructure and content. In 1995 the government sponsored the “maxi” project to develop public kiosks and supporting soft infrastructure such as interface design and secure payment facilities (Multimedia Victoria, 2001a). Kiosk infrastructure was overtaken by Internet development, but much of the content was by design transferable (Rimmer, 2002). Victoria also began to identify “channels” for services, so that the gathering of information within a topic area could be coordinated and facilitated for online delivery (Multimedia Victoria, 1999).

These developments took place in the context of an overall vision of having all agencies online by 2001 (Multimedia Victoria, 1999). In later years the vision was restated as a participation target of all appropriate services being online by the end of 2001 (Multimedia Victoria, 2001b) – a target that has effectively been achieved, within the definitions of “appropriate” and “online” adopted by succeeding policy-makers. The shift in strategies across the period 1995-2001 is of particular interest.

Table 1. Themes for adoption and other issues in online service delivery for major government jurisdictions within Australia. In many cases central agency titles have changed at least once during the time period of this analysis

Jurisdiction	Central Policy group(s)	Policy aspect	1996/97	2001/02
Commonwealth	National Office for the Information Economy / Office for Government Online	Adoption	Early adopters	Universal participation
		Other	Additional delivery medium rather than replacement More equitable delivery Single window access	Authentication Meta-tagging Complements traditional service delivery Personalisation Multiple pathways
		Reference	OGIT (1997)	Office for Government Online (2000)
New South Wales	Office of Information Technology	Adoption	Early adopters	Universal participation
		Other	One-stop shop Equity of access Customer focus Data security	Web portal Regional and rural access infrastructure Single window
		Reference	Department of Public Works & Services (1997)	Office of Information Technology (2002)
Victoria	Multimedia Victoria	Adoption	Key functions <i>and</i> Early adopters	Universal Participation
		Other	Maximum participation Single window access Public kiosks Authentication Online payments	Community access Industry development Regional participation Identification of benefits
		Reference	Multimedia Victoria (2001b)	Multimedia Victoria (2001b)
Queensland		Adoption	Early adopters	Key functions
		Other	Foster electronic commerce Standards Sharing information and systems Business anytime, anywhere	Anywhere, anytime access Improving efficiency of government process Single point of contact
		Reference	Ministerial Council for Information and Communication (1997)	Department of Premier and Cabinet (Qld) (2002)

Jurisdiction	Central Policy group(s)	Policy aspect	1996/97	2001/02
Western Australia	Department of Industry & Technology (Office for Information & Communication)	Adoption	Early adopters	Early adopters (with collaboration)
		Other	Single window Alternative delivery media Collaboration	Community access Information management Common standards
		Reference	AOT Consulting (1998)	Department of Industry and Technology (2002)
South Australia	Department of Administrative and Information Services	Adoption	Early adopters	Early adopters <i>and</i> Key functions (in Service SA mode)
		Other	One-stop service 24x7 Access to government information for commercial purposes "Boundaryless" agencies Whole of Government coordination	One-stop shop Multi-channel access to services Increasing public awareness State portal and government intranet
		Reference	Information Technology Industry Development Task Force (1994)	Government ICS (2002)
Tasmania	Department of Premier and Cabinet (Government Information and Services Division)	Adoption	Key functions	Key functions
		Other	"All band" approach Telecommunications partnerships Community access centres One stop shops Single windows	Intelligent portal Public access points Cross-agency & cross-jurisdiction cooperation
		Reference	Department of Premier & Cabinet (Tas) (1997)	Department of Premier & Cabinet (Tas) (2001)
Northern Territory		Adoption		Early adopters
		Other		Standards & security policies
		Reference		Department of Corporate and Information Services (2002)
Australian Capital Territory		Adoption	Key functions	Key functions
		Other	Public access points Variety of information formats Staff training	Standardised interface (Canberra Connect) Multi-channel access options Access and equity
		Reference	Department of Urban Services (1997)	Department of Urban Services (2000)

My analysis of the policy materials suggests three types of strategy, which I have referred to as early adopters, key functions and mandated universal participation.

5.1 Early adopters

Early adopter strategies rely on innovative agencies, with strategic vision or compelling business cases, piloting OSD and demonstrating its advantages. The Western Australian "Electronic Service Delivery Plan" (Taylor & Wilson, 1998) is an example. It classified agencies from Category 1 (committed to online services as a strategic development and ready to proceed immediately) all the way to Category 6 (not directly providing services to businesses or citizens). The plan then targeted suitable agencies for central support.

Most governments provided encouragement to early adopters at some point, even when central strategy groups have simultaneously developed concepts such as "channels" and "single window" to support navigation by users (Taylor & Wilson, 1998; Multimedia Victoria, 1999). Treatment of agencies as autonomous business units was strongly in favour in the mid 1990s (Dunleavy et al, 2001). The risk with this strategy is that diffusion may never proceed past the early adopter group and therefore achieves limited

benefits, or proceed too slowly for political targets. While slow diffusion may be explained by unfavourable business cases or cost issues, the Commonwealth Auditor-General (ANAO, 1998) found that a strong policy imperative makes cost of implementation just a problem to be solved, not a barrier. Without that policy imperative, the rate of adoption is relatively slow (Dunleavy et al, 2001). Nonetheless “early adopters” is the strategy that has been used most frequently, especially in large and diverse jurisdictions. It is consistent with fragmented governance, as well as suiting trialing and observation by agencies.

5.2 Key Functions

A key functions strategy relies on an analysis of government activities to determine which applications should be given priority in seed provision of resources and expertise. Victoria employed a version of this strategy when it encouraged the development of land, education and business “channels” focusing on services to specific client groups (Multimedia Victoria, 1999). The government of the Australian Capital Territory sought to provide the services most in demand via kiosks, service shops and the Internet (Department of Urban Services, 1997).

Identification of key functions may be based on ease of implementation, rather than functional significance. This is a typical “early wins” approach used by many change programs, which aim to establish quick returns from simple applications with reasonably strong business cases so that other potential adopters can observe the potential advantages of the innovation. Again there is a risk of incomplete participation and therefore limited benefits realisation once the initial easy applications have been implemented. Governments that implemented key functions in early stages of OSD (e.g. Victoria, ACT, Tasmania) had an initially high central government role in infrastructure deployment – the Victorian “maxi” project (Multimedia Victoria, 2001a), Canberra’s “Austouch” terminals and shops (Department of Urban Services, 1997) and Tasmania’s “Service Tasmania” shops and portals (Department of Premier and Cabinet, 1997). Identification of functions was strongly related to selective provision of seed funds from central government.

5.3 Mandated Universal Participation

Several Australian jurisdictions have more recently adopted a mandated universal participation strategy in order to achieve 100% participation. This approach also is in place in Canada (Kieley et al, 2002) and the United Kingdom (Cabinet Office, 1999), albeit with extended target dates. The Commonwealth and the Victorian and New South Wales State governments all set the end of the year 2001 as the date for all “appropriate” government services to be delivered or deliverable online. Agencies were required to submit implementation plans and then to report at intervals against them (Multimedia Victoria, 2001c; DCITA, 2000; Martin & Morton, 2001). Consolidated progress reports went to the relevant Minister or to Cabinet. The Commonwealth and Victoria have publicly reported achievement of their target, and Victoria has also carried out some public evaluation of outcomes (Multimedia Victoria, 2002b).

Mandated universal participation in Australia focuses on reaching a participation target with only generic concern for quality, and responsibility for identification of services remains with individual agencies. Jurisdictions that have moved to mandated universal participation are highly competitive, especially in promoting new economy ideals, and it has been possible for policy advisers to persuade a strong political leadership to make a whole-of-government commitment to a public target. In each case the mandated participation approach has been developed after voluntary participation proved to result in a relatively low rate of adoption and little likelihood of reaching the universal participation target.

6. DISCUSSION

Work done by central policy agencies to promote adoption of OSD by agencies addresses issues that affect the rate of diffusion within a system (Rogers, 1995):

- **Relative Advantage** – Central agencies stress the advantages of OSD in quality of service, potential cost savings, and government leadership. Each of the documents identified in Table 1 begins by outlining OSD benefits. The NSW Blueprint specifically argues the benefits for

government, as well as the general public, for each strategy (Department of Public Works & Services, 1997). In some cases, notably guides prepared by the Commonwealth Auditor-General (ANAO, 2001), discussion of cost-benefit analyses stresses intangible benefits.

- **Compatibility** – All government jurisdictions have provided soft infrastructure such as legislation, authentication of users and data protection. The central agencies have taken on the majority of this work, to establish a compatible environment for OSD. Online services usually complement rather than substitute for existing service delivery activities (DCITA, 2000), even though this is not as cost-effective as a single delivery medium.
- **Complexity** – Participation strategies have allowed agencies to minimise the extent of re-engineering of processes that they carry out. This reduces complexity of change as well as increasing compatibility.
- **Trialability** – Early OSD strategies placed considerable emphasis on agencies undertaking pilot projects and exploring the delivery of particular services.
- **Observability** – Case studies of OSD, preferably within the same government jurisdiction, are documented and cited to persuade agencies and to demonstrate “best practice”. Early adopter strategies assisted individual agencies to develop observable applications of OSD.

In effect, all the activities of central policy units to promote the uptake of OSD have been consistent with diffusion of innovation theory. Even so, the time frames – particularly 2001 targets – have been too short for effective resolution of compatibility and observability issues. For example, it took until 2001 for governments to establish legislation facilitating electronic transactions (Attorney-General, 2001).

6.1 Ubiquitous OSD

Greatest participation in online service delivery by government agencies has been achieved by central mandate – the “universal participation” strategy – in which agencies must individually implement OSD on a service-by-service basis but the main adoption decision is taken centrally and authoritatively. OSD diffusion takes a very long time when observability of methods and benefits is low, and implementing online facilities is complex and incompatible with existing systems. Voluntary adoption by the more conservatively managed agencies, and less innovative Ministers, could take decades to reach a reasonable degree of penetration. It is worth noting that individual government agencies rarely see themselves in competition and incentives for rapid development may be relatively low, unless a political mandate has been requested.

Although some aspects of quality of service are consistent with this mandating, such as web site design and accessibility, it can militate against process redesign and process integration across agency boundaries. A rapid implementation based on checklists of existing services employs all available resources and does not provide any opportunities for trialing and observing successful integration. Agency managers are held separately responsible for meeting deployment targets, with none of the cooperation and collaboration required for real process reform.

7. CONCLUSIONS

Approaching service integration as a second phase, not as part of the original implementation, treats service delivery and service integration as two separate innovations, with the former expediting the latter. Although integration may be facilitated by online delivery, it involves a different set of organisational and process design issues (Burn & Robins, 2001). Initial implementation in Australian governments has proceeded by treating OSD as complementary to existing physical delivery methods (for example, see DCITA, 2000). This also limits possibilities for service integration, since it is likely that new integrated services will only be possible in OSD mode.

Technological developments are not irrelevant. Just as portals have become much more widespread and functional since the availability of XML, the technology of XML Web Services could well provide the technical facilitation of service integration from the client viewpoint, with minimal change to existing agency systems or process reengineering. It will be more practical for a government policy group to promote a “universal integration” model now that the Web Services technology is reasonably well understood and both protocols and tools are available.

This paper has reviewed and analysed strategies employed by Australian governments to stimulate provision of online services by their constituent agencies. In the most aggressive jurisdictions, encouragement of early adopters or support for key functions has given way to mandated universal participation. However, cross-agency integration of services is still at the stage of portals for resource discovery. A focus on universal participation actually conflicts with developing best quality integrated service delivery.

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SMART CARD SUPPORT FOR ANONYMOUS CITIZEN SERVICES

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ABSTRACT

Numerous European countries are currently engaging in e-government initiatives that often comprise issuing digital identification cards to citizens. As most of these cards base access control solely on the identity of the cardholder, the issue of privacy arises. We present a scenario where it is desirable that citizens can access services while remaining fully anonymous. We consider the requirements for an anonymous access from the perspective of both government and citizens. Starting from the idea of mapping the problem of anonymous access to a group membership problem we present a credential-based solution in which digital credentials are used to extend the digital identity of the citizen. We consider the infrastructural components that an administrative body must introduce when using credentials for service access. We finally propose cryptographic means for the implementation of such a system with low-cost cryptographic credentials and smart cards. The implications of the smart card as a computationally restricted environment are discussed and an outlook on future research on credentials in e-government use is given.

KEYWORDS

E-government, Smart Cards, Privacy, Anonymity, C2A Service Access, Credentials

1. INTRODUCTION

Electronic government is a term that refers to the transformation of governmental services in the age of the information society. From the citizen's point of view it means active, modern and more customer centric administrative processes. From a conceptual view, e-government comprises a reengineering of administrative processes. From an IT-perspective, e-government is characterized by the government's shift towards the internet as an important service delivery platform. Some governments have set targets for the first decade of the new millennium that necessitate the electronic delivery of all services that are amenable to this form of delivery.

Many governmental initiatives comprise issuing smart cards to the citizens for access to electronic services. In this paper, we will first discuss privacy problems that may arise from these cards. In section 3 we will present a scenario that requires a strong form of authentication without disclosing the card holder's identity. We consider requirements for anonymous smart card based applications from the citizen's and the government's perspective. We propose the use of anonymous credentials for the given scenario. In section 4 we propose an efficient technical solution that can be used on today's smart cards and reason about requirements for the next generation of citizen cards.

Although some publications exist about privacy in e-government applications, the concept of anonymity in e-government services has not been discussed before. This paper contributes to the discussion on privacy and anonymity and also makes a technical contribution by proposing the use of group signature concepts for low-cost anonymous credentials.

2. PRIVACY THREATS POSED BY MULTI-APPLICATION IDENTITY CARDS

Almost all countries in Europe are currently engaging in e-government activities and many of them plan to introduce a form of digital identity card. Current smart card projects in Europe address many different applications ranging from health service cards to full digital ID cards. Most European identity card projects plan to embed two digital certificates on the card: one will be used for authentication, the other for digital signatures only. However, both certificates tie a card to a real world identity. The signature certificate enables the citizen to issue digital signatures while the authentication certificate will allow citizens to conduct a whole range of transactions on-line, including online shopping, e-banking, paying taxes or even e-voting. However, conducting transactions based on identity certificates also poses a serious threat to the cardholder's privacy.

Whenever the citizen uses the embedded authentication certificate for the setup of a secure connection or other authentication purpose, all transactions within the session can be linked to the identity of the card holder. The use of a single authentication certificate for multiple applications will enable health care institutions, shops, web sites and governmental agencies to link records comprising all transactions of a given customer. While a data collection of a single service provider on its own may not be perceived as a threat to privacy there is always the possibility that several providers may exchange data and compile detailed personal profiles about the cardholders.

Most internet users have come to realize that there is almost no privacy on the internet as any electronic transaction leaves a trace. Most companies (or governmental agencies for that matter) have not installed rigid Electronic Records Management policies (ERM) yet. As a consequence, many citizens fear that the introduction of multi-purpose identity cards will undermine their privacy and possibly give administration more control and insight into their lives. These concerns will have to be addressed by any government that engages in a digital ID card initiative, as user acceptance is a critical success factor (Warkentin et al., 2002).

The use of an authentication certificate tied to a real world identity is a very strong form of authentication. Both from a technical and a data protection perspective, such a strong authentication may not be necessary in many transactions. We will briefly introduce the concept of credentials in the next section and then consider a service scenario involving sensitive data in which the identity of the citizen should remain hidden.

2.1 Digital Credentials – A Privacy Protecting Technology

David Chaum first introduced credentials as a privacy-protecting technology in 1985 (Chaum, 1985). Pseudonymous credentials were intended as a building block for a system in which users could conduct unlinkable anonymous transactions using pseudonyms. A credential is usually defined as a data structure that is issued by an organization, contains statements about the subject of the credential and is signed by the issuing authority (Chaum, 1985).

However, the concept of credentials is not limited to the digital world. In contrary, physical tokens that prove a privilege are in widespread use today. Examples for physical credentials are prescriptions, credit cards, a driver's license, passports, membership cards, stamps or a ticket for a movie theater. All these tokens make a statement about the holder of the credential and are shown to some organization when the need arises to prove a given property.

For our purposes we prefer a definition of the term digital credential that is less restrictive than the one given by Chaum. In accordance with Herzberg and Mass, we consider a credential as a data structure that makes a statement about a subject, is issued by an organization and usually presented by the subject to other organizations (Herzberg and Mass, 2001). Adhering to this definition, we can give some examples for different categories of digital credentials:

Pseudonymous credentials: A pseudonymous credential contains attributes, a pseudonym relating to a real-world subject and a signature by the issuer. This kind of credential enables a subject to conduct unlinkable electronic transactions.

Public-key certificates serve the purpose of binding a public key to a subject. They are issued by a Certification Authority (CA) and contain a public key, a subject identifier and the signature of the CA. A popular example for public-key certificates is the X509.v3 standard.

Attribute certificates are signed certificates that link arbitrary attributes to a subject (or to a key). They are intended to convey information other than public keys in a trustworthy manner.

Digital documents and authenticated records: the right of a subject to access an electronic service may be determined from a digitally signed document or an authenticated record (e.g. from a membership database). Often database records are represented by XML and are digitally signed in order to provide trustworthy information about a subject.

A classification of credentials with regard to static and dynamic qualities (such as divisibility, transferability etc.) can be found in (Maibaum and Cap, 2001). Departing from the definition given above we will present in the next section a scenario from the field of e-government where card holders need to be strongly authenticated with regard to a set of attributes without disclosing their identity.

3. A SCENARIO REQUIRING STRONG AUTHENTICATION WITHOUT IDENTIFICATION

The following scenario stems from a meeting with members of a city council in the United Kingdom that took place in the course of the FASME project (Auerbach N. and Maibaum N., 2002). Although the scenario concerns the U.K. welfare system the problems encountered are generic and apply to other countries as well.

The United Kingdom has a welfare system that is intended to provide financial and other forms of support to citizens in need. There is a wide range of benefits that citizens in the United Kingdom can claim if they meet well-defined criteria. Examples for benefits are housing benefit, council tax benefit or unemployment benefit. Some of these benefits imply discounts at various institutions, such as the council's sports facilities, the local library or the theatre.

Unemployed citizens or people with a low income can claim income support. Citizens on income support are issued a social security booklet where an entry is made for each benefit. The booklet details the period over which the benefit is received and serves as proof of eligibility. However, when claiming a discount, citizens have to prove their eligibility by presenting their social security booklet.

This system has two considerable drawbacks: on the one hand, the system is paper-based and therefore issuing and updating the booklet is a cumbersome process. On the other hand, citizens have to carry the booklet with them at all times. Furthermore, use of the booklet leaks data about the holder: producing the booklet - e.g. at the swimming pool - makes it obvious for the bystanders that someone receives benefits.

3.1 A Smart Card-based Digital Solution

The existing paper-based system can be reengineered using smart cards. A digital citizen card can act as a carrier for trustworthy digital tokens that state the form of benefits that a citizen receives. Such a credential would be issued by the benefits agency, stored on the card and replace the entry in the social security booklet. The credential can be shown in any situation that necessitates proof of a benefit (e.g. where a discount is tied to a benefit). Of course, disclosing a credential must be at the cardholder's discretion - just as today use of the booklet is up to the citizen. A system based on a combination of smart cards and digital credentials has the potential to replace the social security booklet and better protect a citizen's privacy.

A service access that involves sensitive personal data should not be based on identity. Instead, an organization (in our case the benefits agency) can issue a signed statement that a card holder has a right to further discounts and access should be given based on this statement – provided the signer is trustworthy. The identity behind the credential is not relevant for the access decision. Instead, the credential constitutes an anonymous digital identity for the holder. Semantically, the credential states that the holder belongs to the group of benefit recipients.

An authentication based on identity certificates could empower conspiring service providers to compile data collections about the habits of benefit recipients. In contrast, a solution based on credentials can offer full anonymity to a citizen. We will look at three different dimensions of an anonymous service access in the next section.

3.2 Three Dimensions of Privacy in Service Access

The scenario depicted above requires an anonymous modus of service delivery in order to protect the citizen's privacy. When examining this scenario closer it becomes clear that a credential system can contribute to privacy in three ways.

First and foremost it provides anonymity, which means that the identity behind the subject accessing a service remains hidden. This is achieved through the use of a credential that specifies attributes but does not contain a person identifier. In a second dimension, a credential system can provide unlinkability of transactions. I.e. transactions with different service providers cannot be linked and it is impossible to compile a profile of the subject of a credential. As a third improvement, a credential system can help to keep the conditions of the service access confidential.

The price (or access conditions) of a service can be derived from the credentials a subject holds. If a card is also equipped with an electronic wallet then the resulting amount can be directly debited from the card. This would make the exact terms of the transactions invisible to the outside world. The fact that a cardholder is on income support (or any other conditions influencing delivery of service) can be completely hidden from any bystanders. Next to offering anonymity and preventing collection of personal data (data avoidance), a smart card-based system could therefore also reduce possible exposure to discrimination.

3.3 Anonymity versus Administrative Needs

Although governments around the world are adapting their legislation to accommodate electronic service delivery, no government has yet changed the legal framework in a way to grant citizens a right to anonymity. In the Netherlands, there was recently a discussion whether citizens should have a general right to anonymity. The Dutch government rejected this notion and argued that communications with government are subject to statutory regulations and that it is essential to trace a communication back to its originator. At the same time though, they admitted that anonymity might be desirable in some circumstances.

For the electronic delivery of the service described above this implies that any such system may have to incorporate identity escrow. In case of a legal dispute, a designated entity should be able to trace a transaction back to the subject behind the credential. It is technically possible to implement a form of revocable anonymity in a credential system. We will discuss basic requirements for an implementation in the next section.

3.4 Implementation Requirements

We briefly consider basic requirements that need to be met when implementing the above mentioned scenario with smart cards. This list is not intended to be complete but merely serves as an indication of minimal requirements:

Citizen's perspective: citizens will not accept an electronic solution that lets service providers compile electronic lists of benefit recipients. Therefore, anonymity is a requirement. Furthermore, the system should provide a high degree of usability. This implies that the smart card should manage the life cycle of the credentials and hide complexity from the user wherever possible.

Authorities' perspective: Credentials must not be transferable. I.e. the token serving as proof of eligibility must stay on the card of the subject. Smart cards as tamper-proof environments help meet this requirement. Credentials should be revocable in case a citizen fraudulently obtains a credential (e.g. by making false statements towards the issuing authority). Furthermore, there may be the need to incorporate identity escrow, i.e. a possibility to detect the identity behind a transaction.

From a technical point of view, credentials should be as compact as possible, as smart cards have limited storage capacity. A compact size is also desirable given the relatively slow speed of data transmission to and from the card. The resource-restrictedness of smart cards also calls for efficient protocols with low computational complexity. In the next section we propose an implementation based on group signatures that meets the basic requirements presented here.

4. ANONYMOUS CREDENTIALS BASED ON GROUP SIGNATURES

The scenario depicted above can be implemented using any credential system that provides unlinkable multi-show credentials. The system proposed by Camenisch and Lysyanskaya (Camenisch and Lysyanskaya, 2000) meets these requirements. The systems proposed by Brands (Brands, 2000) could be used as well but requires a recertification to provide unlinkability. However, these systems are difficult to implement on smart cards due to a relatively high mathematical complexity. Therefore low-cost unlinkable credentials are proposed that do not offer many features of more elaborate credential systems but on the other hand can be easily implemented on most smart cards.

The credentials we propose build on the concept of group signatures as proposed by Chaum and van Heyst (Chaum and van Heyst, 1991). A group signature system is set up by a group manager who receives members into the group. In a group signature system, members can issue signatures on behalf of the group with the special property that signatures are verifiable only with regard to a single group public key. Signatures remain unlinkable and anonymous for everyone except the group manager. Therefore, group signatures afford members full anonymity within a given group. Group signatures have also been applied to electronic cash (Traoré, 2000) and anonymous bidding systems (Nguyen and Traoré, 2000).

A group signature system works as follows: A group manager sets up a group and creates a group public key that is common to all group members. When a member joins, the member is issued an individual membership secret and the group manager keeps some information that later allows the identification of the originator of a signature. The group member can now issue signatures on behalf of the group. A verifier can only tell whether a signer is a member of the group but does not learn anything about the signer's identity. In case of a dispute however, the group manager can decide to open a signature and divulge the identity of a signer (Camenisch and Michels, 1998). The functionality of identifying the signer can also be moved to a third entity, called the anonymity manager. The anonymity manager is then involved in the issuing process and keeps the data needed for identification of the signer (Ateniese et al., 2000).

4.1 Implementation

We apply the concept of group signatures to the scenario depicted above and map the anonymity problem to the group membership problem. Let us recall the definition of anonymity given by Pfitzmann and Koehntopp (Pfitzmann A. and Koehntopp M., 2001): Anonymity can be defined as 'the state of being not identifiable within a set of subjects'. The larger this set is, the stronger the degree of anonymity. Citizens on income support can be interpreted as a subgroup of the population. A credential that proves eligibility to income support therefore only divulges membership in that subset of the population while still affording anonymity within the group.

A citizen holding such a credential can prove eligibility for a discount by issuing a group signature while remaining fully anonymous. At the same time, in case of fraud the issuing organization can examine a signature and learn the identity behind the signature. Such a credential could contain the following elements: an attributes describing the scope of the credential (e.g. benefit = "income support"), an identifier for the issuing organization, the period of validity, a group public key and the signature of the issuing organization over that data. Figure 1 depicts the content of the credential.

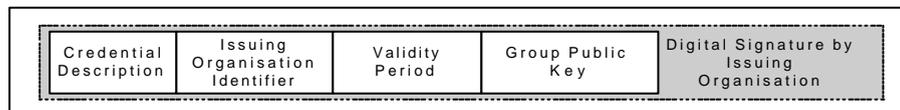


Figure 1. Content of the group signature-based credential

Building a credential based on group signatures yields the benefits of anonymity and, more importantly, also of total unlinkability. As the credentials of all group members are exactly identical, such a credential can be shown an arbitrary number of times without allowing the service provider to link transactions. The proposed credential also fulfils the possible requirement of governmental agencies that a system should not offer full anonymity: evidence of a transaction can be examined in court and with the aid of the issuing organization traced back to the citizen.

This approach is simple but has some limitations as well: this form of credential is suitable for all situations where a large number of people share the same attribute. This is due to the fact that showing the credential divulges the attribute contained in the credential. Therefore a credential should only contain as few attributes as necessary.

4.2 Infrastructure Considerations

The use of a credential implies a trust relationship between issuing organization, citizen and accepting organization. The governmental authority issuing credentials plays a role similar to a certification authority (CA) in a public key infrastructure. As such, the governmental authorities must provide some infrastructural components in order to act as a trustworthy issuer. Figure 2 depicts a conceptual view of the components that are necessary for an extension of digital identity with credentials.

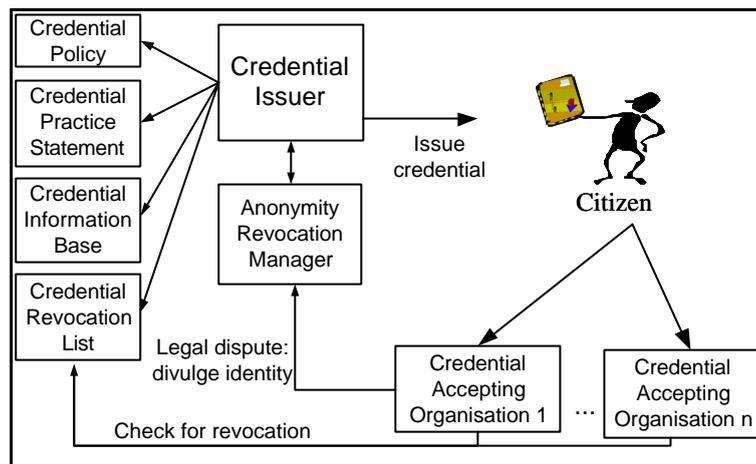


Figure 2. Overview of infrastructural components

A credential issuer needs to publish information about its credentials and provide infrastructural components:

Credential Policy and Credential Practice Statement: the credential policy statement is needed by a relying party in order to decide whether to trust the issuer. The practice statement adds detail to the policy and describes the issuing and life-cycle handling of a credential.

Credential Information Base (CIB): the credential information base is a collection of documents aimed at the end-user. It details where the credential can be used and contains a non-technical description of the scope of the credential and a privacy policy of the issuer. Citizens can get non-technical information about the credential and its use here. The CIB should be accessible via a browser.

Anonymity Revocation Manager: this entity may be an organizational entity within the issuing authority or a separate entity. The anonymity revocation manager is involved in the issuing process and keeps enough information to divulge the identity behind an anonymous credential in case of dispute. Such an entity is optional and only necessary if full anonymity is not desired.

Credential Revocation List: it is sometimes desirable to revoke a credential, i.e. in case of misuse. Revocation of anonymous unlinkable credentials are somewhat difficult to implement: current solutions require either additional mathematical operations linear in the number of revoked credentials (Bresson E. and Stern J., 1992) or require the credential holder to update part of the credential regularly (Camenisch J. and Lysyanskaya A., 2002). An approach encompassing a short credential life-time and recertification could be a more practical solution.

Further components are needed by the relying party that offers access to a service based on the credentials: a credential trust policy language and a processing engine for this language. The policy language describes the access policy for the service by stating how credentials are to be interpreted. It specifies which credential issuers are trusted, which credentials are necessary to access the service and which attributes need

to be demonstrated. Such a language is in its nature declarative and may be expressed in XML (Herzberg and Mass, 2001).

4.3 Concept for an On-card Credential Manager

The requirements stated in section 3 can be met by the proposed credentials. But in order to implement the system on a smart card, the card must act as carrier for credentials and provide functionality to manage the life cycle of a credential. More specifically, a card must accept and store a credential (including the private key), be able to execute a showing protocol, and also discard a credential automatically once the credential's validity period has expired.

Such an on-card credential manager can be envisioned in two versions: one is as add-on component to existent ID cards. In this case, the core of the citizen card manages identification and signature functionality while the credential manager addresses anonymous credentials only. Alternatively, the functionality of identification, signature and credential management could be integrated into one application on the card. This would lead to the integrated approach depicted in figure 3.

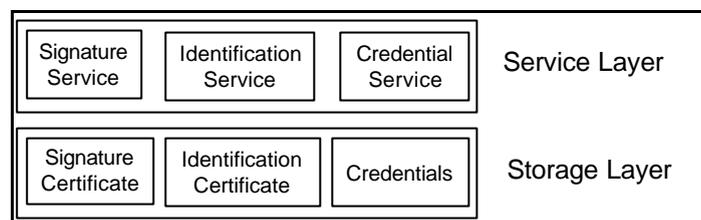


Figure 3. Architecture for an on-Card Credential Manager

The manager's functionality is distributed over two layers: the storage layer manages persistency for credentials and stores different types of credentials (and certificates). The service layer contains the core functionality of the manager. It implements the algorithms necessary for all protocols related to the credential life cycle. This layer constitutes the interface to the applications that use credentials. This could be an electronic kiosk (possibly web-based portal) or a service provider. The services offered by the service layer are as follows:

Issuing service: the manager executes the credential issuing protocol with a credential issuing organization. The credential and associated secret information is stored on the card

Show Service: this service selects a given credential (e.g. by provider and type) and executes the show protocol to demonstrate an attribute about the holder of the credential.

Display Service: displays the credentials that are currently stored on the card to the citizen. This service is needed to give citizen the possibility to see the credentials on the card and also to visualize the attributes encoded into the credentials

Signature Service: in an integrated approach to credential management, the signature certificates are managed by the credential manager as well.

Identity Service: in an integrated approach the credential managers also offers authentication with regard to an identity certificate

The showing protocol comprises presenting the credential to a verifier and proving rightful possession by use of the associated secret key. The verifier supplies the card with a challenge on which the card performs some calculations. This result allows a validation with respect to the credential public key but does not reveal any other information.

Non-transferability of credentials is also an important requirement. Since citizens might try to pass their electronic privileges on to other people, an on-card manager must also ensure non-transferability. In order to achieve this goal, a citizen must be kept from extracting the credential private key from the card. The public part of the credential may be passed on freely since it cannot be used without the associated private key. The fact that smart cards are designed to be tamper-proof makes them highly suitable as credential carrying entities. A card-holder authentication based on biometrics (e.g. finger prints) can prevent citizens from lending their cards to third parties (Auerbach and Maibaum, 2002).

4.4 Implications of Resource Restricted Environments

Digital ID cards are usually based on smart cards that are equipped with a cryptographic co-processor. Given the limited computational resources of today's cards this is a necessity in order to provide a sufficiently fast card-based signature capacity. The co-processors are fully transparent to the software developer and provide an API that includes cryptographic operations for commonly used algorithms (e.g. RSA, DES or SHA-1). Such a cryptographic co-processor could also be used to perform the arithmetic needed by a group signature scheme.

While the group signature system proposed in (Ateniese et al., 2000) requires complex mathematical computations that cannot efficiently be performed by today's generation of smart cards, the optimizations presented in (Canard and Girault, 2002) make it possible to use the concept of group signatures on smart cards. We expect that the discussion of privacy issues in e-government will lead to new requirements for future generation of cards. Credential technology will create a demand both through e-business and e-government applications and we expect that card manufacturers will extend their APIs to support a wider range of mathematical cryptographic functions.

5. FURTHER RESEARCH

We have presented a scenario involving sensitive data about citizens where it is desirable that a citizen's identity remains hidden from a service provider. Further research should be undertaken to clear the question which services by use of citizen cards may be delivered anonymously. A general debate on the scope for privacy enhancing technology (PET) and anonymous services is needed. E-government is a multi-disciplinary field, therefore such a discussion should be lead jointly by citizens, researchers, practitioners from administrative authorities and sociologists.

From a technological point of view, future research should address the use of more elaborate credential systems in e-government such as the one presented by Camenisch and Lysyanskaya (Camenisch and Lysyanskaya, 2000) or Brands (Brands, 2000). The question of how the citizen's privacy can be enhanced by technological means has yet to be given adequate attention both by practitioners and researchers in e-government. Further research should also address generic infrastructure components such as trust policy languages for use with credential systems.

6. CONCLUSION

We feel that most governments will have to answer the question whether digital ID cards are a 'conditio sine qua non' for electronic government. If so, privacy problems will have to be addressed in order to preserve the privacy of citizens and even enhance privacy wherever possible.

We have considered privacy threats introduced by today's citizen cards and presented a scenario from the domain of social security where an anonymous modus of service delivery would be desirable. However, today's proposed citizen cards do not support this requirement yet. We propose an on-card credential manager and the use of group signatures to build low-cost cryptographic credentials that can be used to anonymously demonstrate eligibility for a benefit. We have shown that credential technology combined with smart cards can afford anonymity to the citizen while respecting requirements from the administrative domain. Credentials as an access technology can extend the application area of citizen cards beyond the applications of pure identification and signature cards.

Form a technical point of view, we expect that credentials and other privacy enhancing technologies will become part of the extended digital identity of the citizen. Digital identity will thus in the future consist of smaller informational entities that contain less data than X.509 certificates and that may be shown independently of each other. Also, use of credentials will open up the possibility to provide some services anonymously while offering strong electronic trust relationships.

More research and a public debate is deemed necessary in order to gain a better understanding of the degree to which anonymity is practicable in the domain of e-government. The discussion should also address the question whether the concept of digital identity should be extended by an anonymous component. E-

government and the digitization of governmental institutions can offer chances to enhance the citizens privacy, not undermine it.

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THE “eBZ – DIGITAL CITY” INITIATIVE

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ABSTRACT

Since a few years digital government is becoming an active research area with lots of promises to revolutionise government and its interaction with citizens and businesses. Since up to 80% of transactions between the public administration and its customers take place at the local level, municipalities are the most important access point to government services and information. In this paper we present a new e-government initiative between the Free University of Bozen/Bolzano and the Municipality of Bozen/Bolzano, which aims at fostering the use of information and communication technologies in the local administration. We describe the objectives of the initiative and its context. Two projects have already been started, which are briefly discussed together with first results.

KEYWORDS

E-Government, Digital City

1. INTRODUCTION

Since a few years digital government (e-government for short) is becoming a very active and fast-moving research area with lots of promises to revolutionise government and its interaction with its customers (citizens and businesses). E-government can be defined as the use of information and communication technology as a means to improve transparency, quality and efficiency of service delivery to citizens, businesses and other authorities. Thereby, a particular focus is on the use of the Internet as the most promising technology to change the traditional way of public administration. Apart from these more technical aspects, e-government has many sociological and organisational facets which have to be considered and studied in a necessarily multidisciplinary approach.

Government transcends all sectors in a society (Elmagarmid & McIver 2001), and hence, by both its size and scope of activities, represents the biggest single information content resource for the creation of value-added information content and services. Digital government, as a result, has the potential to profoundly transform citizens' conceptions of civil and political interactions with their governments. Unlike commercial service offerings, digital government services must be made accessible to all.

In a recent study, Ferguson and Baron (Ferguson & Baron 2002) found out that up to 80% of transactions between the public administration and its customers take place at the local level. Municipalities become the most important access point to services and information of the public administration. Therefore, the exploitation of new technologies in local service provision is vitally important for the success of e-government.

In this paper we present a new initiative between the Municipality of Bozen/Bolzano and the Free University of Bozen/Bolzano, which aims at fostering e-government in the local administration. In section 2 we briefly report about some strategic decisions and political initiatives to move towards a digital government in Europe. In section 3 we present the “eBZ – Digital City” initiative. In section 4 we discuss two projects which have already been started and we draw some concluding remarks in section 5.

2. TOWARDS DIGITAL GOVERNMENT

2.1 Political Context

In 1999 the European Commission launched the eEurope initiative with the key objective to bring the benefits of the information society to all European citizens. To achieve these objectives, the Commission proposed several priority areas, one of them being e-government. E-government is expected to transform old public sector organisation and provide faster, more responsive services. Information and communication technology is seen as the enabling technology for the realization of e-government. The challenge for administrations is to adapt quickly to the new methods of working and enable new innovative ways of working.

At the national level, the European countries started to implement this vision of eEurope by taking the necessary strategic decisions and providing the legal framework. In Italy, several authorities and organisations have been established to foster the "digital revolution" of the economy and the society including the public administration. The Italian government has developed the "Action plan for e-government 2000-2002" (<http://www.pianoegov.it>) with an overall budget of approximately 650 million EUR. This plan is the reaction to the eEurope initiative and defines vision, strategies, and objectives of a new digital government. In this document the role of municipalities is absolutely crucial in that they shall become the unique access point for the public administration and have to mediate all information from all other local and central authorities. This move towards the so-called one-stop government with a single point of access to public services and information is a general trend in e-government initiatives (Wimmer 2001).

In Bozen/Bolzano the City Manager in his strategic program 2002 sketches a first vision of a digital city, which exploits the full potential of information and communication technology to revolutionise the internal organisation of the municipality as well as the interaction with citizen and businesses. He further stresses both the importance and the intent to apply information and communication technology in all sectors, which is absolutely necessary to guarantee an efficient and high quality public administration.

2.2 Digital Government and the Web

There is general agreement that e-government evolves along several stages. (Hiller & Bélanger 2001) identifies five stages: In the first stage information generated by the government is disseminated (*one-way communication*). The second stage allows simple requests and changes (*two-way communication*), often based on e-mail exchanges. In the third stage individuals interact with the government and conduct *transactions* (which may also include financial transactions) completely online, with Web-based self-service replacing public servants in these cases. The fourth stage, the *integration* stage, integrates all government services. Constituents can access the service they need from a single portal no matter which agencies or departments offer them. Integration not only of online, but also of back-office systems is a precondition for this stage. In the *participation* stage government sites provide services like voting online, registration online or posting comments online.

Even if e-government is not limited to Internet and the Web, but includes the use of virtually all information and communication technologies, the current vision of digital government is dominated by the Web and the opportunity to offer services over the Web. Web-based e-government systems in the fourth and fifth stage according to the classification presented above are still the exception. Several technical, infrastructural and organisational problems have to be solved, e.g. security, data integration and network infrastructure. Some exemplary government portals are eCitizen (<http://www.ecitizen.gov.sg>) in Singapore, FirstGov (<http://www.firstgov.gov>) in the USA and MAXI (<http://www.maxi.com.au>) in Victoria, Australia.

Recently, also in Italy several cities started to invest in Web portals. For example, the city of Bologna has established a one-stop shop for enterprises (<http://sportellounico.comune.bologna.it>). The city of Parma offers services like the online-enrolment to school (<http://www.comune.parma.it>), where a smart card is used for digitally signing the request. Finally, citizens of Firenze (<http://www.comune.firenze.it/payer.htm>) and Venezia (<http://www.egov.comune.venezia.it>) can pay a part of the taxes online.

3. eBZ – DIGITAL CITY

In February 2002 the Municipality of Bozen/Bolzano together with the Free University of Bozen/Bolzano started a 5-year collaboration, called the “eBZ – Digital City” initiative.

3.1 Objectives

In concordance with eEurope and the Italian action plan for e-government, Bozen/Bolzano shall become a pilot example of a digital city at the Italian and the European level. The city will make considerable efforts and invest substantial resources towards the exploration of information and communication technology in the local government. The overall objective is to improve the efficiency of the administration, to improve the quality of services and to provide an easy and transparent access to relevant information and services for all citizens and businesses.

Public Online Services (e-communication). Great attention will be given to online portals, which provide access to all services and information of the public administration to businesses and citizens:

- Information (competitions, calls, forms, etc.) and services (submission of forms, payment, etc.) should be accessible to all citizens independently of time and location (anyone, anytime, and anywhere). A specific aspect of the initiative concerns the access to all services for disabled people, a point which has been stressed recently in several recommendations and normative documents.
- Citizens and businesses can access services they need without being aware about the internal organisation of the public administration. Information and services can be organised according to life situations.
- While the Web offers new communication possibilities, it cannot completely eliminate the traditional ways of interaction between the public administration and its customers. Therefore the Web portal should be supplemented with traditional channels such as mail and phone.

Internal Organisation (e-administration). The following activities focus on organisational and technological issues in the back-office which have to be considered in order to respond in real time to the needs of citizens and businesses:

- Integration of back-office systems: For historical reasons, the current architecture is characterised by inhomogeneous islands which hamper the exchange of data between single offices.
- Reorganisation and automation of working procedures using tools like workflow management systems.
- Implementation of the digital signature and use of smart cards. These are necessary for higher level online services, for integration between back-office services and for the substitution of printed documents and records by digital versions.

Research and Education (e-education). Research and education are two important support activities. The collaboration with research institutes guarantees the exploration of the newest technology. Education is important to train employees of the public administration as well as to inform citizen about the new services. The following actions are planned:

- Informing the citizen about the new services and establishment of a learning point, where the employees of the municipality will be trained.
- Elaboration of a feasibility study for the implementation of a study program at the Free University of Bozen/Bolzano focusing on information and communication technology and public administration.

3.2 Implementation

The two partners, Municipality of Bozen/Bolzano and Free University of Bozen/Bolzano, will implement the “eBZ – Digital City” initiative by concrete projects. A working group has been established which is responsible for the overall planning and administration. This working group develops annual plans with specific projects to achieve sub-goals. Each new project has to be integrated into the overall framework.

The Free University of Bozen/Bolzano provides the portal to the international research community. Its role will be to support the projects at the research level, to bring in the newest technologies, to implement research prototypes, and to support the Municipality of Bozen/Bolzano in the development of educational programs at the academic level.

4. TWO eBZ PROJECTS

In this section we briefly describe two concrete projects, which have already been started under the umbrella of the “eBZ – Digital City” initiative.

4.1 Automation of Workflow Management

A rather important aspect of e-government is the automation of the back-office. As part of this process, we started a few months ago to introduce a workflow management system at the Municipality of Bozen/Bolzano. Thereby, a very important step was to redesign and partially reorganise administration procedures. As a specific use case, we describe here the procedure of applying for a permit for allocation of public ground. This procedure has been subject to a profound investigation during the last months, followed by a re-engineering of the process and its partial automation.

4.1.1 The COSAP Procedure

If public ground has to be allocated for construction work, scaffolding or road works, a permit from the local authorities (COSAP office) has to be applied for. The requester has to bring in the request with some attachments, such as maps which illustrate the work to be done. This request activates a rather complex internal process, which will be described below (see also figure 1).

1. The incoming request has to be logged, and a preliminary check on completeness has to be done. Eventually, the requester may be invited to bring in missing parts.
2. Up to eight internal offices have to be asked for an opinion, e.g. the Road Construction Office, the Transport Planning Office and the City Police.
3. The opinions have to be evaluated. If one of them is negative, the request has to be denied, and the process terminates with writing a negative answer.
4. If all opinions are positive, the request can be answered positively. A decree is written which allows the requester to allocate the public ground; further a written permission and a bill for the fees to pay have to be generated.
5. The whole file (decree, permission and bill together with the request and the opinions) have to be checked and signed by the person in charge and the executive officer. If they don't approve the documents as they are, some of them may have to be rewritten.
6. The decree has to be signed by the mayor or the vice-mayor. If he disagrees, the decree has to be reworded.
7. The decree and the written permission can be logged now.
8. The decree has to be sent to over 30 internal and external entities which need to know about traffic obstacles, e.g. the police, the fire brigade and the public transport agencies.

9. Now the requester has to pay a fee and he can pick up the written permission for allocation of public ground.

The workflow for the COSAP procedure involves about 10 internal offices in the process and has to inform about 30 internal or external offices and institutions. The input of the process consists in the request form and its attachments and the fee. The output is the refusal, or the permission with the bill and a decree.

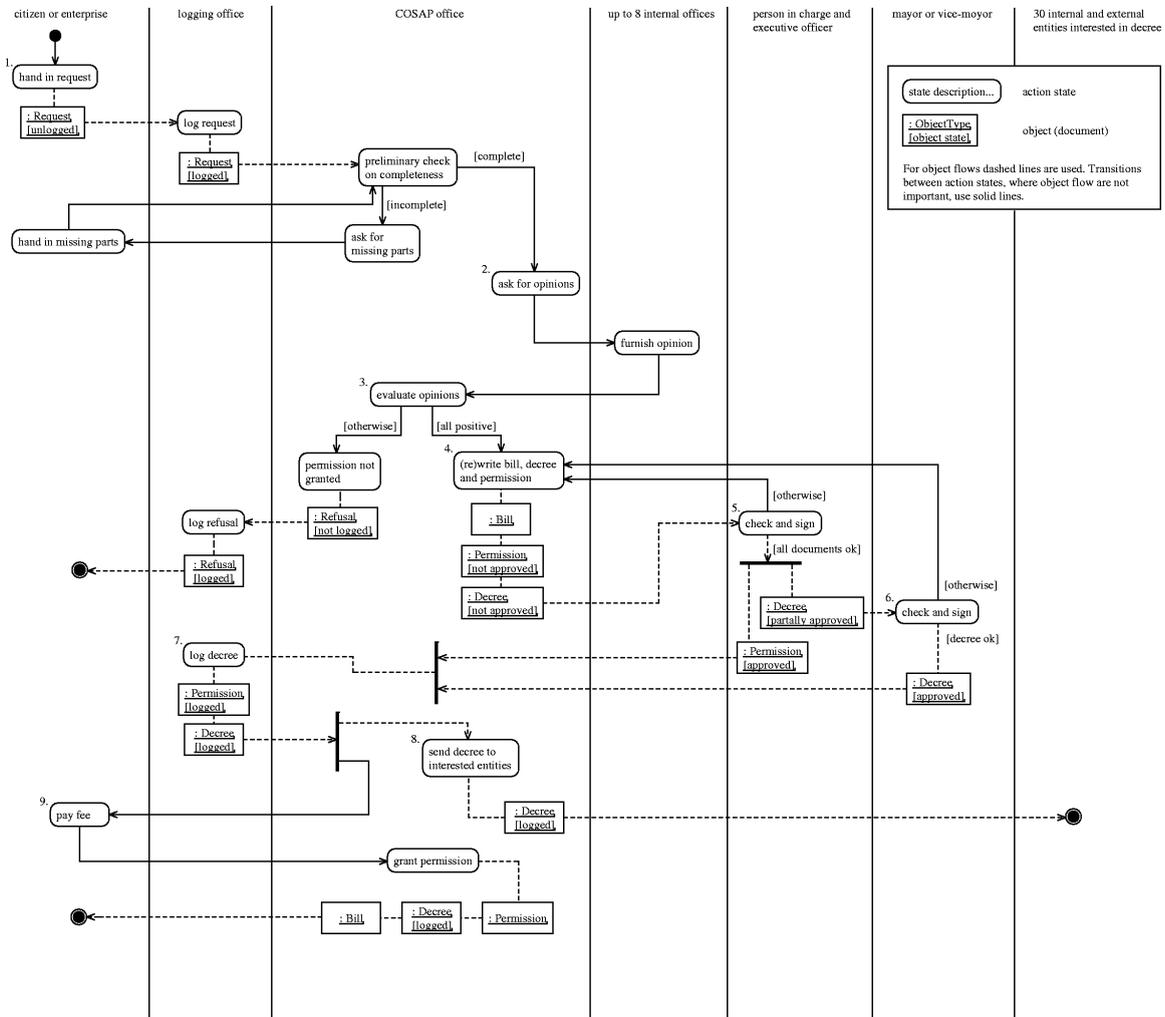


Figure 1. This workflow shows how to apply for a permit for construction work, scaffolding or road works from the local authorities.

4.1.2 Problems and Opportunities

In the following we will discuss problems and opportunities we discovered during the automation of the COSAP procedure:

- Decentralising logging:** Three documents have to be logged (see step 1 and 7). As the documents for logging have to be sent to the central logging office via internal post, this is a very time consuming process (a couple of days for each logging step). In order to speed up the overall process, the logging step could be decentralised to the COSAP office. As all documents of the municipality have to be numbered consecutively, this can't be done independently from the central logging database. However, it turned out that so far it was not possible to interface the central logging server with the workflow application. Therefore all COSAP operators had to be instructed to use the

same client application as the operators of the central logging office. As they have to log only few types of documents, this was feasible.

This solution, however, is not satisfactory, as the workflow application stores all information necessary to automatically log the documents. While APIs (Application Program Interfaces) to the logging database would be very helpful in this case, we suggest interfacing clients and server via Web services.

- *Asking for opinions in parallel:* So far opinions have been asked serially, sending the request and its attachments in paper form via internal post to all the offices concerned. Even though it would not be a problem to copy the paper request and its attachment in order to ask opinions in parallel, there are dependencies between the opinions which cannot be considered that way. By digitising the process not only it is easier and faster to distribute the copies of the file, but as an additional benefit the various offices can see the opinions expressed by all the others in real time.
- *Eliminating redundant input:* By digitising all information about the files and creating output documents (i.e. refusal or bill, decree, and permission) semi-automatically from templates, redundant input can be avoided. As a side effect of the digitalisation process, the document templates and forms have been reviewed and some of them have been eliminated.
- *Digital signature:* No digital signatures were used up to now. Therefore some steps could not be automated, e.g. in step 1 the digital signature would be essential to bring the service online, as the request has to be signed by the requester.

The automation of the workflow offers a lot of opportunities to make the process more efficient. Not only time can be saved by sending information via network which would otherwise have to be sent by the relatively slow internal post, but as a side effect processes are reviewed, simplified and dusted. Some processes can only be made parallel, if they are digitised. Redundant input can be avoided and documents can be created semi-automatically. We also discovered that program integration is a crucial problem. The use of Web service interfaces instead of API interfaces seems to be a good way to go. Finally, the widespread use of digital signatures is a key issue to fully be able to digitise a service.

4.1.3 Status Quo and Perspectives

The automation of this workflow was implemented as a Web application. Each participant in the workflow has his/her individual Web interface through which he/she gets access to all the documents. Depending on the role of the participant and the actual status of the document, only specific operations on these documents are enabled. The workflow application has been developed and is hosted by ASI Mantova (<http://www.asimantova.it>).

After running extensive tests over some months, the application is now operational since February 2003. The next step is to evaluate how the automation affects the quality and the effectiveness of the COSAP procedures. A further step will be to introduce the digital signature and to bring the service online. One of the problems to face in this context will be the acceptance of the digital signature—by both, those who have to sign the documents (e.g. in step 6) and those who receive them (e.g. in step 8).

4.2 People

Bozen/Bolzano participates together with 53 other local authorities in the PEOPLE project (Progetto Enti Online Portali Locali E-government—project of public bodies with online local gates of e-government, <http://www.progettopeople.it>), which covers 13% of Italy’s population. The project was launched in 2002. Its goal is to establish a standard for accessing the 200 most important services offered by local authorities (e.g. permissions, social services, payment of council taxes). A middleware layer will be implemented, which allows to access the standardised services regardless of the legacy applications in use. On this middleware layer a Web portal will be build and a network between PEOPLE members will be established. This network will use messaging capabilities of Web services in order to integrate services offered by different municipalities. Supporting services (e.g. online payment, authentication and authorisation) will be shared between members in the PEOPLE network.

The first challenge has been to aggregate for a common project the municipalities which substantially differ in size (ranging from small cities with some thousands of habitants to Rome with more than 2 million),

experience of their technical staff and political orientation. Working groups have been formed which concern with the design of the overall architecture, the investigation and standardisation of the various services, and usability issues for the future Web portal. The organisational structure and the ways of interaction between the working groups are being defined.

We expect this project to be a major step towards e-government for Italian municipalities. Together with the architecture and the Web portal which will be developed, the standardisation of the 200 services will be the most important output of the project. As a (hopefully) critical mass of municipalities will agree on these standards, there are good chances for them to become a national standard. Further the detailed description of the services will constitute a valuable source of information for a better understanding of the domain.

5. FINAL REMARKS

E-government has the potential to revolutionise the quality and the performance of governmental services and to transform citizens' conceptions of civil and political interactions with their governments. Since the mid-1990s governments around the world have been executing major initiatives in order to leverage information and communication technology to deploy e-government services. Many governments have started making claims that they have already transformed themselves into e-government. However, most of these claims are shallow, and much effort is required before e-government can be fully realized. The progress of e-government, in particular the distribution of information and services over the Web, has been evaluated in quite a few reports (Ronaghan 2002, Sharma & Gupta 2002, Wauters & Kerschot 2002).

There are also a number of running research projects which foster new technologies in the public administration. For example, the project eGov (Wimmer 2001) aims at the provision and evaluation of an open, extensible and scalable platform for realising online one-stop governments. As part of this project, the GovML description language is being developed which supports the exchange of data within this framework. GovML is based on XML and RDF and is inspired by ebXML.

In this paper we presented the "eBZ – Digital City" initiative between the Municipality of Bozen/Bolzano and the Free University of Bozen/Bolzano, which aims to explore the vast potential of information and communication technology—in particular the Internet—for the purpose of improving quality and efficiency of the local administration. Similar initiatives have been launched in several European countries, for example eTampere (<http://www.etampere.fi>) in Finland and the Gaia Digital project (Gouveia & Gouveia 2002), Portugal.

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AN AUTHORIZING SYSTEM FOR THE AUTOMATIC GENERATION OF VIRTUAL EXHIBITIONS

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ABSTRACT

The use of virtual reality on the Web offers exciting opportunities in several application fields (e.g. cultural heritage, e-learning, e-commerce). Nevertheless, the adoption of such technology is not as widespread as one would expect. The main reasons can be found both in the difficulties for the development of virtual environments, which requires a collection of advanced skills and a variety of tasks, and in the limitations of current desktop virtual reality technologies which do not allow users for a comfortable navigation of the scenes. To overcome these problems, we propose an authoring system which enables authors without skills on 3D technologies to automatically generate their own virtual exhibitions. Moreover, to simplify the navigation within the scenes, a specific paradigm based on the concept of guided tour has been adopted in the generated exhibitions.

KEYWORDS

Authoring System, Automatic Generation, Virtual Reality, Web3D

1. INTRODUCTION

In the last years, thanks to the parallel availability of wide Internet bandwidth and powerful 3D graphic hardware for a broad range of personal computer users, some institutions have experimented communication initiatives that use 3D representations as an alternative or a complement to hypertextual ones.

Such experiences showed that in many contexts the 3D provides enough enhancements to justify the discard of traditional 2D metaphors. Encouraging results were found in e-commerce, where 3D allows users to get more information about the goods [Po3D], in entertainment, with complex videogames, and in edutainment, where many authors report enhancements in cognitive process using virtual environments. [Bre93, AIH00, CDP02]. In particular, desktop virtual reality seems to be one of the most appealing technologies for educational and cultural heritage advanced applications, both because users (and in particular students) are fascinated by the adoption of innovative solutions to convey cultural and educational information, and because Virtual Reality (VR) enables to discover the world through a *sense and motion learning process*, more natural for human beings than the symbolic-reconstructive way, such as writing [BBC00]. But, at the present, the diffusion of such technologies is limited by some factors. From a developer point of view, the creation of virtual environments is a challenging task. In fact, the majority of 3D worlds currently available on the net are created by 3D experts using professional but difficult tools, such as 3D

Studio Max [D3DS] or Maya [AWM], absolutely not suited for naïve authors. Only in recent times a limited number of tools propose simplified approaches, suitable for a broader range of users. For example, Outline3D [Out3D] allows to easily draw an interior starting from a plan and completing it with furniture taken from a comprehensive catalogue, using a *drag & drop* mechanism. The Virtual Exhibitor [VeX] is a tool that permits to construct and simulate in 3D an exhibition space where to place freely the exhibit items. However, these tools adopt a direct manipulation paradigm of 3D primitives, in order to correctly place and show the set of objects composing the virtual environment. This task can still be challenging for people unskilled about 3D concepts, limiting the adoption of such tools. A different approach is offered by the MATTHEW system [GrC99], which aims to be an easy-to-use visual authoring tool to help inexperienced users setting up an exhibition. However this tool helps the authors only on disposing in an optimal fashion the objects to show within an environment starting from its 2D map, without generating any resulting virtual scene.

From an end-user point of view, the main factor limiting the diffusion of virtual environments on the web is the difficulty with the orientation and navigation in a 3D space. Indeed the standard input devices for personal computers, such as mouse, touchpad or trackball are limited to two degree of freedom (X and Y axis), while the exploration of virtual environments requires, at least, four degree of freedom (2D pan, yaw and pitch). Moreover, current Web3D browsers offer hostile interfaces, which do not satisfactory support the users during navigation.

The aim to simplify the production and the use of meaningful virtual worlds has motivated us to develop an Authoring System, which allows an automatic generation of 3D virtual exhibitions using a user-friendly interface. The generated worlds include a navigational paradigm based on the guided tours, which simplifies the use of virtual exhibition by desktop end-users. Moreover, our system results general-purpose, because it is able to fit very well a large variety of domains, ranging from Cultural Heritage (development of virtual museums) to e-learning (as a Learning Content Management System) or e-commerce (development of virtual shops).

The paper is organized as follows. In section 2 we will present the proposed authoring system, its architecture, the underlying navigational paradigm, and the structure of the generated 3D exhibitions, while in section 3 we will show the system interfaces for both the authoring and the navigation of the virtual scenes.

2. THE AUTHORING SYSTEM FOR THE GENERATION OF VIRTUAL ENVIRONMENTS

We experienced that the adoption of direct manipulation interfaces for the development of virtual environments is not the best solution for naïve authors, because, even if such systems often support stunning features and allow a perfect placement of the objects, they have a very steep learning curve, discouraging potential unskilled users.

To overcome these problems, we have developed a easy-to-use authoring system for the generation of virtual exhibitions, which presents a form-based user interface. In order to define a virtual scene, an author selects some objects via a simple query (something like: “Create an exhibition where Author = Michelangelo and Type = sculptures”) and the engine of our system creates the customized virtual environment containing the required 3D objects. Such world is dynamically generated in VRML (the standard language for the description of 3D scenes on the web) [VRML], using the Java Server Pages [JSP] technology.

2.1 The System Architecture

The system was developed adopting a typical three-tiered schema, composed by:

1. Some clients, with a Web3D-capable browser;
2. A web-server, able to manage dynamic contents;
3. One or more database servers, equipped with relational DBMS

In order to obtain a portable, reusable and open-source tool, the system adopts the HTML for the user interfaces, VRML for the 3D scenarios and Java (with its related technologies) as programming language.

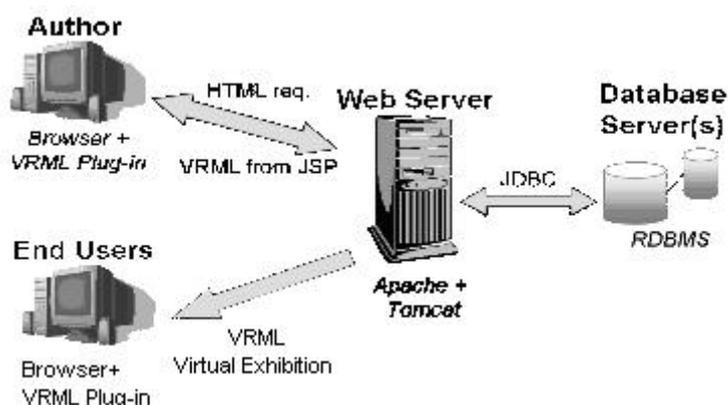


Figure 1. The three-tiered system architecture

Figure 1 describes the architecture of the system and its typical usage. We suppose the existence of one or more databases containing the relevant objects to show in the scene, along with their appropriate descriptions and a link to their representations in VRML. As first task, an author defines, via a simple HTML form, a virtual exhibition containing a particular set of objects, selected from the databases. The web server, equipped with Apache and Tomcat, then processes the requests and generates a VRML file using Java Server Pages technology. Such file, containing the demanded 3D objects taken from a relational database, is then published on the web, in order to allow, afterwards, an end-user to navigate that virtual scene.

2.2 The Database Schema

To allow the greatest flexibility in the selection of the objects to show, it was fundamental to define a database schema containing as more information as possible.

To this aim, we implemented the Dublin Core (DC) [DCS] metadata schema. The DC is a core set of 15 semantic definitions for describing resources likely to be useful across a broad range of industries and disciplines. It was defined by the Dublin Core Metadata Initiative (DCMI), an organization instituted by the National Center for Supercomputer Application and the Online Computer Library Center. The DCMI is dedicated to “promoting the widespread adoption of interoperable metadata standards that enable more intelligent information discovery systems” [DCS]. The DC was successfully adopted by the Computer Interchange of Museum Information to catalog the artworks of the principal world museums, such as the British or the Smithsonian.

By adopting the DC metadata, for each item in the database, it is possible store, among other information, the title, the author, the date of creation, the size, the format, some describing keywords, and a link to the digital counterpart. For our purposes, this can be an image (GIF or JPEG), a 3D object (VRML), a movie (MPEG, AVI, MOV), a sound (MP3, Wav, MIDI, AIFF; AU), a hypertext (HTML) or a hyperlink (URL).

Because the DC is a worldwide-accepted standard, our authoring engine can connect to eventually distributed databases too, on condition that the contained items have some digital representations in a supported format..

2.3 The Underlying Navigational Paradigm

It is widely recognized that orientation and navigation are crucial issues for an effective and pleasing interaction with virtual environments, but, in spite of that, current Web3D browsers do not offer satisfactory solutions to support these tasks. Among the major drawbacks, the paradigm of interaction in many cases is not easy to understand, often there are too many options for navigation, the default interface usually lacks tools for orientation, the visual field for desktop virtual reality is narrow and the scene representation has to be simplified due to performance limits on average personal computers [Pit01]. It is widely recognized that the guided tour paradigm allows us to resolve many of the navigational problems, since the user has to follow a preferred path in order to explore the virtual exhibition. The path is composed of a set of nodes, and the 3D

browser is responsible to move the viewpoint smoothly and in a semiautomatic way from one node to the next. To increment the effectiveness of the guided tours, preceding works led to formulate the concept of “Interaction Locus” [CeP01] to represent and characterize sets of nodes: the whole 3D environment is divided in themes, named Interaction Locus that are characterized by homogeneous morphologic features and the same interaction modalities. Each theme informs the user about its specific nature by starting a coordinated set of information streams each time the user enters inside of it. Such information streams involve several user senses, e.g. using parallel visual, auditory and hypertextual communication channels. Thus, multimodality, a peculiarity of the real world experience, is used to overcome the limits of vision in desktop virtual environments, allowing the user to gain more awareness of the 3D world structure for orientation purposes.

The navigational paradigm which is underlying the proposed system is based on the Interaction Locus concept. Such paradigm turns out to be suited for a broad range of virtual exhibitions, where a sequence of 2D/3D objects are shown to users within a specific environment and the user can receive different levels of information about each item. For example, in e-commerce, a virtual shop is constituted by a set of areas containing the goods. The user can receive an overview of each good, as well as an in-deep description of the items in which he/she is interested.

The proposed model adopts the guided tour as the main modality to access the 3D scene, but it also considers other navigational paradigms to allow users to access directly to specific features of the exhibition. Then, our navigational model proposes the following modalities to access information:

- *Guided tour*, which allows the user to navigate the virtual exhibition by following a preferred path in a semiautomatic fashion, providing a sequential access to the elements characterizing the 3D world.
- *Index*, which allows the user to navigate the virtual exhibition by identifying the elements of interest from a list.
- *VE Map*, which allows the user to navigate the virtual exhibition by identifying the elements of interest from a graphical map of the 3D scene.
- *Query*, which allows the user to access directly to any element via a search engine [CDF02].



Figure 2. The access primitives

We introduce in figure 2 some symbols representing the adopted access primitives, to visually describe the proposed navigational structure in figure 3.

All the relevant objects of the exhibitions are organized inside Interaction Locus. The main modality for navigate the virtual exhibition is then a hierarchical guided tour, that conduct the user through the set of items composing each Interaction Locus. Therefore, from a navigational point of view, entering into a specific Locus is the condition required to access information about specific objects. Moreover, as shown in the figure 3, the information about each object is structured into two different levels: at the first level the user receives basic information about its features, while at the inner level he/she gets an in-deep presentation of the item. The access to the more detailed description may be mediated by an index, because, even if in many cases there is a unique in-deep description of the item, it is possible to present to the user different information about a certain object. For example, in the cultural heritage field, it is possible to show different presentation of an artwork, given by different art experts.

Finally, note that the Query modality overrides the general rule of mediating the access to items with information about the Locus (and therefore the context) where they are placed; in this modality the visitor, interested in finding a particular information rather than in visiting the exhibition, is “teleported” in front of the desired item; after having visited the requested level, he/she may then choose to visit the rest of the exhibition or to perform another query.

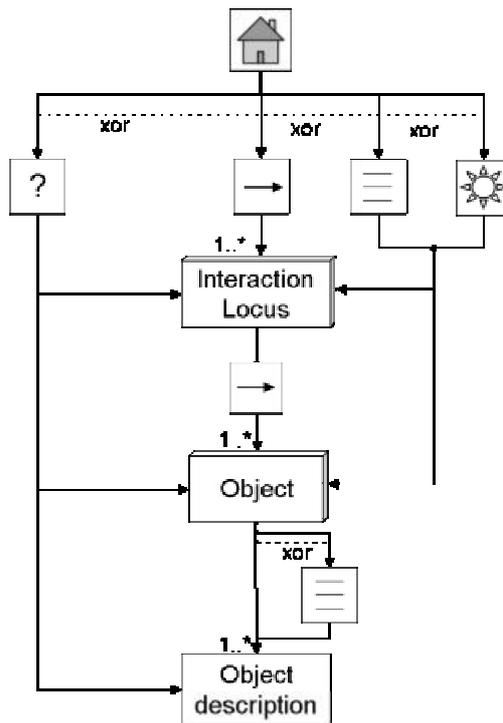


Figure 3. The proposed navigational paradigm

2.4 The structure of the generated virtual exhibition

To realize a comfortable exhibition, the generated virtual environment is composed by a variable number of rooms, dynamically calculated basing on the amount of objects to show, like in a real museum. The 3D objects selected by the author are placed inside the rooms, by using some procedures leading to scenarios with a balanced distribution of the objects, taking also into account the real dimension of each object (coded in the database). The system has virtually no limits on the amount of objects to show, because it can easily scale increasing the number of rooms, simply linking each other. In Figure 4 it is shown a virtual exhibition generated by the system, composed by three rooms and containing some paints on the walls.



Figure 4. A Cultural Heritage virtual exhibition generated by the Authoring System

To concretize the concept of Interaction Locus, the system creates a correspondence between rooms and themes of the virtual exhibition. Each theme has its own morphologic characteristics, such as specific background audio clips, particular textures on the floor, and so on, selected within a set of predefined combinations or specified by the author. Figure 5 shows a possible arrangement of two themes, mapped onto two rooms of the virtual exhibition.

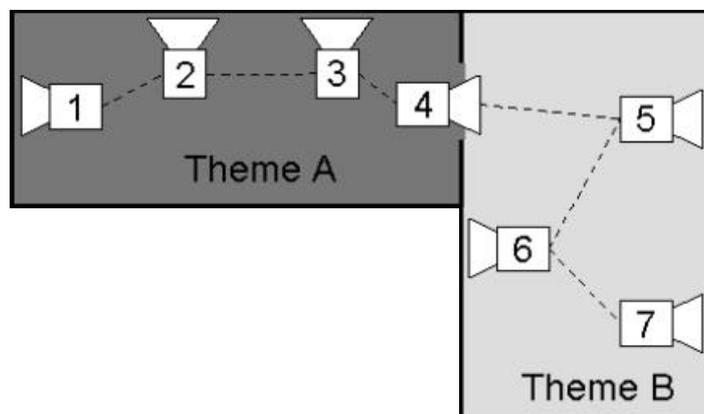


Figure 5. A scheme of a virtual exhibition with two rooms

To implement the proposed navigational paradigm, the system generates a guided tour within the virtual exhibition, which directs the user through the whole scene. Each 2D/3D object shown in the virtual world constitutes a node of the tour; for example, each theme of Figure 5 contains three items, which, once linked together, compose the guided tour. VRML clients [CorP, CosP] implements some features to support the guided tours, such as a smooth camera transition from a viewpoint to the next. Unfortunately, such transitions do not take into account eventual obstacles that are present in the trajectory between two adjacent viewpoints, passing through them. So, in order to avoid the 'ghost effect' of a wall-through pass, the system automatically adds some 'dummy' viewpoints, placed near the doors of the virtual rooms, as the one numbered 4 in Figure 5.

Moreover, the system automatically creates a list of link to all the themes and the objects composing the scene and a small map of the virtual exhibition, to allow the users to direct access to all the objects showed.

3. USING THE SYSTEM

The engine of our system can be profitably used in a wide range of domains, thanks to the great flexibility allowed by the adoption of the Dublin Core standard to describe the objects.

In particular we have experienced three contexts:

1. Cultural heritage, to permit institutions to easily define virtual museums;
2. E-learning, as a Learning Content Management System (LCMS), intended to support the teachers in the definition of educational virtual exhibitions;
3. E-commerce, as an authoring system to easily define the layout of virtual shops.

All these domains include a phase where an author uses the system to easily define some virtual scenes, and then a phase where the end users explore such world. In the next subsection, we will describe the graphical user interfaces (GUI), designed to support authors and end-users.

3.1 The interfaces for the author

The author interacts with our system, through some HTML-based interfaces, for two main tasks:

1. To specify the set of objects to show in the virtual exhibition, among those present in the database;

- To group the set of previously selected objects, in order to define the set of Interaction Locus composing the virtual exhibition.

Figure 6(left) shows the web page that allows the author to define the exhibition. It contains 15 fields that correspond to the set of DC metadata. The author inputs the data useful to define his/her query in these fields just like a search engine, optionally using Boolean operators to define more complex queries, and then submit the form to the web server.

As result, he/she receives the web page shown in Figure 6(right), containing all the records in the database that match the submitted query. Through this page, the author can group together the objects with some inherent relations (e.g.: all the paints of a specific artist) in order to define the Interaction Locus of the virtual exhibition. Optionally, he/she can specify, for each Locus, some morphologic characteristics, such as the wall color, the audio background, and so on. If the author does not specify any grouping, the system automatically proposes some themes, basing on the input information (e.g.: Authors, Object types, creation data, keywords, etc...)

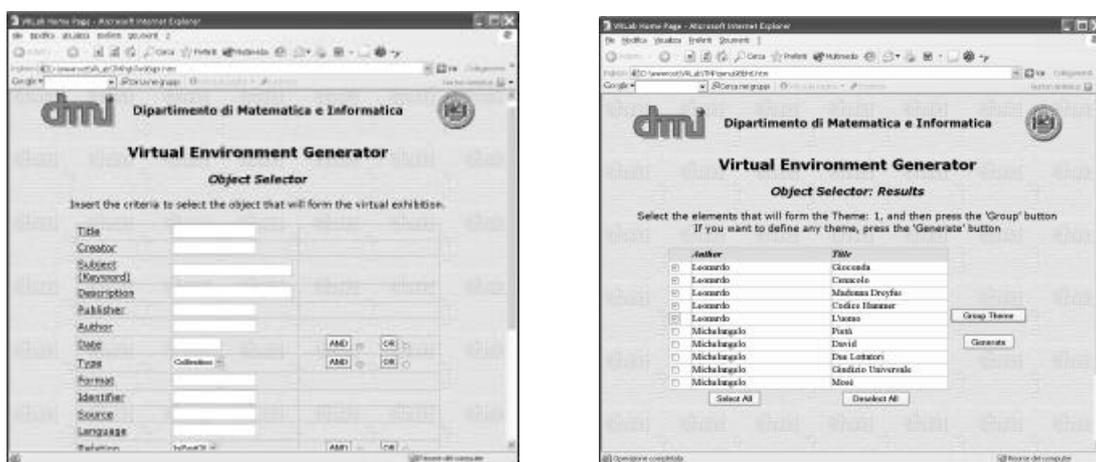


Figure 6. The interfaces for the author

3.2 The interface for end-users

To allow the users to profitably enjoy the proposed navigational structure, we have defined a specific interface for visualizing the virtual exhibition, called *VEGUI* and shown in Figure 7.

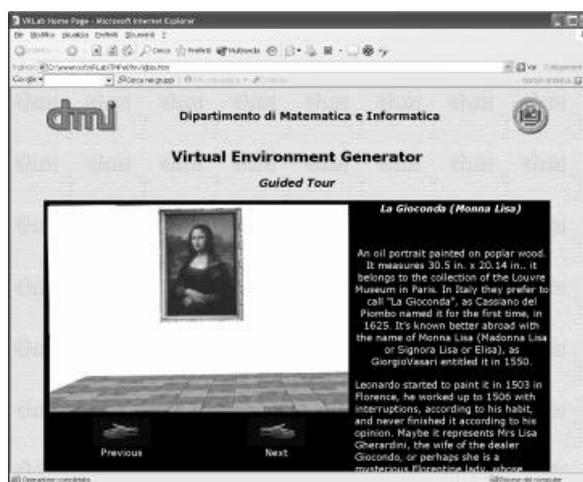


Figure 7. The VEGUI

The VEGUI is structured in three zones: on the top left there is the VRML canvas, showing the virtual environment. On the right, there is the hypertextual description of the shown object, while in the bottom there are the widgets enabling the navigation through the guided tour.

A start page shows to the user a link to the beginning of the guided tour, a list of links to all the Interaction Locus together with the contained objects, and a clickable map of the virtual exhibition. Once started the guided tour, the user has simply to press the button "Next" or "Previous" to move through the nodes because the 3D browser will smoothly change the viewpoint. When in front of an object, its high level description appears in the right frame, while by clicking on the object (i.e. the paint in the fig. 7), a pop-up dialog opens, showing to the user the in-deep information.

4. CONCLUSIONS

In the last years, strong efforts have been devoted towards the definition of systems that allows an easier definition and fruition of Virtual Environments. In the paper we propose an authoring system useful to easily spread knowledge over the Internet using the Virtual Reality metaphor. In fact, it enables authors unskilled of 3D technologies to create their own virtual exhibitions. The generated scenes contain a set of 3D objects selected from a database through a user-friendly, form-based GUI.

Moreover, the authoring system enables end-users to easily navigate through the generated scene, taking advantage from a specific navigational paradigm, based on an enhancement of the guided tours.

Thanks to its features, the system can be profitably used in a wide range of domains such as e-commerce, e-learning or cultural heritage.

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COLLABORATIVE LEARNING IN A VIRTUAL REALITY ENVIRONMENT

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ABSTRACT

3-D virtual environments for online learning may be considered a second generation of software for distance learning support and allows learning by doing. The construction of these environments with both proprietary and open technologies was the object of the work related in this paper. Methodology and processes used in the creation of 3-D objects and in the development of a collaborative learning environment software using virtual reality are presented as well as some details about implementation. A virtual tutor based on chat technology is also part of the designed and implement virtual laboratory aimed to support collaborative learning.

KEYWORDS

Virtual reality, collaborative environments, artificial intelligence, distance learning.

1. INTRODUCTION

We are living now in a digital era of learning. Transformation in learning is taking place from "broadcast" learning to "interactive" learning. No longer are today's generation of learners satisfied in being the passive recipients of the traditional teaching process, rather, they want to discover it for themselves by becoming interactive with the learning. Though, how successful technology-mediated learning activities will be at facilitating higher order thinking skills will be dependent upon the approach taken to the design, delivery, selection, and utilization of appropriate and effective technologies with a support structure to maintain and sustain the learning transactions. Recent advances in information technology have made it feasible to employ distance learning systems in support of the growing demands for educational services. Unfortunately, it is difficult for present distance learning systems to deliver the 'hands-on' learning environment that a well equipped laboratory provides. Virtual Reality may be used to allow the distant student to access an interactive virtual laboratory. It is important to note that a VR system is essentially an interactive simulation that can represent a real or abstract system. The simulation is a representative computer based model which provides appropriate data for visualization (could also include auditory and haptic/kinaesthetic) or representation of the system in a virtual world.

Virtual Worlds are real or imaginary buildings that can be emulated with the use of computational resources applied to the construction of 3-D collaborative environments. Such environments provide immersive, creative and constructive interactions for knowledge acquisition by learning communities in the cyberspace. A project named ARCA (Collaborative Virtual Reality Environment for Learning) was designed and two prototypes were built aiming during its development of a teaching-learning environment based on Internet that can be a tool to support a differentiated pedagogical practice. We tried to provide conditions for a meaningful learning, using the attributes defined by Jonassen (Jonassen 1999) as illustrated in figure 1.

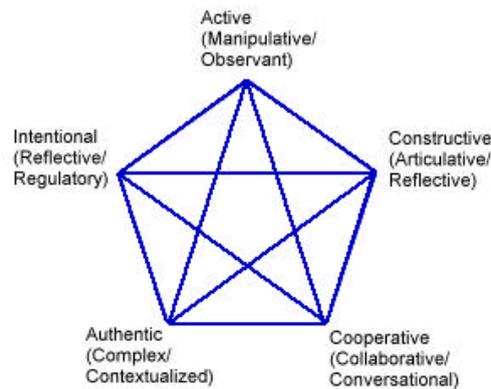


Figure 1. Attributed of Meaningful Learning

So a combination of technology elements was used to foster engaging students in meaningful learning through an environment that enables collaboration in a virtual reality environment. Aiming design, build and test such kind of environment it was choose use of a combination of tools derived from three computer science areas:

- ◆ **Virtual Reality** to build a virtual laboratory where learners may conduct experiments handling virtual devices able to show up significant proprieties of equipment and/or processes being targeted by the learning process, including augmented reality.
- ◆ **Collaboration** to promote conditions for supporting Vygotsky's theory of social cognitive development stating that "social interaction plays a fundamental role in the development of cognition" (Vygotsky, 1994).
- ◆ **Artificial intelligence** to make possible construction of pedagogical agents that supports learning in the virtual world.

With the results we get, students and teachers experienced telepresence, through an avatar. This way they can act and collaborate, not as themselves, but as a character, the avatar. The group analyzed several aspects for the creation and operation of this environment aiming to optimize it, both in terms of network performance and computation systems involved, and interface and conditions to support knowledge building.

2. ARCA VIRTUAL REALITY ENVIRONMENT

Aiming at finding a platform to support the virtual reality environment, the group considered some solutions such as *Cybernet Worlds*, *Galaxy Worlds* and *Other Worlds*. Although the results of each one were relatively similar, we chose the virtual active worlds manager system by Activeworld named The Active Worlds Educational Universe – AWEDU (Active Worlds 2001). It enables the adaptation and extension of initial functionalities in the fulfillment of environment requirements. Other significant aspects are its free availability for education use, and the use of a technological base quite advanced in terms of multi-user system in a 3-D environment accessed through the web.

AWEDU interface is framed in five intuitive and easy-to-use areas. The program offers a series of commands that are activated through a textual menu or buttons. In the central part the 3D display and navigation area are located as well as fields for conversation via chat. At right side of the window a navigator is activated allowing interactions with web based applications.

2.1 ARCA Environment Components

Our premise was the construction of a computational environment able to be used in Internet connected networks. The model proposed, using AWEDU environment, may be presented through four entities used to represent the computational models and their respective relations (Figure 2).

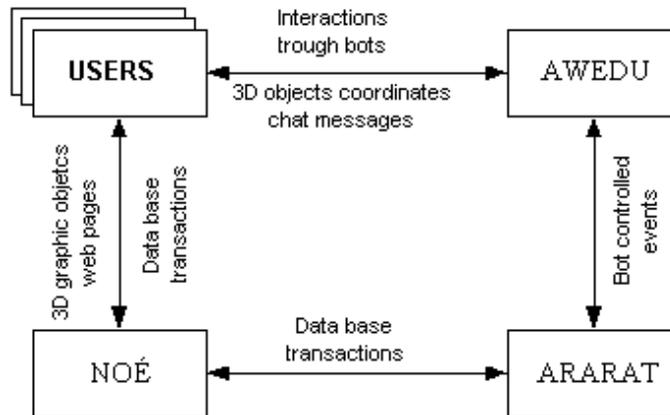


Figure 2. Diagram of computational components relations

- ◆ **USERS:** Comprise learners, teachers, specialists and support personnel related to a certain learning event modeled at ARCA. Relations between users and components AWEDU and NOÉ are set by an interaction between 2-D and 3-D objects. A browser of virtual worlds and the web controls and make them available.
 - ◆ **AWEDU:** This component is in the network environment of Activeworlds. Its function is to keep track with configuration parameters such as, for example, registered users, objets and web pages storage place, chat manager and geographical coordinates of 3D objects. After running the navigation program a connection between USERS and AWEDU components is established. This way, it is possible to identify the user, and start displaying of virtual reality contents.
 - ◆ **NOÉ:** The database of ARCA environment is implemented in this component. Besides HTML and PHP files, the database has a set of tables managed by MySQL application and 3-D objects in RenderWare Scrip language. Users make the insertion and retrieve tables information through PHP applications or applications built as bots. Bots are automated processes when executed remain in an endless loop, acquiring the ability of monitoring and acting based on events set in any virtual world. This component is installed at a Linux server.
 - ◆ **ARARAT:** This component runs applications able to monitor events in learning spaces modeled for ARCA. User's logins and other interventions, by chat or 3D objects manipulation, are controlled through bots programming. Building this kind of application requires the use of a functions library available by Activeworlds. Additionally, the functions library of MySQL made possible to assign bots the ability of maintenance in ARCA data tables.
- The entire complexity that involves ARCA distributed computational environment is hidden from user.

Besides the options the browser provides, it is possible to identify the register of a virtual world in the interface, used in ARCA implementation. At the central window we find 3-D objects, among them we identify the construction of learning spaces as circular buildings, interconnected by tunnels. Below the 3-D visualization area we find interface elements used during chat sessions. Figure 3 shows different interaction areas available: virtual reality environment, chat tool and navigator window.

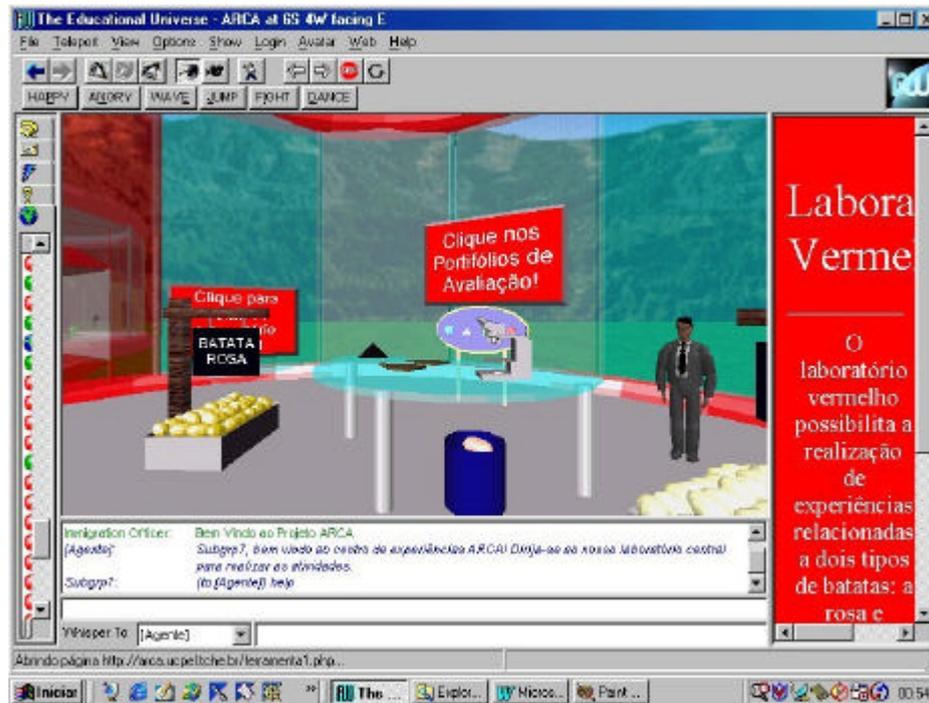


Figure 3. User's view

2.2 Vygotsky's Socio-Cultural Approach

To support the collective model of distance education, the purpose of this work has as theoretical foundation, the theory of Vygotsky (1998). One of the important concepts of the theory of Vygotsky is that mental activities are based on social relationships between the individual and the environment in a historical process and that this relationship is mediated by symbolic systems, through instruments and signs. For Vygotsky (1998) the signs are artificial incentives with the purpose of mnemonic aid; they work as middle ground for adaptation, driven by the individual's own control. The sign is guided internally. The function of an instrument is to serve as a driver of the human influence on the object of the activity; these are guided externally. Both have in common the mediation function.

Another fundamental concept in the Vygotsky's theory is the proximal development zone (PDZ). In mentioning the PDZ, it is necessary to define which are the levels of the student's development: the Real Development Level (RDL) refers to the functions that the student already possesses. The Potential Development Level (PDL) determines the functions that a pupil can develop, through an adult's aid or from the collaboration of more experienced friends. PDZ is the distance between the real development level and the potential one. Besides these concepts, Vygotsky defends that cognitive functions happen first at social level for later to happen at an individual level: firstly among people (inter-psychological) and, later, within the person (intra-psychological). The psychological abilities, in the same way, happen initially in social relationships (inter-mental) and afterwards within the child (intra-mental).

3. COLLABORATIVE LEARNING

Most of pedagogical methodologies and, above all, methods involving new technologies prefer situations or contexts of individual learning. In counterpoint to this trend, the number of research involving promotion of learning using advantages of social relations, and collaborative learning has been growing over the last years. (Kumar 2001), (Larsen 2001).

Vygotsky's Theory of Social Cognitive Development (Vygotsky 1994) reasons that social interaction plays a fundamental role in the development of cognition. Instruction can be made more efficient when

learners engage in activities within a supportive environment and receive guidance mediated by appropriate tools. Another notable aspect of Vygotsky's theory is that it claims "that instruction is most efficient when students engage in activities within a supportive learning environment and when they receive appropriate guidance that is mediated by tools". These instructional tools can be defined as cognitive strategies, a mentor, peers, computers, printed materials, or any instrument that organizes and provides information for the learner.

Collaboration is a process of shared creation: two or more individuals with complementary abilities interact in order to create a shared knowledge that none of them had before nor could get at their own effort. Collaboration also creates a shared meaning about a process, a product, and it was this way ARCA has developed its environment. The argumentation should be based on their existing knowledge as they try to accommodate new knowledge that is internally inconsistent. When the focus is on the learner's accommodation of conflicting ideas, it is necessary that the instructor act as a catalyst providing learning opportunities that enhance this process. Provision for opportunity to reflect on both the learning content and process is important. (Kanuka 1999).

Based on the premise that knowledge construction is a socio-linguistic process dependent upon the content and culture where it occurs, this view argues that we use conversational language to negotiate meanings that results in shared knowledge and understandings. By continually negotiating the meaning of observations, data, hypotheses and so forth, groups of individuals construct systems that are largely consistent with one another. Users experiment telepresence in the virtual laboratory as avatars, like shown in figure 3. Each user is represented by an avatar that may move in the scenario, touch objects and activate related behaviors. Results from an action commanded by one user is visible to any user in that room despite different views being presented depending of the position of each observer.

Coordination between user collaborating in this environment is done using a chat tool. While working in this environment, an user may interact using a chat tool that allows whispering (send a text message) to an specific participant or send a text message to all. A virtual tutor is a permanent participant (represented also by an avatar) and provide instructions about experiments available on each laboratory as well as other information related to that context. The virtual tutor behavior may be adapted to each virtual laboratory and experiment. In fact the virtual tutor is one of the pedagogical agents used in this learning scenario as it will be described above.

3.1 Pedagogical Agents

Virtual environments offer rich opportunities to research and implementation of the so called *Animated Pedagogical Agents*, which are autonomous agents that support human learning through interaction with students within the context of an interactive learning environment. Investigation points arise when pedagogical agents appear to the student as animated figures, undertaking a character, an avatar for example. In these cases, the agent, named animated pedagogical agent can be in a permanent dialogue with the student and produce a behavior that seem natural and appropriate (Elliot 1999).

Two differentiated techniques were designed to implement pedagogical agents. The first uses an agent based on artificial neural networks, genetic algorithmic and Jean Piaget's schemes theories in order to act with sensorimotor actions (type 1) (Ferreira 2001); the second is based on the BDI logic formal system (mental states of beliefs, desires and intentions) to act with more complex reasoning (type 2) as reasoning about some affective factors involved (Bercht 2000). These two agents develop differentiated and specialized functions that complement each other. Agent type 1 acts in the perception of the student's motor actions sending it to agent type 2 analysis. The final action is then the result of agent type 1 perception together with information coming from the environment and deliberation of type 2 agent about which pedagogical action should be performed.

On the other hand, in the case of the second technique, we have developed an investigation on the fact that many times a behavior is adequate, independent whether the belief is true or not. The fact that rational systems may exist does not mean that substituting a false belief for a new one always lead to a transformation of behavior. We may say then that there is a connection between the representations that motivate the production of a non-intentional effect and the representation of these effects on agents, which try to maintain beliefs and desires representations that determine the effect produced.

Investigations we are undertaking relate agents' situation and performance and try to provide subsidies for better understanding of the motor phases and corresponding cognitive processes (agent 1), as well as the study of beliefs, desires and intentions according to expected behaviors (agent 2).

The implementation of pedagogical agents with differentiated architectures in ARCA environment enabled different tests, and also made possible the analysis of generation and behavior of agents through the integration of cognitive sciences, in the aspects of visual and tactile perception, motor coordination and the semiotic process of communication.

Techniques of Artificial Life were used to simulate some processes involved in the conservation and deterioration of aliments. Artificial Life is an area of Artificial Intelligence that wants to understand life. It tries to understand the main biologic dynamic processes and reproduce them in other artificial means, such as computational systems. Artificial Life sub-group studies how AL technology could be used to make it easier the process of learning in a virtual environment. That is, the student will be able to visualize and mainly to control the process of deterioration by microorganisms in a potato. A specialist of Food Technology Institute provided specific data about the evolutionary and deterioration process of aliments. Arts Institute created 2-D and 3-D multimedia images of potatoes for the Virtual Reality environment. Through the integration of studies carried out by the interdisciplinary team we have developed models that are able to make the sensorial appropriation of concepts established by laws of evolutionary processes, and of Artificial Life for learning promotion.

The first stage of this research was the theoretical study about the membrane of a living being. The objective was to study and simulate how the membrane exchanges information with the world. The study on the membrane provided the group a better understanding of life process. All living beings are autonomous systems. The objective of this work wasn't to propose a formal closed model; on the contrary, the objective was to make possible the emergence of an organized open system, an artificial organism that can model itself, a virtual membrane. In order to represent the self-organized system proposed, we decided to face some issues about the evolution process that do not allow its development. Firstly we analyzed the contradiction principle. Later we approached the principle of the third excluded, the Modal Logic (Ueno 2000). Based on comments of Poincaré (Poincaré 1964), Brouwe (Brouwe 1964) and Frege (Frege 1964) we present a proposal for the emergence of Artificial Life where an event is defined by some conditions, in this case the event is the rise of an organic structure that may form one life. However, an event may be observed or not, depending on the meaning of the concept for the observer. That is, the observer's viewpoint. This way, the observer's knowledge (subjectivity) becomes a need when one wants to observe a dynamic environment where virtual life evolves.

The second stage of this research has developed based on studies of the first. Its objective was to get information about the situation of virtual microorganisms, that is, information that would be obtained through the analysis of experiences with real microorganisms, according to information the specialist on food engineering provided. This phase had two different parts: the first resulted on an expert system responsible for receiving and storing information about the microorganisms behavior; the second part was responsible for receiving information of the virtual environment where the virtual microorganisms were, and correspond with the set of behaviors that describe the microorganism situation, based on the knowledge base updated by the specialist. The Expert System we built is different from the traditional ones, since its knowledge base is composed of mathematical formulae that generate microorganisms' behavior rules when operated. Data for the activation of these formulae are obtained from the environment (for example: temperature, potato quality, season, if the potato had been cut, if it underwent some kind of process, etc.)

3.2 Perception and Interactions

The initial proposal was to study the perceptive activity in the ARCA relating it to knowledge building. As a principle, it is clear for designers that interaction by itself is not enough to promote significant learning and knowledge building. The interaction must be at the level of meaning, whereby the learner seeks answers to new questions, arranges the material into new structures, or performs other manipulations which succeed in raising the level of comprehension. The perceptive effect we wanted for the environment was **immersion sensation**, once it could enable permanence, and motivate exploration, thus implying the possibility of knowledge building. Aiming at studying factors that incremented the immersion sensation we needed to redefine the notion of perception. Perceiving is producing sensor-motor correlation congruent with media disturbances in the process of operation of an organism in a certain coupling domain. This way it was

possible to assert that virtual environments may produce perceptive domains different from those related to the sensorimotor experience acquired in non-virtual environments. This notion enabled the group to undertake some steps in the directions of provide user with the possibility of reverting phenomena that would be irreversible in traditional labs. Another result was that interactions between participants of the virtual environment would bring collaboration becoming an important factor promoting immersion sensation. A virtual tutor was included as a permanent participant, designed to give answers and advising to users. Interactions with virtual tutor are handled like interactions between user. A user may whisper to another selecting the target of the message typed in a chat area. Virtual tutor as a permanent participant is always available to receive messages and using chat robot technology. It was initially designed to give only a few pre-specified answers but latter its design was oriented to use natural language artificial intelligence chat robot technology to provide possibility of interactions with a more ergonomic human-computer interface.

3.3 Software Specification and Development

The virtual reality learning environment development used C Programming Language, JavaScript and PHP, as well as the manager system of MySQL database. The work platform being defined, we elaborated a methodology of development for the environment, strongly directed to the programming proceedings and graphic modeling. During research, many objects were aggregated or re-built, besides programming of control functions, that do not take part in AWEDU technology.

The start point of the specification and implementation process was a Storyboard created by a specialist on each content unit. *Storyboard* contained objects for the intended virtual set and a brief description of relations between these objects and their behaviors (how one may interfere on their state, appearance, etc.). Storyboards were discussed, refined and entity-relationship diagrams were derived. Yet based on Storyboard descriptive tables with the actions and respective transformations of learning events required by ARCA were elaborated.

In order to fulfill graphic requisites of ARCA we developed some basic constructive modules, exploring functions proposed by RenderWare language (RenderWare 2001). These virtual buildings were made in RenderWare Script (.rwx) and will be used in AWEDU software. RenderWare Script language made possible to describe primitive 3-D objects. These objects joined through basic operations of rotation and translation resulted in buildings, which were named virtual labs for collaborative learning. On the other hand, objects of great constructive complexity (microscope, aliments, instruments, furniture, etc) were modeled in the graphic software Caligari trueSpace 4.3.

The development of software to amplify functionalities of AWEDU technology was carried out with the implementation of Bots, cgis and/or filling the Action box of Object Properties window. All these components could demand information insertion or retrieval from a MySQL database. Bots are a denomination of a category of programs that run in the virtual environment built with AWEDU technology. Such programs may perform functions the user can view, assuming the figure of an avatar or object. On the other hand, bots can be useful in the implementation of a number of routines hidden from the user's view. A library of functions is available in a Windows DLL file, making it easier the development of client/server applications in C language. Using EduVerse browser area to run a navigator, links can be activated through objects, enabling the information processing with CGI applications written in PHP.

4. CONCLUSIONS

First phase of the project aimed the design and development of a virtual laboratory focused on food production and conservation and more specifically on the potato handling process. Solution implemented included design of tools and procedures to apply on the potato being able to impact retention or lose of some characteristics on time. Time could be adjusted on demand by user to accelerate a process and made results visible more soon or to delay a process to follow step by step transformations occurring. Learner was able to freeze, cook, cut potatoes and inspect its proprieties after some time. Inspection could be done observing visual characteristic of the potato like change in color as well as the object of analysis could be brought to a electronic microscope that is able to "analyze" the potato giving values to level of certain components on its structure. Calculation of this values used artificial like algorithms.

Results we have reached until now make evident that 3-D virtual environments, may propitiate a more significant learning, making it easier the approach of complex topics and warranting the potential of social relations with the use of avatars and other graphic objects. However, in order to build learning environments of this nature, knowledge and an interdisciplinary praxis are necessary. In this first phase researchers from several area gave contributions: Computer Science, Cognitive Science, Arts, Food technology.

A second phase of the project aimed to not only repeat the process on a different focus area where there were more content specialist available and processes to be simulated were more simple. It was choose Physics Newton Laws. This phase included a more complex virtual tutor that could answer questions proposed in natural language. The knowledge base used by the virtual tutor was built using chat robot technology. Results were tested with learners from a secondary technical school. Motivation for learning more and beyond proposed time was some of the results.

A third phase will be developed including audio and video capability to allow voice communication between participants of the laboratory, natural voice understanding and voice syntheses on the interaction between participants and virtual tutor, as well as other content area.

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EDUCATIONAL INFORMATION SOCIETY IN GREECE: THE GREEK SCHOOL NETWORK

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ABSTRACT

In this paper, we present the Greek School Network. This project is financed by the Second and Third Community Support Framework of the European Union. Research and Academic Computer Technology Institute (CTI) has the responsibility for the design, coordination and the implementation of the project. The main object of the project is the implementation of a network infrastructure for the interconnection of school laboratories and educational administration offices and the provision of network services in a wide range. It forms a closed educational network, which is based on the Greek educational and research backbone network (GRNET). The Greek School Network statistics show that teachers and students have adopted the services of GSN in their school life and learning activities.

KEYWORDS

Educational Networks, Greek School Network, Content Filtering, Internet, Greece

1. INTRODUCTION

The Greek Ministry of Education (www.yppeph.gr) has advanced the planning, growth and operation of an advanced educational network, named Greek School Network (GSN – www.sch.gr), responding to the need for reform of educational services in Greece and of the integration and exploitation of Information and Communication Technologies in education. The main objectives of this network are to create a national infrastructure, interconnect all schools in an educational Intranet and provide and support advanced telematics services to the school communities. The Ministry of Education has already financed projects for small school networks since 1996. Today, the GSN is implemented with the collaboration of the Ministry of Education and many collaborating Universities and Research Centers. The technical leader of this project is the Computer Technology Institute. In this particular way of collaboration, the equivalent cover of all geographic parts of the country and particularly, the creation of powerful relations of collaboration between schools and Universities and Research Centers, the support of schools from institutions that are placed near them and the progressive transfer of the know-how to the secondary education, are ensured. The GSN planning, implementation and operation accord with the European Union policies and are financed by the Second and Third Community Support Framework (CSF) (Operational program for the Information Society www.infosoc.gr).

The experience from the European countries, U.S.A, Canada, Australia and the other countries shows that there is a national policy for the import of Network Technologies in the schools of Elementary and Secondary education. The result of that policy is the creation of a network of schools of national scope or, in certain cases, the creation of regional networks of schools of wide geographic coverage. The national

academic and research network of each country which interconnects the Universities, the Research Centers, the Educational Institutes and in some cases other institutions such as Libraries, Substantiation Centers and Museums, is usually used as the backbone network of the school networks. It is remarkable that almost each European country has a national, academic and research network. The use of private institutions (ISP: Internet Service Providers) for the provision of Network Technologies to the schools is relatively limited. Also, there are initiatives from the corresponding Ministries of Education of a lot of countries, for the connection of the school networks of each country to the national research networks (Table 1).

Table 1. International experience for school networks

Country	National Research Network (NRN)	School Network	Access Network (NRN/ISP)
EUROPE			
Austria	Aconet	Austrian SchoolNetwork (ASN)	Aconet (NRN)
Belgium	Belnet	Peripheral, because of different languages Scholen Internet Project Brunette	ISP/NRN
Holland	Surfnet	Direct connection to Surfnet or indirect through Universities that are connected to Surfnet	Surfnet (NRN)
Denmark	Sektornet Darenet	Direct connection to Sektornet	Sektornet (NRN)
Finland	FUNET	There isn't School Network	Free choice through FUNET ? ISP
Norway	Uninett	There isn't School Network	ISP & Initiatives of the Ministry of Education for connection to Uninett
Sweden	SUNET	Swedish School Computer Network	SUNET (NRN)
Island	Isnet	Direct connection to Isnet	Isnet (NRN)
United Kingdom	Janet/Ukerna	There isn't National School Network	RM IFL (ISP) Program of the Ministry of Education NGfL
Ireland	Heanet	Schools IT 2000 Ednet Ireland	Telecom Eirann for access to NRN Ireland-on-Line (ISP)
France	Renater	Peripheral networks with direct connection to Renater	Renater (NRN)
Portugal	RCCN	Direct connection to RCCN	RCCN (NRN)
Spain	Rediris	There isn't National School Network	ISP, Initiatives of the Ministry of Education for connection to Rediris
Germany	DFN/B-WiN	Schulen ans Netz	Deutsche Telecom for connection to NRN
Italy	Garr	Deure Bologna Kidslink	Garr (NRN)
Hungary	Hungarnet	Sulinet	Hungarnet (NRN)
Greece	GRNET	Greek School Network	GSN (Greek School Network)
OTHER COUNTRIES			
Australia	EdNA	EdNA, Actein, National networks at the level of states	EdNA (NRN) States Networks (NRN)
U.S.A	Esnet NSFnet	National networks at the level of states - K12 net	NSFnet (NRN) ISP
Japan	Nacsis Imnet	100 School, Networking	Initiatives of the Ministry of Education for connection to NRN
Chile	Enlaces	Direct connection to Enlaces	Enlaces (NRN)
Canada	Canarie CA*net II	Schoolnet - Plugging kids into the World	Canarie (NRN)
China	Cernet	There isn't National School Network	Initiatives of the Ministry of Education

The international experience shows that the research and educational networks present some characteristics that are not presented in the other commercial networks. Those characteristics are the following:

- High speed of transmission with reliability in the interior and in the exterior. The majority of the backbone networks operate at the speed of 34 and 155 Mbps.
- Requirement for transmission of multimedia, so as educational applications to be supported.

- Avant-garde concerning the used technologies and the added services.
- High subsidy at the beginning of the operation of such networks.

The GSN is ambitious to provide useful and certified networking services as the refresh the educational methods, the encouragement of collaboration, the effective distribution of educational material to the students and teachers, the support of the learning process through the networking environment, the flexible search and retrieval of useful verified information, the creation and distribution of presentations, the conduct of thematic discussions, seminars and lectures through the network, the access to services of digital libraries of educational and research institutes, the co-operation and communication between Secondary and Higher Education, the communication with European and international educational networks and the capability of supplying education to persons with accessibility problems. As a result, the GSN aspiration is to constitute an environment of application of new technologies to the educational system where it will be possible for new educational methods to be applied, evaluated and used.

2. NETWORK ARCHITECTURE

At the time the network was being designed, some crucial factors were taken into account that affects its implementation and its future development. Special care was given to the users' specific needs, the interconnection speed and the basic and advanced services provided to the users from the school network. These factors were (a) the geographical areas that the network covers, (b) technological issues, i.e. available networking technologies, provided applications, expansion possibilities, etc, and (c) financial factors, i.e. cost of equipment, installation cost of telecommunication circuits, network operating cost, Internet access cost, housing cost at the points of presence, cost for the pilot running, management and operation cost, equipment depreciation and backup system implementation cost, etc.

The design model and the operational specifications of the GSN are based on the TCP/IP protocol. Also, the network's topology has a hierarchical structure and consists of the following levels: Backbone network, Distribution network, Access network and Local area network in school laboratories

As **backbone network** is used the Greek Research and Technology Network, (www.grnet.gr), with seven entrance points and total installed capacity up to 40 Mbps. The choice of GRNET as the GSN's provider was a strategic choice of the Ministry of Education, absolutely compatible with the international practice.

Distribution network is the part of the network that interconnects points of presence with the backbone network. The topology has such design in order to preserve the operational cost in low levels, which is particularly critical in large networks. The network nodes are distinguished in two categories: (a) Main nodes that are points of presence which are interconnected directly with the corresponding node of the backbone network, and (b) Secondary nodes that are points of presence which are interconnected indirectly with the backbone network through connections with the nearest regional node.

All the nodes have special networking devices that provide the interconnection of the educational and administration units in their area, as well as the interconnection between the nodes. Also, there are a large number of servers, distributed all over Greece, that provide the network services to the users and the administration tools for network management.

Access network is the part of the network, which interconnects educational and administrative units with the nearest node.

Speaking for wired connections the common broadband technology is the ADSL (Asymmetric Digital Subscriber Line), which is supports maximum capacity 8Mbps/800Kbps (downstream/upstream), using the existing local loop infrastructure for a distance until 5.5 Km, approximately. Then, as the optical networks is raised more and more and approaches the schools, the VDSL (Very high rate Digital Subscriber Line) becomes an attractive choice, especially for the large school units. Although, the VDSL does not have still standardized, it is expected that it will supports capacities up to 55 Mbps/19 Mbps (downstream/upstream), using the existing cooper wires and in distance from 300 until 1500 meters.

Our final scope for the access network is the wide use of optical fibers, where it is possible. This is the solution with the larger time life, as a fiber is a data channel appropriate for any data technology transmission at very high data rates (1 Gbps at least). In the case where the optical fibers are a part of a wider network (condominium fiber or community/municipal fiber), then are raised important economic profits, caused to the reduction of telecommunication for schools. Moreover, the usage of the optical fibers gives the flexibility to

the GSN to select the desirable data technology transmission. This is done owing to the absence of a certain telecommunication provider in order to interconnect our nodes.

A wireless network can be a very attractive solution when the construction of a wired broadband network is impossible for technical or economical reasons. Today there is a large number of wireless products, such as wireless bridges (IEEE 802.11b – WiFi), which are operate in the ICM band (2.4 GHz) and support capacities up to 11 Mbps. Other wireless technologies and protocols, such as the IEEE 802.11a and LMDS, supports data rates in the range 34 – 50 Mbps and they can be used by the GSN in order to interconnect its nodes or schools.

3. NETWORK USERS

Because the sensitive educational character of the GSN and the need to protect the students at their access in the Internet, the GSN has adopt as a strong requirement the certification of its users. So, the users are distinguished in the following categories: (a) School units, in which are given one or more accounts to access the network, (b) Administrative units, in which are given one or more accounts, (c) Teachers, in which are given personalized services (including dialup access to some subcategories of educators). The identification process is provided through an automated environment, (d) Students, which have access to GSN through the school laboratories, such as and personalized services. Their identification is done directly from their schools, with the collaboration of school administration software and LDAP service of GSN and (e) Administrative personnel, which has access through their interconnected school or administrative units, such as and personalized services.

4. NETWORK SERVICES

Most of the network services planned are already up and running, while some of the most advanced services are at the implementation stage. The network services are divided into three categories: Fundamental, basic and advanced services.

The fundamental services are defined as the set of minimum services and constitute the basic frame of the network. These include (a) the addressing scheme and routing plan and (b) the Domain Name Service (DNS) scheme.

The basic services offered to the Greek schools are the following:

1. The Dial-up service and the connectivity to the network. This service is provided only to educational or administrative units and to a very small number of teachers. We are planning to provide this service to a large number to the near future.
2. The well known E-mail service than can be delivered using various ways, such as POP3, IMAP, or webmail (www.sch.gr/webmail).
3. The Caching and Proxy Service: This service provides the smart exchange of information and improves the whole network's operation.
4. The service of Web Filtering is mainly based on the proxy service. It is transparent to users and obtains the exclusion of access to sites with harmful content. More details about this service will be given in the following slides.
5. The service of Web-page generator allows our users to make their WebPages in a simple and fast way, and using the
6. Service of Web hosting they can upload their web pages to the servers, using an ftp client. The possible users of the above two services are also schools or teachers (users.sch.gr/<user name>).
7. The well known service of the World Wide Web is also allowed to our users.
8. The service of Discussion Forums allows the communication among members of an educational group as well as the newsgroups service
9. The Directory Service (LDAP) provides access to indexes related to users' information. This service is very important, because it supports, in the background, the other services.

10. The service of the School Network Portal (www.sch.gr) provides useful information about school network and interconnected units and also operates as the single point of the school web sites. (Information: info@sch.gr)
11. The services of Personal Calendar and Address Book are two services with obvious use.
12. In order to manage the large number of network users, there is the Users' Administration service (www.sch.gr/usersadmin), which supports a distributed operation and several hierarchical levels of administration.
13. News service (news.sch.gr)
14. The service of Statistics (www.sch.gr/statistics) provides useful information on the network's operation and is very useful when the network's upgrades are designed.
15. The Voice over IP is a pilot service, which is provided on a limited scale, mainly to administration units.
16. Finally, the service of Help-Desk (www.sch.gr/user_support) is based on a distributed structure and obtains the uninterrupted operation of the whole network. The service is accessed by users mainly over a free phone line, but fax, email or web access is also provided.

About the Advanced services, we expect a number of these are going to be set up in the next months. These services are the Teleconference, the Asynchronous Open Distance Learning and the Video on Demand.

5. THE WEB-FILTERING SERVICE IN THE GSN

In this section we will describe the policies about a crucial service for every educational environment. This is the content (or web) filtering issue. We also describe the architectural scheme we have chosen to implement this service in the GSN.

As is also known, the minimum requirements to control the usage of the telematic services only for educational scopes are (a) the use of acceptable use policies, (b) the information of the teachers, (c) the control of the software that gets installed in school computers and, of course, (d) the creation of educational material.

The implementation of our policy is based on the following steps (a) specification of the pages considered improper, harmful or illegal, (b) information of the teachers, parents and students, (c) creation of educational software (this is done by other project), and (d) policies and techniques in place

Since everybody seems to admit the problem, we must find the methods which will deal with it in the best way. These are the use of: (a) keyword blocking, (b) negative and positive lists and (c) content labelling and rating systems. Definition of content with the use of Content Labelling and Rating systems is done with the attachment of a set of tags to each Webpage, which specifies the kind of the information displayed on it. Organizations that provide ratings for web sites are the Internet Content Rating Association (ICRA), the SafeSurf and the Entertainment Software Rating Board (ESRB). While the SafeSurf is the first system at this kind ever implemented, it seems that today the most famous rating system is the ICRAfilter. The ICRAfilter is a browser-independent tool which is intended to provide parents with a means to filter their children's internet access according to ICRA labels, their own "block" and "allow" lists or third party lists of web sites. We will be able to install it on any PC running Microsoft Windows. The real power of the ICRAfilter is that it also supports lists of web sites created by other organizations and companies extending the width of its solution. ICRA is talking to a number of potential list creators and there is special provision to have several lists available.

To implement the service of content control we can use Commercial Software, Freeware programs (here the Rating Systems are included) or Hardware Solutions. All these are mainly based on the use of negative lists. There are three different sub-approaches: (a) The proxy-cache server does the filtering on its own, if filtering and blocking requests are not massive and if the server provides such a possibility, (b) Plug-ins does the content control. That approach offers much more options and in most cases, there are ready site lists grouped by their content. These lists are updated frequently, and (c) The last category includes the products that can operate as independent servers used only for filtering. In this way they can be used separately, especially when they are not used for caching, whereas the site lists are provided and updated automatically.

For the GSN needs, we decide to adopt an Open Source solution. What made us eventually prefer freeware programs was the fact that Commercial programs are mainly intended for client machines, while hardware solutions always have a considerable cost. Combining that with the exceptional performance of Squid proxy server left us with no other choice. As is well known, for a school network the use of the proxy server – especially when it is configured as transparent – is the ideal point to implement the control on the requested objects, because it concentrates the users’ requests and is the only entrance point of web traffic. As we use Squid as the transparent proxy-cache server, that solution fits us perfectly in our case. Also, we use some external programs, such as the SquidGuard, to accomplish efficient and quick access control. This approach offers much more options and in most cases, there are ready site lists, frequently updated and grouped by their content. An interesting piece of information is the way related sites are grouped. Our blacklist database contains the following categories: porn, aggressive, drugs, violence and gambling. Specified statistical data about the usage of the web-filtering service are presented in the Statistical Data section.

6. STATISTICAL DATA OF THE CONNECTIVITY PROGRESS

In this section we present some statistical data of the project’s progress and the GSN’s usage. The connection of the schools and the administrative units, takes place simultaneously with the qualitative upgrade of telecommunication connections of the units to the Internet and with the provision of new advanced services to the users. The distribution network has been completed according to the planning since the spring of 2001, while its extension and upgrade has already begun, so as to completely serve the necessities of networking of the elementary education. The total number of connected units is 7.763 educational and administrative units (January 2003). The interconnection of the educational units of the secondary education has been completed since December 2001 according to the eEurope targets (Table2, Figure 1).

Table 2. Interconnected educational units in GSN

Level of Education	Total of units	Percentage of interconnection
Kindergarden	5.667	2,8%
Primary education units	5.974	46,0%
Secondary education units	3664	100,0%
Initial Vocational Training (IVT) units	141	100,0%
Total	15.446	

Also, more than 1.000 administrative units have been connected to the GSN, while more than 2.000 teachers have acquired personal account for access to the services of GSN following automated process of registration through the site www.sch.gr.

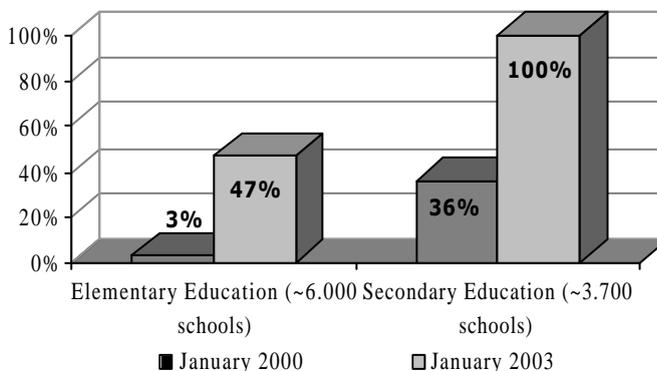


Figure 1. Interconnection of schools of the elementary and secondary education

The exterior traffic (inbound/outbound) from/to the GSN has rapid growth, as it is shown in the Figure 2. It should be marked that the following data concern the traffic from/to GRNET and do not concern the internal traffic of GSN that does not pass through the nodes of GRNET and that is also very important.

The proxy and content control service ensures the controlled access of users of GSN to the World Wide Web, while it contributes to the better disposal of the resources of the network. The average number (years 2001 – 2002) of demands to the Proxy service is 1.600 requests/min and the maximum value is 7.300 requests/min. At the same time, the followed (from 1999) policy of the content control cuts off the 7% of the access demands to sites with content that has been characterized as inappropriate for the students .

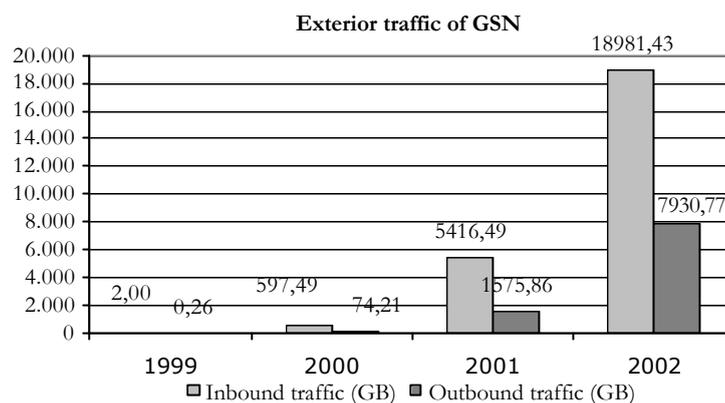


Figure 2. Exterior traffic of GSN from/to GRNET

The user's administration service ensures the certification and the management of the user accounts of GSN. The active accounts are shown in the Table 3.

Table 3 Number of accounts of GSN per category

Category of users	Dec. 2001	Dec. 2002
Active e-mail accounts	6.065	13.789
Accounts of Elementary education units	1.053	3.384
Accounts of After-Secondary education units	419	455
Accounts of Secondary education units	4.103	6.842
Accounts of teachers (certified users)	228	2.041
Total of active user accounts	5.803	12.722

7. CONCLUSIONS

Most of the educational networks offer access to the Internet, while all of the developed or developing countries have elaborated programs of connecting Schools to the Internet. Specifically, according to studies developed in U.S.A, the reason that teachers and students use access to the Internet is to perform the above functions: (a) Use of the e-mail to communicate with persons outside school, (b) Exchange of ideas and information by using e-boards, (c) Search and information retrieval concerning educational resources, school papers and studies, (d) Entertainment and search of information according personal interests, and (e) Participation in the elaboration of common work through the Internet. The same studies concluded that the most used applications, of those that are used to give access to the net, are the e-mail and the Web Browser.

Every school that has access to the Internet uses the network services for educational issues. Specifically the communication between the members of the educational community is ensured via the use of e-mail, e-boards, thematic news groups, services for interpersonal and common discussion, etc. Important

quantitatively and qualitatively is the use of WWW in the educational process. Also, frequent is the use of collaboration services for the development of common work using the network. Similar are the network services that are also used in the educational networks that do not constitute part or do not give access in the Internet.

In the case of Greece, the Ministry of Education which designs, implements and coordinates the project of the GSN, has enrolled projects in the Operational Program for «Information Society» (www.infosoc.gr) (3rd Community Support Framework), so as to be ensured the continuation of the operation of the network and the provision of network services and support to the final users. Moreover, these projects that are keeping pace with the international technological development, implement the upgrade of the backbone network (routers and servers) at the level of the switching speed and at the level of the number of the access ports. In that way the total of the educational and administrative units of the Elementary and Secondary education (time of completion May 2003) is served efficiently and qualitatively. The implementation of the upgrade of the access network also proceeds with the installation of broadband connections (500 connections of type ADSL, 150 connections of type VDSL and more than 200 wireless high speed connections) to equivalent number of schools of the Secondary education. Because of the high speeds that will be provided by these connections, it will be possible the provision of advanced high quality services of telematics to the particular school units. For the elementary education is forecasted the completion of interconnection to the GSN all the primary schools and an important number of Kindergartens, during 2003. Also, the planning forecasts the provision of personal access accounts to the services of the network to all the teachers of Elementary and Secondary education, administrative employees of the schools and the administrative units, and also pilot to the students. Finally, it is designed the exploitation of the infrastructure of GSN for the provision of distant learning educational services (synchronous and asynchronous distant learning).

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BUILDING AN E-COMMUNITY OF IRANIAN NGOS

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ABSTRACT

The Iranian Civil Society is developing very fast. Hundreds of Non-Governmental Organizations (NGOs) are engaged in a process of socio-organizational networking, which is mainly coordinated by two resource centers in Teheran. The paper presents experiences with the technological support of this networking process. The introduction of an Iranian NGO Community System (based on a groupware system BSCW) is described referring to a process model of integrated organization and technology development (OTD). Training measures and efforts of socio-organizational and technological developments are analyzed and mechanisms of coordinating the networking e-community are presented.

KEYWORDS

Civil Society, e-Community, Community Systems, Computer Mediated Communication, Integrated Organization and Technology Development

1. INTRODUCTION

The paper presents a project aimed at supporting the community building of Iranian Non-Governmental Organizations (NGOs). In this project an approach of integrated organization and technology development is used for the participatory design of a community system. This task was defined before the background of a politically widely isolated Islamic state which is characterized by a very fast growing civil society. Even more dynamics is brought in the process by the ongoing and rapid increase of technological infrastructure and the exploding number of internet accounts in Iran. These conditions make the building of an e-community of Iranian NGOs a very challenging process. Concerning the introduction of a technological community system, the development nearly starts from the scratch.

Furthermore, the actual conflict between parts of the western democratic states and Iraq influences the political stability of the whole region and affects the most middle eastern countries. Without being able to discuss all implications of this political background, in this paper the ongoing process of Iranian NGO community building will be analyzed as a hopeful development for the very lively Iranian civil society.

2. BACKGROUND: IRANIAN CIVIL SOCIETY

In Year 2000 for Iran were counted 1,500 to 2,000 traditional community based Civil Society Organizations (CSOs), 5,000 women cooperatives, 1,500 modern NGOs, and for about 3,000 easy credit funds (cf. Namazi 2000). These Non-Governmental Organizations are building the basis for the Iranian civil society.

The large number of traditional Iranian community based organizations has a very long history and strong affinities with people. They are sustained by community funds, focus on the most pressing needs of the people, and have survived pressures of both the monarchy regime and constraints of the Islamic Government. The growing number of so called modern NGOs in Iran is directed towards the fields of women questions, youth and children interests, health and population matters, sustainable development and environmental protection.

2.1 State of the art of national NGO networking

In 1997 and 2001 two national conferences of Iranian Non Governmental Organizations (NGOs) took place in the cities Busher and Mashad. At the Mashad conference in September 2001 more than 120 participants from NGOs, scientists, government delegates and representatives of the UN were engaged (cf. Hamyaran 2001). The meeting was organized by the Hamyaran NGO Resource Center in Teheran, which was registered officially as an NGO at the Iranian Government in March 2001 and which is coordinating the ongoing networking process of Iranian Non-Governmental Organizations. The next national NGO conference is planned for spring of 2003.

These conferences mark important points for the NGO networking in Iran, which is driven quite far already in many areas. National women NGO networks, environment and development NGO networks, youth organizations, and health/population umbrella organizations are already existing.

In the beginning of 2000 a study on Iranian NGOs, which was funded by the Ford foundation and the Iranian Population Council analyzed the situation of Iranian Non-Governmental Organizations as characterized by two areas of conflict: (i) differences between rural NGOs and urban organizations which are located centrally in Teheran and the (provincial) capitals and (ii) the significant distinctions between so called "new" NGOs and traditional community based organizations of the third sector, which are mainly focussed on relief work (cf. Namazi 2000).

The recent networking process is shaped mainly by the integration of these different NGOs, which are segmented by origin, style of work, and organization.

2.2 State of the international NGO networking in Iran

In the Year 2000 only nine official secretaries of international Civil Society Organizations (CSOs) were located in Iran (Anheier et al. 2001: 284). These international organizations have got 932 registered members living in Iran (ibid.: 288). Both statistics prove that related to the international average the Iranian civil society is characterized by a very low degree of organization. This is due to the far reaching international political isolation of the Iranian state and the repressions by the Iranian regime.

2.3 Challenges for the technological support of NGO networking

The Yearbook of Global Civil Society 2001 documented for the years 1999/2000 that only 11.2% of the Iranian population has got access to telephone, 3.2% to personal computers, and only 0.2% of the population is able to access the internet (Anheier et al. 2001: 256). The illiteracy-rate decreased for about 12% during the 1990s, but is at 25% in 1998 (ibid.: 277).

Although both statistics should have been improved during the last years (esp. the number of internet accounts and providers is growing rapidly, but official numbers are missing), the lack of internet access for private households and NGOs as well as the illiteracy are the most important barriers for the national NGO community especially in rural provinces and regions of Iran.

3. THE PROJECT IRANIAN NGO COMMUNITY SYSTEM

In 2002 the International Institute for Socio-Informatics (IISI) concluded a contract with the Department for International Cooperation of the German political foundation Friedrich-Ebert-Stiftung on a research and development project which aims to support the community building and networking of Iranian NGOs. Within the Year 2002 IISI provided the cooperation platform "Basic Support for Cooperative Work (BSCW)" in order to support the networking process by technical means. The BSCW System was developed by the Fraunhofer Institute FIT (cf. Bentley et al. 1997). IISI organized the introduction of BSCW to the Iranian NGO network, consulted an integrated process of Organization and Technology Development (OTD; cf. Wulf and Rohde 1995) referring to the Iranian NGO Community System, and realized a train-the-trainer programme for members of Iranian NGOs, which focused not only on technical trainings but was directed to community building, cooperation trainings, and project development also.

This project started in March 2002 and ended with a delegation visit of leading Iranian NGO members and civil society experts in Germany in December 2002.

3.1 Project approach

The project called “Iran NGO Community System” aimed at the support of the socio-organizational community and network development as well as of the technological networking of the Iranian civil society. Therefore, IISI followed an approach of Integrated Organization and Technology Development (OTD), in which these socio-organizational and the technological networking is looked upon as interdependent and combined in a participatory process (cf. Wulf and Rohde 1995).

It was planned that in the long run a total of about 500 NGOs with around 25,000 members in the regions of Tehran, Khuzestan, Lorestan, Fars, Sistan and Baluchestan should be able to benefit from the project’s outcome. Therefore, the project (which duration was limited to 8 months) focused on an approach of sustainable development and consulting, that means Iranian NGO practitioners have to control and to continue the process themselves after the project’s end. This participatory approach is necessary to take the Iranian NGO members as experts of their own NGO networking.

3.2 Project outlines

During the first stage of the project the institute provided expertise for the development of the networked cooperation between Iranian networks of women NGOs, health NGOs, school building philanthropists, youth NGOs and environmental NGOs. Most of these cooperation partners were one-issue networks or umbrella organizations. Thus, the project was directed towards a ‘networking of networks’.

First, a defined group of facilitators within the NGO network was to enable to (tele) cooperate with each other via the so-called “NGO community system”. During the next step these facilitators had to be trained in order to work as trainers themselves for their colleagues and other NGO members.

The project aimed at developing adequate basic structures for

- tele-communication and -cooperation
- virtual communities of practice (cf. Wenger 1998)
- project development and management
- expertise sharing, community learning, and knowledge management (cf. Ackerman et al. 2002)
- preparation of national meetings (e.g. the planned Mashad+2-meeting)
- and process evaluation.

During the year 2002 in three expert visits to Iran IISI trainers conducted workshops in which Iranian NGO members were trained in the use of the NGO-CS as well as in the theoretical basics of the development of socio-organizational structures that enable expertise sharing, community learning, and project development.

3.3 Technical support

In the project the BSCW System (cf. Appelt 1999) was used for the development of structures for networked communication and the dissemination of national and international information among the Iranian NGO community. On the technical basis of this BSCW System and with help of the IISI experts, the Iranian users set up a NGO community system (NGO-CS). The NGO-CS requires internet connectivity. The NGO-CS provides workspaces for different kinds of working groups, NGO-networks, topics/issues etc., which are to be set up by the users themselves. That means, IISI supported a process of participatory design in which members of Iranian NGOs defined their own spaces and activities, selected the members addressed, defined groups, invited new members, sent group-mails, and started discussions on topics chosen by themselves.

Furthermore, the system supports them by a version-management-system for co-authoring, by features that allow storing and exchanging of most of usual document types, and by the possibility to set links to external web sites. The system provides a lot of awareness features to inform about activities and events within the NGO-CS (cf. Figure 1).

3.3.1 Advantages of the technical system BSCW

BSCW is a cooperation platform with rich groupware functionality and is developed as an open web based system (cf. Bentley et al. 1997, Koch and Appelt 1998, Appelt 1999). That means one only needs an internet account and any usual web-browser to access the system. No installation of additional software is needed. In 2000 the system was used by more than 80,000 users worldwide.

The use of BSCW is free of charge for not-for-profit purposes and scientific research projects at universities. Each user of the system got 10 MB Webspace for free. Only if there were specific requirements for server hosting and system administration (security aspects, system performance, etc.) in Iran, it would be necessary to buy a server licence which usually costs the amount of 16,850 € for more than 1,000 users (3,500 € for more than 300 users) per year.

For the Iranian NGO CS it was very important that the system is provided free of charge and that it can be used with any internet computer. BSCW avoids high tech elements and advanced graphical features. Thus, even with low transfer speed (58 kb/sec) the performance of the system is quite comfortable.

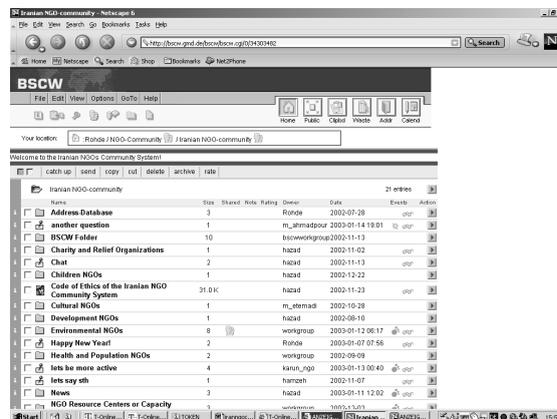


Figure 1. Snapshot of the Iranian NGO Community System, first folder level

4. RESULTS AND ACHIEVEMENTS OF THE PROJECT

During the Project Iranian NGO CS IISI experts visited different Iranian provinces three times (in May, July, and October/November 2002). In these visits several consulting services have been provided to Iranian NGOs. According to the project's approach and the goals, a number of meetings, trainings, and workshops for Iranian NGO members was conducted.

The cooperation platform BSCW was introduced and the structure of an Iranian NGO community system was designed. This NGO CS was set up as a closed system exclusively for invited Iranian NGO members only. At the end of 2002 for about 180 members of different Iranian NGOs are registered users for this system.

The following sections describe the different measures of the project in more detail:

4.1 Train the trainer measures

16 Iranian NGO members were trained as trainers for the BSCW system in Teheran, another 14 NGO members in Urumieh in the province West-Azarbeijan, 20 persons in Shiraz and another 18 participants in Esfahan. Most of the participants had basic English language and computer skills. More than one third of the participants have been women of all ages (cf. Figure 2).

The trainings measures were conducted in English, some parts have been supported by English-Farsi interpreters. Each training course lasted two full days, containing six trainings sessions on BSCW, six practical exercises in small groups with internet access, and discussions on (tele-) cooperation and computer-mediated communication.

Furthermore there have been provided theoretical basics and scientific findings on collaborative computing, and in a reflection phase needs for adaptation of the system and specific requirements for the future visits were elaborated.

4.2. Support for self-learners and self-organized trainings

By translation of the training materials (mainly power point slides and commented snap shots of the system's functions) into Farsi language, self-learners are supported (cf. Figure 3). These self-learning materials can be downloaded out of the system itself. Additionally several tools for planning, organizing and conducting training measures are provided to enable participants to realize self-organized training courses. Different institutions in Teheran started to provide these training measures in autumn of 2002.



Figure 2. Training participants in Urumieh



Figure 3. BSCW training slides, translated in Farsi

4.3 Development workshops

In several workshops the Iranian NGO community system's structure was developed, strategy and culture for the usage of the community system were discussed, the process of tailoring was started, and tasks for the system design could be defined. Furthermore specific problems of internet connectivity of (mainly) provincial NGOs were addressed, and the crucial aspects of the ongoing community building process amongst Iranian NGOs could be identified and reflected.

4.4 Facilitators and Working Group

During the second and the third expert visit there were conducted advanced training measures and follow-up trainings for the 16 participants of the first Basics training, an Iranian working group (consisting of 3 NGO network managers) for the coordination of the process was set up in Teheran, and 15 facilitators were established. In the provinces a reasonable number of trained trainers are prepared to take over this role as facilitators.

4.5 Code of Ethics

Together with the facilitators and the Teheran working group a proposal for a "Code of Ethic" concerning the Iranian NGO CS was worked out and published in the system for discussion. This Code of Ethic deals with

- criteria for membership,
- the non-hierarchical system's structure,
- the participatory introduction and adaption process,
- the content structure,
- some rules for information and document management,

- roles and access rights,
- privacy matters,
- and some cultural aspects of cooperation and trust.

4.6 Fostering “Communities of Practice”

During the expert visits tools for project proposals, project planning and documentation were provided to Iranian NGO members, a project development workshop was conducted, comprehensive cooperation projects for the Iranian NGO community have been planned, and several practical projects were brought on their way. In our workshops most participants complained about the lack of experiences with a ‘culture of cooperation’ in Iran. To support such cultural experiences and to foster the building of “social capital” (cf. Putnam 2000, Cohen and Prusak 2001) and the collective learning of the Iranian NGO community, together with the facilitators several cooperation projects were planned to establish so called “communities of practice” (Lave and Wenger 1991, Wenger 1998).

Within these ‘communities of practice’ social construction of meaning, community learning, and collective processes of identification in sense of “social identity” (Tajfel 1982) or “collective identity” (Simon and Klandermans 2001) can be enabled and supported.

4.7 NGO delegation visit in Germany

A visit of an Iranian NGO delegation to Germany and to the European Commission in Brussels has been organized. This visit took place in December 2002. Ten leading members of Iranian NGO networks, managers of resource centers, and civil society researchers have been participants in this NGO delegation. In Germany and Belgium they met with German NGO networkers (mainly of umbrella organizations), scientists and civil society experts, politicians, EU consultants, representatives of ministry administration, and business people to exchange experiences.

Further meetings in Iran and Germany, scientific exchange, and several cooperation projects have been agreed on between the Iranian and European experts and have planned for the year 2003.

4.8 Sustainability of the process

Furthermore, for the sustainability of the process the following measures were already set up:

- the translation of the system’s user interface into Farsi language,
- the elaboration of a newsletter with information about the project, the community system, and the networking process which should be published to Iranian NGO networks in Farsi language, electronically as well as paper based,
- the design of a website (IRANngoCS.net) which is accessible for the public and informs about the NGO community and the system,
- the future development of this website into a Iranian NGO Community System “entrance portal”,
- the development of a database with information on all Iranian NGOs, their activities, and civil society practice,
- the opening of the system (or parts of the system) to Iranian Governmental Organizations and international NGOs,
- additional strategies for the national and international networking of Iranian NGOs,
- concrete projects to establish a starting point for a “community of practice” of NGOs in Iran.

5. EVALUATION OF THE PROJECT

The described project and the several measures have been evaluated in different ways: Every meeting, training, and workshop was evaluated by the participants by filling out a questionnaire. Additionally, several expert interviews with very engaged Iranian NGO networkers have been conducted by IISI members.

Furthermore, the activities in the NGO CS are recorded and the absolute frequencies are registered anonymously (cf. Figure 4).

Some of the results of these project activities are already visible, others will show up in the future development. At the end of 2002 for about 180 Iranian NGO practitioners in several Iranian provinces are working with the introduced NGO community system. The activity statistics shows that usage of the system is increasing slowly but continuously (cf. Figure 4). As more NGO members in several Iranian provinces are registered in the community system and as more specific cooperation projects are established, the number and range of activities will raise.

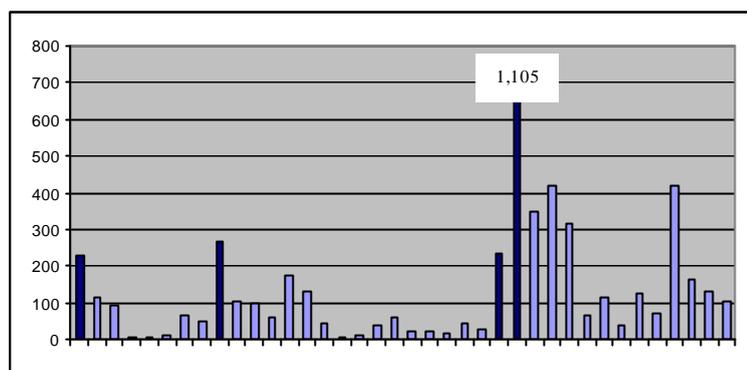


Figure 4. Statistics on the Iranian NGO community system's usage: absolute number of user activities per week; 37 weeks of usage; each column is a week; dark columns are training weeks; the 25th (training) week was cut at 700 but counts 1,105 activities in total.

All materials for trainings, presentations and checklists are provided in English and Farsi language for trainers and self-learners. Several self-organized trainings of Iranian trainers have already been conducted. Besides our Iranian NGO CS workspace structure, there are developing several additional workspaces in the system for single NGOs and different projects. Also the new Iranian Civil Society Resource Center in Teheran is using the community system as its communication and cooperation platform.

The expert visits succeeded in planning the sustainability of the networking process of Iranian NGOs. The project and our community system were promoted in the Iranian provinces and in the broader public. After the third visit, for about 70 NGO members in four Iranian provinces are trained for the community system and for conducting own training courses in Farsi language. A working group has developed a Code of Ethics as a "living document" for the Iranian NGO community and coordinates different projects for the future.

The next steps are aimed at fostering a living culture of cooperation and a "community of practice" of Iranian NGO network practitioners. The evaluation of the training measures and the meetings with facilitators and the Teheran working group underlines that there is a significant need for further trainings on different issues concerning communication and cooperation, project management, fund raising and campaigning, IT and new media in the Iranian NGO community. Additionally Iranian NGOs express their strong need for future cooperation with German and international organizations.

The next national NGO meeting in Iran (planned for spring of 2003) is expected to foster and support these ongoing networking activities of the Iranian civil society organizations.

The next important steps in this process should be

- intense national and international cooperation between Iranian and international NGOs, resource structures, and civil society researchers as well as
- follow-up evaluation measures concerning the further development of the Iranian NGO Community System and the ongoing networking process of Iranian civil society organizations.

6. CONCLUSION

The paper presents experiences which were made in a project fostering the networking process of Iranian civil society organizations (CSOs). To support this process by technical means, a NGO community system was introduced and an Iranian NGO e-community was brought on its way.

Nevertheless, it has to be noticed that the community building project has mainly reached urban NGOs and their members in Teheran and the provincial capitals. Participants of the trainings in these cities and urban regions got adequate language and computer skills to take part in the measures. Further activities are necessary to integrate NGO networks and members from the rural regions and provinces in Iran. Therefore, Farsi translations of training materials, the system's user interface, and the realization of self-organized trainings were set up.

Besides this national NGO networking, the project aims at the support of international cooperation of Iranian NGOs as well. In December 2000 a delegation visit of 10 leading Iranian NGO members to Germany and to the European Commission in Brussels was organized. In several meetings these Iranian delegates exchanged experiences with German NGO practitioners and experts, with politicians and civil society researchers. This delegation visit marks a starting point for cooperations and international relationships between Iranian and German CSOs.

To guarantee a sustainable process of building an e-community, a living culture of cooperation and a "community of practice" of Iranian NGOs are needed. The future success of the system is dependent on the engagement and the activities of Iranian facilitators and supporters of the networking process.

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MEASURING E-GOVERNMENT

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ABSTRACT

In this paper we describe research we have conducted on measuring e-government in the Netherlands. This research was commissioned by the Ministry of Economic Affairs and the Ministry of the Interior in the Netherlands. There are many aspects and benefits of e-government which are missing in existing measuring tools and concepts. Existing benchmark studies lack a theoretical basis and merely look at the availability of electronic government services. Actual use or the impact of electronic public services is not captured. We therefore have developed a new concept and measuring tool on e-government. This tool is being used in our benchmarking study. We have described methodological aspects of our approach in this paper. We believe our experience in this research project and this measuring tool can contribute to the discussion on new ways to measure and evaluate e-government in an international perspective.

KEYWORDS

E-government, international benchmarking, methodology and measurement tools.

1. INTRODUCTION

The hype about e-business may have died down, but the high expectations concerning e-government have certainly not diminished. E-government is a subject that is high on the political agenda. Expectations are high regarding the presumed effects or promises it has to offer. The quality of service provision is improving, transparent government is emerging, less business has to be conducted over the counter and the relationship between the public authorities and the citizen can be improved (Dialogic et al., 2002; Dialogic, 2001). Out of this transformation, it is claimed, a completely different type of government is reckoned to be finally appearing, and one that is better able to perform public tasks to the satisfaction of all relevant target groups. Customer satisfaction for citizens, reduced red tape for businesses and efficiency gains and reduced costs for government should be some of the resultant benefits - to name only the measurable ones. However, the road to this ideal situation is strewn with obstacles (though fortunately with opportunities, too). The crucial point is that it must be possible to ascertain whether promises are really being turned into reality, and what further effects are still emerging.

Measuring tools offer an important gauge for gaining an understanding of the state of affairs and undertaking policy actions. Little by little, measurements of e-government are beginning to take shape in various countries. These measurements sometimes consist of evaluations of programmes or individual national studies, in which a country surveys its progress in the area of e-government. One particular feature of these studies is that they are usually repeated over time. Then there are the international benchmark studies, in which the current state of play with respect to e-government is compared in different countries (e.g., Accenture, 2002, CGEY, 2002, Gartner/IMD, 2001 and UN/DPEPA, 2001). Strikingly, these benchmarks often lack the necessary depth, have scarcely any theoretical foundation, and often confine themselves to the supply side of e-government.

At present, however, there is no coherent and soundly constructed measuring tool on which researchers and international bodies such as the OECD and the EU can agree. Attempts are being made in individual countries to record the current state of the information society, including e-government, for example studies from the e-Envoy (2002) and the Australian National Office of the Information Economy (2002). However, the various individual research projects and benchmarks are not particularly well suited to make proper comparisons possible, since each country employs its own definitions and measuring tools, producing

measurements that cannot be compared with one another. The customary approach used in existing benchmarks is that data is gathered from secondary sources, with aspects and indicators being included which 'happen' to be present in those sources. This is not very satisfactory. Sooner or later, primary research will also have to be conducted, in which international teams use identical conceptual frameworks and tools to produce truly comparable research results. These results will need to relate not just to the supply of services, or the 'exterior' of e-government: they will also need to direct the spotlight 'behind the scenes' of service provision (the organisation of the back-office), and on the intensity of use and effectiveness of electronic services.

We recently performed research in the Netherlands on behalf of the Ministry of Economic Affairs and the Ministry of the Interior (Dialogic et al., 2002). (You can download an English version of the benchmark report at www.dialogic.nl.) For this benchmark, the assignment was to create as accurate a picture as possible of the state of play with e-government in the Netherlands and the position compared with other countries in the benchmark (Australia, Canada, Germany, Finland, France, Japan, Singapore, Sweden, the United Kingdom and the United States). This biennial benchmark aims to measure and evaluate progress of Dutch ICT policies. A few years ago, the Dutch government formulated the ambition that the Netherlands should be among the leading countries with the use of information and communication technologies (ICT). E-government is one of the domains in which the government every two years compares the Dutch position internationally. This benchmark helps to determine whether Dutch ICT policies are successful. Furthermore, this benchmark encourages policy learning. By looking abroad, the Dutch government can learn from other countries' experiences with the development and implementation of ICT policies (especially e-government policies). For example, results from the benchmark can stimulate e-government areas where the Netherlands seems to fall behind the international leading group.

On the basis of our experiences, we offer suggestions regarding an appropriate international approach and recommendations about the measuring tool and method. This paper constitutes a first step towards the constitution of such a measuring tool for e-government. It deals with three questions:

- What do we want to measure?
- How do we want to measure?
- What methods are suitable?

The response to these questions should produce a framework within which e-government can be measured. The framework is intended to produce a survey of the state of progress with regard to the development and penetration of ICT in the public sector in a given country. An important feature is that the tool must be applicable in more than one country. It must therefore provide comparable information, regardless of the administrative culture and structure. As we develop this framework, we shall make sure that we draw attention to its advantages and disadvantages. After all, e-government is never complete. Technologies and services are subject to continual change. A measuring tool therefore needs to be flexible, and to grow together with its subject.

The definition and elucidation of concepts is the subject of Section 2. Section 3 is devoted to a number of methodological issues. Section 4 focuses on our conceptual model, while Section 5 deals with devising the measuring tool in indicators. Section 6 presents some results of the Dutch benchmark study on e-government. Conclusions and recommendations are dealt with in Section 7.

2. DEFINING AND CLARIFYING CONCEPTS

We speak of e-government when a government organisation, for the conduct of its public tasks - and, beyond them, its operational processes, services and interaction with citizens and businesses - uses ICT, combining the new media with the old media. It thus relates to internal operational processes, external service provision and the supply of information by government institutions via open and/or closed electronic networks. The government is able to use Internet technology in support of various processes, involving different relations between the various players. However, we must widen our scope to include more than just the Internet.

ICT is a wide-ranging concept. Central to it is the computer. Infrastructures and network services connect computers with one another. In addition, all kinds of information and communication services, some of them

featuring audio and video technology, also fall within the scope of ICT. In this analysis, the term ICT is used in the broad sense, to mean all technologies with which information – data, text, images and sound – can be stored, processed and (re)presented, and all technologies used for communication. ICT is more than just the Internet. Within the field of e-government, interesting developments can also be identified in closed networks (e.g. Electronic Data Interchange (EDI) for the tax and customs authorities) and non-Internet related services and platforms (mobile communication, smart cards etc).

E-government can also be described and categorised with reference to the various players involved in it and relations between these players (government, employees, businesses and citizens or customers). Business to Government (B2G) relates, for example, primarily to purchasing (e-procurement), in which the government in fact operates as a market player. It is striking that this categorisation into players and their relations is becoming an increasingly prominent feature of e-government policy in different countries. In Singapore and the USA, for example, activities in e-government policy are clustered on the basis of these interaction models.

One relevant aspect of the definition and delimitation of terms is the question of what goals are set. These goals may be very broad and far-reaching, or highly restricted and narrowly defined. Within these definitions, we discovered considerable differences in countries' level of ambition. What immediately strikes one's notice is that most of the national goals are formulated in terms of means, e.g. '75% electronic service provision at central and decentralised level by the end of 2006' or 'possibility of submitting forms electronically'. The overwhelming majority of targets are formulated with respect to the supply of services and information – and hence with respect to readiness indicators, rather than to use (intensity) or the effects of use (impact). In practice, the use of technology (the electronic channel) is elevated into a strategy in its own right. A second striking point is that, although all kinds of ambitions are formulated, there is usually no associated measurement of progress.

A subsequent aspect of definition (in addition to goals) concerns the fields in which the government is involved. Which public tasks should be taken into account in the analysis? In the Netherlands, we tend to distinguish e-government from areas such as e-learning and e-health. In other countries, it is different: in the USA, for example, the tendency is to take all public tasks into account, and to include all fields of application, including e-health, e-learning, 'e-military' and even 'e-court' under the heading of e-government.

Finally, there is the question of maintaining a dynamic perspective. E-government is never complete. It is an on-going innovation that needs to be fed by learning processes. The following steps or phases in this process are often distinguished: Information provision, interaction between players, transaction, integration of government services and agencies and transformation of the entire government.

3. METHODOLOGICAL ISSUES

'Benchmarking is systematic research into the performance and underlying processes and methods of one or more leading reference organisations in a certain field, and the comparison of one's own performance and operating methods with these 'best practices', with the goal of locating and improving one's own performance' (Camp, 1989). These elements of benchmarking stand out all the more clearly when measurements are repeated periodically, revealing the subject's relative progress compared with others and compared with previous periods. A country may have made progress in absolute terms, but may at the same time have been overtaken by other countries on both sides. The longitudinal perspective is thus of importance. A single measurement is simply a snapshot, and does not supply much information. However, a few points need to be made regarding the measuring of e-government in an international perspective.

Firstly, a remark is called for on the unit of analysis - the individual country. It might be more logical to compare regions or metropolitan areas. There is something odd about comparing the Netherlands with countries the size of the USA and Germany. In terms of relative scale, it would be more obvious to compare the former with an individual state in one of the latter countries. Singapore has more in common with a large city than with a nation state. From the methodological viewpoint, this problem is insoluble, given the availability of sources. When interpreting the results, then, allowance will have to be made for this variation.

The second point concerns the incorrect identification of the term e-government with the Internet. This is found in numerous sources, and frequently leads to considerable errors of measurement. Closed networks

(EDI) and stand-alone applications can also be important. Furthermore, it is important to look 'behind the website' at how service provision actually works. How valuable is the possibility of obtaining a copy of a birth certificate via the Internet, if a two-month waiting period and a trip to an office are then needed in order to collect it? Finally, there is the question of the efficiency and intelligence of the whole service-production system, and not just the presence or attractiveness of the Internet as a layer of presentation.

This brings us to a further point. Truly intelligent solutions are not very visible, and that makes them difficult to measure. Technology plays less of a leading role here: it is more a question of organisational and process-related adjustments. An example here is child allowance, which was originally dealt with by a separate organisation in the Netherlands, and was then provided via a tie-in with the Municipal Basic Registration as a pro-active service (there is no need to apply for it - you receive it if you are entitled to it). Smarter than the one-office principle is the no-office concept, in which the customer's knowledge (data in a record) is directly (without interaction) converted into a value-added service. In our own research, we have sought to make this visible, by also analysing concrete services.

A fourth comment relates to the fact that multiple parties have an impact on progress in the field of e-government. This applies both to the infrastructure of e-government (ISPs and broadband providers, for example), but also service providers in areas such as payment traffic (banks), safety and so on. It is also possible for market players to be brought in to perform all or part of public tasks - an example here is certification authorities. If this is done successfully, should it count as (electronic) government? For the target group - whether they are citizens, business leaders, or the employees of other government bodies - the identity of the service provider makes no difference: all they judge is the result.

Finally, obvious errors of measurement may also be committed if insufficient consideration is taken of factors such as administrative structure, culture and extent of government in a country. In particular, differences in the extent of the public sector in the different countries can lead to distortion.

4. CONCEPTUAL MODEL

What, ideally, would you wish to measure when considering progress in the policy area of e-government? As a researcher, you would like to be able to pronounce on the effects of policy drives and new developments. If so, however, you have to conduct research into what the target groups of e-government (citizens, businesses and people within the government itself) experience in terms of gains and increased convenience (as ever, we leave pleasure out of the picture). What gains of time and efficiency are realised? To what extent can citizens be seen to be more involved in decision-making? In short, what added value is created? Note well that, for these target groups, it is irrelevant whether the added value is generated via electronic means or not. They want their problem to be solved, and are mainly interested in an intelligent (pro-active, thoughtful, integrated, etc.) government (and not directly in e-government as such). These pronouncements concerning effects are called impact indicators. Unfortunately, these effects or impact indicators are almost never surveyed systematically. In this area, new primary research is therefore required.

Slightly less ambitiously, we seek measurement data that will tell us something about the use (or rather, intensity of use) of services and processes that are offered electronically. This involves research topics such as the use that citizens and businesses make of specific electronic services, the extent to which the government uses ICT in connection with public participation in policy processes, and so on. We call these indicators intensity indicators. Unfortunately, the source material that is available on these points is highly sporadic in nature. Thus, it is only very rarely that we encounter figures for the number of visitors to government websites. This is another area in which new primary research is needed.

What certainly is possible at this current stage in the development of e-government is research into the prerequisites for e-government. These criteria can be divided up into aspects that have a direct influence on the policy area of e-government and those that have more to do with the information society in general. Examples of these include Internet penetration, public attitude, citizens' ICT skills, privacy and safety laws and available electronic infrastructure. We call these prerequisites readiness indicators.

In the introduction, we claimed that there is no robust and well-defined measuring tool available. What we do find in various places are lists of indicators which - taken together - represent the beginnings of a measuring tool. However, we have not yet arrived at any proper understanding of how these indicators relate to one another. To take a step in this direction, we have devised a 'complete overview' of topics, indicators

and explanatory variables, represented in the form of a flywheel (Figure 1). This flywheel indicates what needs sorting out in order to achieve further progress in the area of e-government.

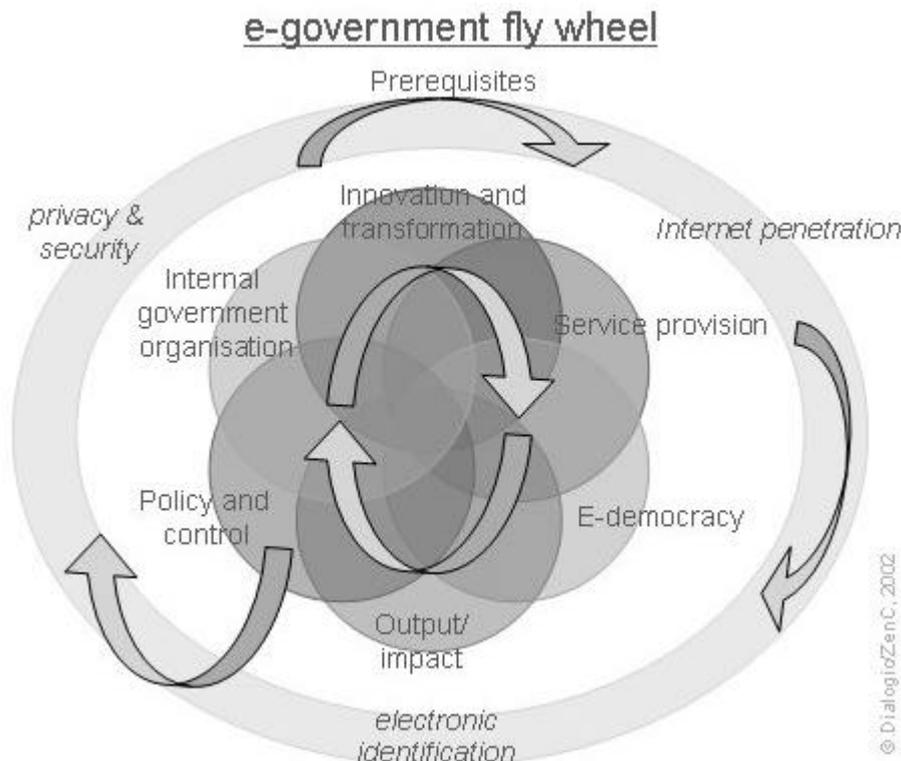


Figure 1. The e-government flywheel

As prerequisites for e-government in the outermost ring in the figure, we have identified a number of factors that are of importance for the development of e-government. These are factors over which the government is able - to a greater or lesser extent - to exert influence in its policy on e-government. Before service provision is possible by electronic means, there must be sufficient connectivity (Internet penetration in households and businesses); for transactions, an electronic identity (electronic signature) is required; for citizens it is vital that privacy can be guaranteed; and there must of course be a certain critical mass of available services.

Within the flywheel, various themes together provide a picture of the development (or level of sophistication) of e-government. These themes should be regarded as 'pieces in the puzzle', and are thus closely interconnected. As our starting-point, we have chosen policy and the method of control. Policy partly affects the prerequisites, but also leads to new applications within the government - which in turn create the conditions for external service provision. Within government, not only does new technology need to be introduced and information provision and exchange optimised: operational processes and organisational structures also need to be changed. We call this (business process) reengineering the 'innovation and transformation' of government. For example, it may relate to cooperation between government institutions in order to arrive at integrated service provision. This organisational change is scarcely visible - let alone measurable - but nonetheless is ultimately of central importance within the conceptual model and hence the measuring tool. Within the subject area of e-democracy, the openness of government information is of relevance, together with other factors that contribute to the transparency of government machinery. This side of e-government is regarded as of great importance by citizens in particular. If all these links in the flywheel do their work properly, this will lead to the effects (customer satisfaction, increased efficiency, a reduction in administrative tasks, etc.) which we earlier identified as impact indicators, and these will in turn set off a new round of policy and governance measures.

5. MEASUREMENT TOOL

We have, where possible, translated the subject areas from the conceptual model in Section 4 into 'underlying' indicators. The list of indicators (i.e. our measuring tool) looks as follows:

Table 1. Subjects and indicators of e-government

Subjects	Indicators
Policy and control	- Policy objectives and progress
	- Budget
	- Government control and organisational coherence
	- Relevant legislation and regulations
	- Policy on public-private partnership
Prerequisites	- Internet penetration in households and businesses
	- Electronic signature (citizens and businesses)
	- Privacy
	- Percentages of websites for government institutions
Provision of services to citizens	- Penetration of electronic services provision
	- Level of sophistication of service provision
	- Use of electronic service provision
	- (Examples of) integrated service provision
Provision of services to businesses	- Penetration of electronic service provision
	- Level of sophistication of service provision
	- Use of electronic service provision
	- (Examples of) integrated service provision
Internal government functioning	- Quality of services offered: presence of government portal, product catalogue, electronic forms
	- Chosen solutions for identification/authentication (government-side PKI)
	- Streamlining of basic data
	- Intranet among government institutions
	- Policy on standardisation
E-democracy	- Policy on openness
	- Percentage of members of parliament with their own website
	- Policy on ICT in policy development
	- Availability of legislation on the Internet
Output and impact	- Availability of policy information on the Internet
	- Effects of provision of electronic services to citizens (customer satisfaction)
	- Effects of provision of electronic services to businesses (reduction of administrative load)
	- Gains in efficiency and productivity increase within government

Each of these indicators obviously requires further elaboration. Agreement on the details is required between those countries that wish to be monitored and compared internationally, for example with regard to definitions and measurement standards. A complicating factor is that some indicators hardly can be quantified (e.g., policy on openness and standardisation). This can be overcome by the use of qualitative data. Unfortunately, qualitative data such as captured in case studies, are difficult to compare. The use of this measurement tool, at this moment, inevitably results in the use of many different kinds of sources such as statistical data, case studies, websites (if possible: web statistics), expert opinions, policy reports and interviews with government agencies. However, one might assume that the development of e-government will be accompanied with the (international) design and application of new qualitative and quantitative measurement tools.

6. PROVISION OF SERVICES TO BUSINESSES

In order to illustrate our approach we will present the results for one of the subjects mentioned in Table 1, namely ‘provision of services to businesses’ (and its related indicators). The *penetration of electronic service provision* has been measured by counting the number of public internet services for businesses (CGEY, 2002). These services do not include not-Internet related services (e.g. EDI). Unfortunately, this indicator includes European countries only. All European countries provide more e-services than the Netherlands. In order to gain a better understanding of service provision, we decided to survey four high impact services. High impact services include public services that many businesses include very often. In our case we examined VAT, collection of social security, customs formalities and the registration of a new company. Anglo-Saxon countries, France and Singapore provide these services on-line whereas Dutch government agencies only provide the collection of social security and customs formalities electronically.

The next two indicators, *the level of sophistication of service provision* and *the use of electronic service provision*, have been captured by an in-depth survey of four specific services, namely customs formalities, VAT, the registration of a new company and e-procurement. As far as possible, we analysed whether a service is provided electronically (readiness) and whether businesses use that service electronically (intensity). Compared to other countries customs formalities are very well developed electronically. However, the Netherlands lies behind with regard to the other services. Especially VAT and e-procurement are less developed.

Finally, we gathered *examples of integrated service provision*. Anglo-Saxon countries and Singapore heavily invest in ‘one stop’ business portals. The Gateway project (UK) aims to offer a mid-office functionality to support electronic correspondence between government agencies and businesses. Another example of integrated services is the the Finnish TYVI system where companies can post their tax and social security declarations (www.tyvi.org). The Netherlands lack a national integrated form of service provision, despite three local pilot projects where local authorities, the Tax Department and Chambers of Commerce co-operate to establish ‘one stop’ business services.

An expert group evaluated and scored a country for each indicator using a five point scale. The radar chart (Figure 2) summarises the individual scores on each indicator for all benchmark countries.

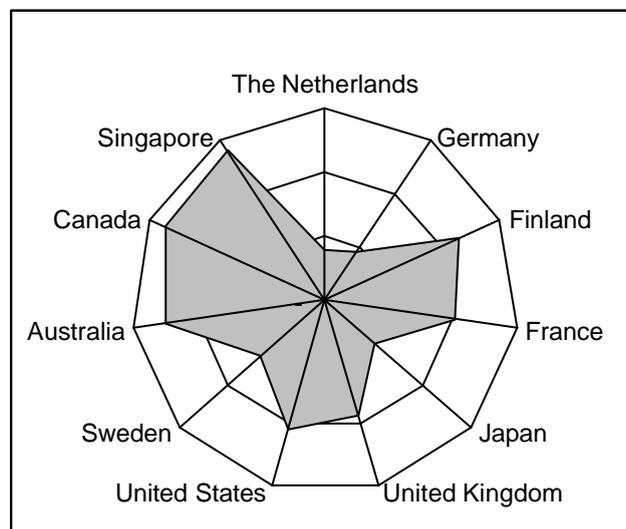


Figure 2. Summary of provision of services to businesses

Figure 2 shows that the Netherlands follow other countries with regard to the provision of services to businesses. We have carried out a similar exercise for the other subjects and indicators (Table 1). Unfortunately, available publications did not include output and impact indicators. On the basis of all subjects and indicators (as listed in Table 1), we must state that the Netherlands do not

participate in the leading e-government group. The Netherlands only score above average with regard to the subjects of the provision of services to citizens and e-democracy.

7. CONCLUSIONS AND RECOMMENDATIONS

There are numerous methods to measure and compare the state of play with regard to e-government at international level. In the foregoing, we have already discussed one frequently used method: that of a benchmark on the basis of secondary analysis. This means using desk research (Internet and literature research) to collect and analyse as many sources and publications as possible about e-government. This analysis should be conducted on the basis of the aspects and indicators we have itemised in our measuring tool. As far as possible, the secondary source material must meet the following requirements:

- The reliability and validity of the measuring tool and measurement results;
- Repeatability. As we want to have biennial updates of a benchmark, preference is given to research which is likely to be repeated in the same manner every few years;
- Topicality. We should collect research that is as up-to-date as possible. In any case, it should not predate the previous benchmark;
- Completeness. As far as possible, the research that is collected should cover countries included in the benchmark.

Experience teaches that working with secondary sources does not suffice to provide the detailed input for our measuring tool. Every researcher who performs an international benchmark on e-government will face problems with regard to the issues mentioned above. There is scarcely any quantitative material available, at either international or national level. Above all, it is often difficult to assess the validity and reliability of the quantitative studies. One consequence of this is that we are compelled to fall back on qualitative individual national studies. These national studies are highly valuable in themselves, but the results are hard to compare with those from other national studies (different definitions, items, tools and points of time). Furthermore, many national and international studies are not repeated automatically. Moreover, the international sources are not based on our tool (and often not on any e-government measuring tool). This sometimes calls for a lot of juggling with the data, which undermines the reliability and validity of a benchmark. Besides, many data, especially at the international level, often become obsolete due to the time it takes between measurement at the local level and reporting at the international level.

Fortunately, there are sufficient alternative ways of gaining insight into the development of e-government in an international context, and, above all, of drawing comparisons. They call for intensive international harmonisation and research coordination. In order to measure e-government, countries need to arrive at an agreement about a measuring tool in which all relevant aspects and indicators of e-government are described in context with one another and operationalised. To this end, we have described an example of a common reference framework. Each country would then be responsible for measuring and analysing the national situation with regard to e-government. The same set of research tools would be used for this in each country, preferably during the same time period. If necessary, the measuring tool could be adapted to the national context. The results would then be collected and compiled at international level.

An important consequence of this approach is that the benchmark for e-government would be based on primary data collection in the individual countries, whose results would be comparable with those of other countries. Obviously, some thought would be required concerning the methods for primary data collection. One possibility would be panel research among different e-government target groups (citizens, businesses, government employees). They could be given the opportunity to respond to written, telephone or web surveys about e-government. Another method would be the collection of web statistics about e-government. Other possibilities include the straightforward counting of purchased electronic services and transactions. In terms of impact, a survey could be conducted of the gains in efficiency (time and money) resulting from use of the electronic channel as compared with other, traditional channels with respect to a selection of services.

The process of judgement of the benchmark results is a form of evaluation. The simplest evaluation is to compile a country ranking for each indicator. For each indicator, an average score is calculated. Countries can see whether they are higher or lower than this score. Although this appears to be the most objective measure, it does have a number of drawbacks. We have referred in the foregoing to the different weightings

that can be assigned to indicators. However, a complicating factor is that the assigning of weighting may differ from country to country. Some countries may attach more value to a particular indicator than others.

There are still further ways of arriving at a final judgement. If required, these may be used in combination with one another. However, these are somewhat more laborious. Firstly, a selection of e-government goals can be made. The scores of countries are then compared with this international standard. The e-government goals would be determined within international organisations. They would be based on what is technically and organisationally feasible with regard to e-government and what is realistic at the time of measurement. Therefore, researchers should at the beginning of each benchmark assess whether a measurement tool is up to date because electronic governments transform too. The measuring tool would focus on these goals. An important advantage of this is that with each measurement, the goals and the measuring tool would 'automatically' evolve together with the current possibilities in the area of e-government.

We conclude this paper with some remarks about the added value of benchmarks in the policy-making process. Why should policy makers compare their country with other countries? At the beginning of the third section, we defined benchmarking. Dutch policy makers are, thanks to benchmarking, able to locate and improve Netherlands' performance with regard to e-government. In plain words, benchmarking stimulates policy learning. Policy learning creates a better understanding of the policy-making process. Benchmarks provide the necessary input into policies that should be developed in order to achieve policy outcomes. Therefore, (international) benchmarks can be considered valuable assets to the policy-making process.

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POLITICAL PARTICIPATION AND THE INTERNET. OPPORTUNITIES AND LIMITS OF ELECTRONIC DEMOCRACY

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ABSTRACT

In 2000 for the first time in Germany and may be world wide a virtual party convention was held completely on the Internet. An important result of this experiment was to demonstrate that virtual meetings can be an interesting complementary feature and even a substitute for regular meetings. There are a number of characteristics which are special for virtual meetings which are highlighted in the paper. Advantages and disadvantages will be discussed.

KEYWORDS

e-participation, virtual party convention, Germany, digital divide, political process, decision making.

1. INTRODUCTION

Already the 1980s, theoreticians of democracy such as Robert Dahl hoped that two of modern democracy's greatest problems could be tackled with the help of communication and information technologies. These problems are on the one hand that citizens are less and less informed about politics and on the other hand that people's interest in political participation is weakening. Many people dealing with these problems hoped that the Internet would bring a break-through. Difficulties which had been discussed in the 70s and 80s, such as the centralisation of political power as well as centralised surveillance and control, became less important than hopes concerning the democratic potential of the new communication technologies. Optimists thought that the Internet would help people to be better informed about political topics and decisions of all kinds. Furthermore, the easy availability of information through the Internet was expected to lead to more participation in political decision making. The fact that there are no physical obstacles, such as being bound to be at a certain place at a certain time in order to take part in a conference or voting, might also lead to more participation. Likewise, people who hesitate to express their opinions in public may become more confident through the anonymous Internet. Another opportunity the Internet could offer is the possibility that spontaneous groups form within a short timeframe around specific issues. E-mail allows the fast exchange of information, quick co-ordination of activities and lobbying. The Internet was considered to be an instrument against governmental control and censorship especially in political systems of little or no democracy. From the point of view of politicians, the Internet could offer an opportunity for experimenting with new kinds of political opinion research via the Internet, such as opinion polls dealing with certain issues or research concerning voters' preferences.

Yet apart from these expected trends, there might also be more fundamental structural changes in the political process. What is for example going to happen to the principle of territoriality? In Germany, politics and administration are mainly organised locally. Parties strongly depend on their local organisations, so does the public administration. Maybe the Internet makes these local structures superfluous. It might at least help to develop a virtual structure additionally to the regional structure. Ideally, the Internet would finally give citizens a stronger influence on the agendas of politics and the government. Journalists, MPs and parties which, according to many, have a distorting effect on the public opinion, become less important. The more open distribution and access to information via the Internet might also lead to less hierarchical structures. The

final consequence of this process might be the end of Germany or other states as a national entity or even the end of democracy as it is known to us. In its place there might be a system of informal relationships and networks without a definite centre.

However, all these visions will take a long time to come true – if they turn into reality at all. Meanwhile the enthusiasm with relationship to e-participation and e-government has cooled down. Previously the debate has been dominated by theoretical and conceptual discussions. Few empirical data were available. Recently this has changed and we see an increasing number of empirically based knowledge on the effects of the Internet on the political life. Yet the above mentioned big expectations are still the backdrop against which we have to ask the question which changes are really going to happen. The generation of new, “digital policy-making” structures is an ongoing process which takes its time. Several of the Center for Technology Assessment’s projects have dealt with information technology and its development. As part of these projects, the question was analysed in how far the latest technological developments really can fulfil everything expected of them. The results of these projects verified the hypothesis that only a small part of all the things possible is really put into practise. Especially such innovations are accepted which easily can be integrated into already existing processes and structures. Therefore, information technology has until now enforced current trends and dominating structures rather than offered revolutionary innovations. Also research on the Internet’s role in politics has struggled to transcend a certain, very popular technological determinism – the assumption, often implicit, that technology still imprints its own logic on social relationships. The Center’s approach has been different. It analyzes the many ways in which an actor (within an institution or organisation) appropriates technological devices in order to pursue specific goals, strategies and relationships that the institution has already organized. In the following we will therefore review how e-democracy is practiced at the moment in political parties, highlighting the example of the first virtual party convention of Bündnis 90/Die Grünen in the German state of Baden-Württemberg and then analyze the perceptions of the citizens vis-à-vis the new medium Internet.

2. HOW IS THE INTERNET CURRENTLY USED BY THE POLITICAL PARTIES?

A couple of years ago, German political parties only reluctantly accepted the Internet as a medium for communicating with their party members and other interested people. Today, however, the situation has completely changed. Now, all the major parties are using the Internet intensively. Not only the websites of many parties have developed into outright Internet portals, offering a wide range of links for Internet users, party members and functionaries, but also their focus has changed. Today, parties offer besides information more and more communication and interaction. For some time now, discussion platforms dealing with topics of current interest or the party’s programme have become widely accepted. Yet a new element is the fact that parties especially use these Internet platforms to get a better understanding of their members’ and voters’ opinions. One example is a debate in the Internet, which also included an opinion poll, among the members of the CDU before the CDU’s party conference that dealt with topics concerning education and politics. Equally new are Virtual Communities offered for example by the SPD’s Virtual Local Branch (www.vov.de) and the Liberal’s Virtual Federal Party. In these cases a variety of party functions are represented in the Internet and accessible to all people using the Internet. (for further examples see Brandt/Volkert 2002). An advanced case of using the Internet represents the virtual party conference of Bündnis 90/Die Grünen in Baden-Württemberg. The unique feature of this conference has been to mirror all elements of a real party congress on the Internet.

3. HOW DOES A VIRTUAL PARTY CONFERENCE LOOK LIKE?

The virtual party conference of the German Bündnis 90/Die Grünen in Baden-Württemberg from 24 November until 3 December, 2000 is a hallmark in a new phase of how parties and political organisations use the Internet. For the first time, a party conference was completely held in the Internet. In virtual reality, members, delegates and the managing committee made real decisions which had a concrete effect on state politics. During the virtual party conference different motions concerning shop closing times and electronic

citizen democracy were discussed, changed and voted on exclusively via the Internet. The following will give an idea of how such a virtual party conference looks like. Basically, the virtual structures are very similar to the real ones. There were two groups of people participating in the party conference. The first group consisted of all the normal Internet users. Everyone world wide could visit the party conference and have a look at its results (www.virtueller-parteitag.de). The other group consisted only of party members. This second group could take an active part in the conference after they had obtained a password. They had the chance to discuss and to support other peoples' motions as well as to bring in one of their own. The decisions were then made by the regional party's delegates as well as by the managing committee just like in reality. The virtual party conference took place in several virtual rooms, each with a different function. At the virtual conference co-ordination centre, information was available about the conference's agenda and the results so far. At the virtual conference room, the so-called "content management system" automatically co-ordinated people's contributions to the debate. Last but not least, there was the election room containing a ballot box. With the help of a special encoding system which checked the authenticity of the digital ballot, the "Trust-Centre" ensured data security.

4. WHO ARE THE PEOPLE WHO PARTICIPATED IN THE VIRTUAL PARTY CONFERENCE?

In order to evaluate the party conference, the Center for Technology Assessment carried out a survey with all those people who took part in the conference. The following deals with the results of this survey (for a detailed analysis see Bubeck/Fuchs 2001). The survey's evaluation shows that the idea of a virtual party conference didn't appeal to all of the 7,500 members of the Green party in Baden-Württemberg. Those who actually took part were mainly politically very active members who also regularly use the Internet. These people are generally well educated. More than 70 per cent are either university graduates or are still studying at university. There were very few people without secondary education.

All in all 303 party members were registered at the conference. 113 of these were either appointed delegates or members of the party's managing committee. The other 190 participants were interested party members who either took part in the discussion or who just wanted to have a look at the virtual conference. Thus, compared to a "normal" party conference, rather more "ordinary" party members took part in the conference. Furthermore, as many as 792 contributions to the discussion were made, 397 of these to a certain issue. All in all, clearly more people participated in this conference than in any before, especially considering the fact that nearly one half (47,2%) of the participants came up with a contribution of their own and 62,7% used their right to put in motions or back other people's motions.

Essential indicators for how much a person participates in politics is his/her age and extent of political activity. The more politically active and younger a person, the more he/she participated in the conference. A certain gender bias could be recorded. 30 per cent of all the people taking part in the conference were women, thus women were under-represented. Yet if we consider the fact that only 40 per cent of the Green Party's members are women, the under-representation becomes less dramatic.

5. WHAT DID PEOPLE LIKE? WHAT DID THEY NOT LIKE?

The majority of the participants were satisfied or very satisfied with the debate, but they were not very satisfied with its structure. The survey generally shows that many people had problems with the complexity of the virtual party conference, which all in all contained twenty discussion groups. Another fact which made things complex was that the longer the conference was going on, the more difficult it became to follow the flow of discussions. The discussions became ever more confusing because contributions to the debate were filed according to the time they were written without being put into some kind of thematic order. Another drawback was the fact that many participants missed the personal contact at the conference. Personal interaction was missing and could not be compensated by the column "party gossip" in the virtual "coffee shop". People couldn't communicate with each other - neither in real time nor confidentially. Furthermore, people had no way of knowing who was there with them at the conference. Many participants missed the

special atmosphere of a real party conference with its passionate speeches, confidential talks and the possibility of getting to know other party members in real life.

However, people express their opinions much more open on the Internet. There it isn't necessary to stand up in order to give a speech in front of lots of people listening and looking on. People also liked that a virtual party conference takes up less time than a real party conference. Another advantage of the virtual conference is that people don't have to leave their work place or home so that they easily could integrate the conference into their every-day life. The survey shows that people visited the conference a couple of times a day for rather short periods of time so that they didn't have to interrupt their daily routines for long. Therefore, it doesn't come as a surprise that more than 80 per cent of all those who took part in the conference said that virtual party conferences help to reconcile party work with the family and the job.

6. CITIZEN PANELS AND E-DOMOCRACY

So far (May 2003) there has been no further example of a virtual party convention such as the one described above. One reason for this is surely that the public at large is still uneasy about the influence of the Internet on the political process. It is obvious that most debates on E-Democracy are technology-centered and the still undecided problem of the social embeddedness of the new technologies in political and cultural structures is not yet sufficiently considered (Kubicek and Hagen, 1999; Leggewie and Maar, 1998). Until now we know little about how the citizens at large, being directly involved, think about political participation via Internet. How do they assess the opportunities and where do they see limits? What are their doubts and fears? Where do they see fields of application for EDemocracy? Do they think regulations are necessary? Do they at all accept the Internet as a media for political participation?

The Center of Technology Assessment was therefore instructed by the German Ministry of Education and Research (BMBF) in November 2000 to examine the acceptance and preferences of technological applications of E-Democracy within the framework of a research project ("Technology, Communication and Discourse in the Age of Multimedia". Partial project: "The Method of Discourse as Participation in Modern Democracies – Options and Means of Electronic Democracy"). Citizen panels were used as empirical method for the study.

- In May 2001, the Center of Technology Assessment organized five citizen panels on the topic "Civic Participation and the Internet. Opportunities and Limits of Electronic Democracy". They were carried out in the following cities of the federal state of Baden-Württemberg: Bad Schussenried, Ettenheim, Mannheim, Stuttgart and Weikersheim. These cities were selected according to the number of inhabitants and the geographical location (urban or rural area).
- The participants of the citizen panels were selected at random. Letters were written to the registration offices of the participating cities asking for about 600 randomly selected addresses (interval printouts) of inhabitants who were at least 18 years old.

The following questions and group tasks, the participants of the citizen panels had to deal with, were developed by the project team:

- summing up of the discerned significant deficits of democracy and communication in the present political system,
- opportunities and limits of a political participation of citizens via Internet,
- opportunities and limits of an improvement of the communication among the citizens and politicians via Internet,
- ideas of a possible applications of Electronic Democracy,
- proposals for main thematic emphases for Electronic Democracy,
- possible prospect of success for temporary citizen networks in the Internet,
- problems of equal opportunities concerning Electronic Democracy,
- problems of data security in votes and elections via Internet,
- political, institutional and individual conditions for the use of the different forms of Electronic Democracy.

The participants were given two days to complete the tasks.

6.1 Results of the Citizen Panels

With the *exception of the topics* that are generally treated in a mainly populist manner in the public and that revive or stir up emotions against minorities (i.e. discussions about death penalty, the right of asylum, the migration of foreigners) all other political topics on all institutional levels (EU, national state, federal state, local authorities) are accepted by the citizen panels as suitable for discussion via Internet. The municipal level is favored insofar as it is here that the citizens' expertise will be most effective and because the limits and risks of Electronic Democracy remain manageable at least in the beginning.

The citizen panels see *opportunities* in the potential of the Internet to make the political communication and information flow more efficient and more transparent as well as to improve the possibilities for citizens to participate in political processes. Most significant are:

- a more efficient administration by means of virtual institutional operations,
- a more efficient communication between politics and citizens,
- activation and motivation by means of the Internet to engage in politics outside the Internet as well,
- more realistic political decisions by integrating the citizens' knowledge based on experience.

The citizen panels see *risks* regarding Electronic Democracy primarily in the still unsolved problems such as:

- the danger of manipulation in case of votes and elections because of a lack of sufficient data security,
- the danger of a divide within society into those persons who are informed and those who are not (digital divide) and a resulting damage to democratic equal opportunities,
- the danger of trivializing politics by influencing the process of political decision-making through too many spontaneous and unreflected opinions,
- the danger of propaganda of criminal and extremist groups and their influence especially on the younger generation.

As *concrete possible applications* of the different forms of Electronic Democracy the citizen panels would like to have:

- the opportunity to make use of electronic services in administration (taxes, issue of passports, etc.),
- populist and comprehensive information relevant to present times, i.e. on land utilization plans, reports of the municipal council etc. on the municipal level and i.e. on legal initiatives, vote results etc. on all political levels,
- the establishment of citizen networks (citizen initiatives, collection of signatures, parents' initiatives, neighborly help),
- the opportunity of online communication (questioning hours, public debate etc.).

Binding votes via Internet in the sense of a direct democracy are still controversial in the five citizen panels. Plebiscites on ethically controversial subjects (i.e. death penalty) and on other complex decisions requiring a profound and special engagement in the matter were refused unanimously. The citizen panels, on the other hand, unanimously think it is useful to ask for opinions on current political discussions via online votes in connection with a reliable identification by means of the digital signature.

To take part in elections from the home computer is a further controversial subject in the citizen panels. Some citizens think this is a chance to put an end to the so-called election fatigue (especially among youngsters). Others refuse it because of considerations on the political culture and the authenticity of the given votes. There is, however, a consensus in the conclusion that the present state of security does not yet allow any legally valid online votes.

The results of the citizen panels are the summary of the citizens' attitudes and preferences, beliefs and opinions in the citizens panels of Stuttgart, Bad Schussenried, Weikersheim, Mannheim and Ettenheim. The documented answers were given in small groups after having completed a group task that lasted about 45 minutes and was initiated after giving certain information. The process of decision-making within small groups is the core element of a citizen panel. Within small groups as many arguments as possible may be brought into discussion by various persons with the aim to find a consensus. The aim to come to an

agreement leads to an argumentative concentration on the spheres of disagreement leading to a high consistency of argumentation. This may be emphasized by the social heterogeneity in the citizen panels resulting from the random selection of participants. Entirely different people come together, different in age, gender, origin, values, profession, education, experience and future orientation. The method of constantly changing small groups enabled each participant to utter his or her opinion guaranteeing that the documented opinions represent a summary of various experiences and situations in life.

The citizens described the following points as significant and fundamental basic conditions for the introduction and use of forms of Electronic Democracy:

- The citizens' willingness for political engagement and participation requires the politicians' willingness to make political decisions more transparent and to integrate citizens.
- A broad acceptance of E-Democracy is only possible if the citizens have trust in the new media. Efforts must be made for the further development of security measures to protect communication and data transfer from abuse and manipulation.
- Civic participation via Internet is useful in the long term as long as it is not concentrated on single prestige projects but used comprehensively and in connection with all political topics. To guarantee this, it is a requirement for politics to care for the necessary structural and legal conditions.
- The danger of a digital divide of society is relevant and must be taken into consideration. The promotion of media literacy is a necessary step to face this problem. Various educational institutions may take over responsibility for this task. Yet structural conditions must be optimized to provide access to the Internet to the broad mass of the population.
- All considerations about the use of forms of Electronic Democracy must take into account that previous opportunities of obtaining information, of communication and participation will be guaranteed outside the Internet to the same extent in the future as before. The Internet should always be an additional opportunity but no substitute.

The presented results from the citizen panels are an authentic, complex and lifestyle reflecting summary of opinions of public representatives, namely citizens, on opportunities and forms of Electronic Democracy, on the desirability and possible applications. The attitude of the citizens may be described as skeptical openness. This skepticism will be reduced if those responsible succeed in solving the fundamental and significant problems of data security, digital divide and the willingness of politicians to admit more transparency and civic participation.

7. SOME LESSONS

The experiment "Virtual Party Conference" helped to gather useful know-how about how to use the Internet in a complex political process. The experiment was insofar successful as the conference took place without any major difficulties. Not only could the Green Party present itself to the public as an especially progressive party which isn't afraid of the new medium Internet. The participants on the whole were also very satisfied with the conference. The great majority of the participants (89,7%) would like further virtual party conferences, 74 per cent would even like virtual party conferences for the whole of Germany. Yet, people also clearly said that virtual conferences shouldn't completely replace real conferences. Only one respondent said that there should only be virtual conferences. One third of the respondents said they would like to have virtual conferences alongside real conferences. The remaining majority of two thirds said that virtual party conferences should alternate with real party conferences.

However, definite predictions can't be made about in how far and in what way virtual party conferences will change the political process. Expectations about a more fundamental participation have not or only to some extent come true so far. As mentioned before, those people who took part in the virtual conference were politically active, technically interested and highly qualified young men. This isn't surprising because this is also the group which generally uses the Internet most often. The social composition of the conference participants is still more selective, however, than that of the group of Internet users. This can be partially explained by the special characteristics of the party membership.

The virtual party conference is a sign that the political process becomes at least a bit less hierarchical. On the one hand, people said that it was better possible to take part in the discussion and decision making

process. On the other hand, the party's managing committee or famous party members could hardly influence the discussion. So far, the Internet doesn't offer a mechanism for such spectacular interventions.

These first results show that we should have a closer look at what is going on between politics and the Internet. In the last couple of years, the discussion about digital politics has been very much ideologically biased. Projects such as the virtual conference of the Green Party help to gather more concrete knowledge and information and point the way for further discussions.

8. CONCLUSION

The reasons for the scholarly interest in the ability of the Internet to expand political participation should not come as a surprise. In a technology oriented discourse the Internet seems the cure for many a health problem of advanced democratic societies. It has become obvious, however, that the average citizen has a rather well balanced perspective on the opportunities of the Internet (far removed from the euphoria of the technophobes). It has furthermore become clear that those persons with Internet access come from high socioeconomic backgrounds. A consensus thus seems to have emerged that the Internet will only reinforce the existing patterns of unequal political participation.

The results of our studies have generally supported this more cautious consensus. It has shown as well, however, that there is a potential to tap, if Internet participation is geared towards the needs and interests of the citizens. The results of the analysis of the Virtueller Parteitag have interestingly demonstrated that there is a potential for a specific group to transgress structures of political participation and these are people with a high affinity to the Internet. In this case, the Internet party convention of Bündnis 90/Die Grünen did not one dimensionally advantage those endowed with traditional resources. Given these results one might speculate that given a more equal distribution of Internet skills, the Internet could develop a potential to act as an outlet especially for young, technology oriented people. In this regard there must be seen a very strong impetus to develop Internet skills on a broad basis, if one wants to bring politically disaffected people to participate.

Nevertheless it remains true that the participatory potential of the Internet and its realization in everyday practices of ordinary citizens remains uncertain. Current growth rates for Internet access do not foretell whether this trend will continue to work in favor of equal access. Here looms an important task for political action to support the spread of the Internet and the competences to use it.

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TWELVE LESSONS TO DEVELOP AND SUSTAIN ONLINE KNOWLEDGE COMMUNITIES

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ABSTRACT

The development of online communities is rapidly becoming one of the important tools in Knowledge Management. Online communities have been emerging steadily and rapidly since the early nineties. Initially these online communities were being developed outside the corporate world. More recently, however, they have also become an organization reality. The concept of Communities of Practice has fuelled its growth and made it a strategic concern in a growing number of forward-looking firms. This paper presents practical lessons for organizations that aim to develop and sustain online communities in the context of knowledge program initiatives of a few leading organizations. These lessons (and the specific examples) are based on the actual experiences of eleven large organizations that were part of a large research that included interviews in Canada, U.S.A., Brasil, United Kingdom and Germany. The following organizations were part of the study: ADC Telecommunications, Bain & Company; Bank of Montreal; Brazil's Finance Ministry IT Agency (SERPRO); Context Integration; Eli Lilly; Hill & Knowlton; Nortel, Siemens, Texaco; and Xerox. Each company provided an opportunity to develop in-depth case studies using a structured qualitative and quantitative inquiry guide. The research was gathered through a combination of face-to-face meetings and telephone interviews. The paper also presents a brief literature review. The key conclusion is that technology only plays a secondary role in developing and sustaining online communities. Much more important are human-centric issues related to leadership, focus, motivation, identity and rewards.

KEYWORDS

Knowledge Management, Online Communities, Global Companies, E-learning, Case Studies, Reputation

1. INTRODUCTION

We believe it is difficult for large, global organizations to remain competitive in industries that demand rapid cycles of knowledge creation, diffusion and usage, without highly advanced digital collaboration tools. With integrated web-based collaboration tools, the sophistication, user-friendliness and mobility capabilities of online communities have been taken to a much higher level. This is not going unnoticed by leading knowledge-focused organizations. Various KM initiatives are strongly leveraging Online Communities of Practice (CoPs).

In this paper, we will present how some leading organizations are applying collaboration tools into effective use to leverage their "knowledge" know-how. It presents the lessons learned related to the development and support of online communities in large organizations that have strong KM programs. Each lesson is illustrated with many practical examples extracted from the case studies.

Eleven organizations were selected to participate in the study because of their advanced stage in their knowledge management implementations and their strong web-based supporting capabilities. In almost all cases, these were large, global companies that had a strong need to share knowledge across offices situated in different corners of the world. The following organizations provided us with the opportunity to understand their KM/online communities initiatives and develop in-depth case studies: ADC Telecommunications, Bain & Company; Bank of Montreal; Brazil's Finance Ministry IT Agency (SERPRO); Context Integration; Eli Lilly; Hill & Knowlton; Nortel, Siemens, Texaco; and Xerox. The interviews were conducted with employees located in Brazil, Canada, Germany, United Kingdom and the United States.

2. METHODOLOGY

The paper is based on in-depth case studies using a structured qualitative and quantitative inquiry guide. The research was gathered through a combination of face-to-face meetings and telephone interviews. The research interview guide was based on extensive literature research and researcher's personal experiences as practitioners of knowledge management. We chose a detailed case study analysis based on a mix of close-ended and open-ended questions. This choice, we believe, was necessary because of the very early stage of this topic. Very few organizations have fully embraced and/or are providing dedicated resources (people, money and infrastructure) to support the development of strategic online communities. Thus, this research was very exploratory in nature and the choice of the title for this paper intends not to convey the idea of generalization, but that there are many sequential steps that should be well-planned ahead when starting an online knowledge community.

In every case, we conducted a number of in-depth interviews with senior executives in charge of KM and corporate portal initiatives. We did not, however, limit the interview process to KM leaders. More often than not we also interviewed project managers, users (employees) and community leaders. Generally, we interviewed three to eight persons per organization. More often than not, we were also introduced to live demos of the web solutions and/or were provided with screenshots to support interviews over the phone. A number of companies also shared their internal documentation related to the KM efforts.

After an initial round of interviews, as researchers, we would then prepare a first draft of our conclusions and submit it to the organization for further review, discussion and refinement. This allowed the researchers involved not only to correct any misinterpretations, but also to take the interviews to a deeper level of communication as interviewees were prompted to reflect about what they had learned (Many interviewees have expressed their appreciation for the opportunity to develop the cases). They think that this exercise led them to pause for a moment and, through a dialogue with us as researchers, to rethink their overall goals, achievements and lessons learned.

The focus of our research was not on the issues of IT implementation. The understanding of the IT infrastructure only provided us with the necessary context to analyze the KM and online communities initiatives that were being supported. Indeed, as we found out through our interviews, the most important factors of success were related not to the choice of technology, but with the managerial practices and processes aimed at increasing knowledge flows in the organization.

The key strength of this methodology was the unveiling of detailed anecdotes, stories and tips that are just being tested in the field by practitioners. This is reflected on how each proposed "rule" for developing and sustaining online knowledge communities is illustrated by very specific examples from the cases studied. This richness of detail is of paramount importance for other researchers that may engage in similar research projects.

In the next section, we provide a brief literature review and then in item 4 we discuss what the key learning insights were from our eleven research cases.

3. BRIEF LITERATURE REVIEW

Experiences with online communities, such as AOL, Compuserv, WELL and Listserv, pre-date the web. Some people, including sociologist and Berkley University professor Manuel Castell (2001), have suggested, "the origins of on-line communities were very close to the counter-cultural movements and alternative ways of life emerging in the aftermath of the 1960s". Since the web, however, they have become a mainstream fixture for focused files, information and knowledge exchanges. These communities cross the boundaries of organizations, countries, age groups and profit and non-profit organizations. The nineties saw the growth in collaborative work supported by LAN (local area networks) and WAN (wide area networks) in many large organizations (see box below with some of the key lessons from research on Computer Supported Cooperative Work). Since the web, however, online collaboration has reached a much wider scale within and outside the business world. Collaboration and community building applications are, indeed, becoming a key component of many knowledge management initiatives. They can increase the ability of employees, especially from different locations, to develop stronger bonds and a sense of community.

In the face of the tremendous challenge of fostering knowledge sharing within and across companies we also need to highlight the concept that precedes the web and online communities, but that is also greatly benefiting from these technologies: Communities of Practice (CoPs) which was originally coined by the organizational theorist, Etienne Wenger. Communities of Practice (CoPs) consist of people who are informally, as well as contextually, bound by a shared interest in learning and applying a common practice. CoP members may be part of the same department, belong to different areas of a company or even to different companies and institutions. Members may create semi-open "clubs," where membership is based on relations of high trust and on the contribution that each person brings to the community or network (Wenger & Snyder, 2000). The term CoP refers to the ways in which people naturally work together and/or associate with others. It acknowledges and celebrates the power of informal communities of peers, their creativity and resourcefulness in solving problems, and their ability to invent better, easier ways to meet their commitments. What holds CoP members together is a common sense of purpose, the needs of individuals to connect with others that share similar experiences or learning goals and, ultimately, each member's real need to know what the other members know" (Brown & Duguid, 1991).

Some organizations that are knowledge intensive, such as consulting companies (like McKinsey, Bain and Accenture, for example), have been fostering the development of global CoPs for a long time. Most organizations, however, have yet to pay close attention to CoPs. This is starting to change. Recently, a number of leading organizations (for example Xerox, World Bank, IBM, HP, Siemens, Shell, Texaco, etc.) have started to recognize the contribution that such networks can make towards the creation and diffusion of knowledge and have started to formally support CoPs. According to the research firm Gartner (2001), by 2004, formally supported CoPs will be prevalent in more than 50 percent of Fortune 500 enterprises.

This trend probably derives from the conclusions of Wenger & Snyder (2000), about the many benefits of CoPs. According to them, communities add value to organizations in many ways. They:

- Help drive strategy;
- Start new lines of business;
- Solve problems quickly;
- Transfer best practices;
- Develop professional skills;
- Help companies to recruit and retain talent.

Based on our own research and case studies, we would add the following possible types of contributions:

- Win new businesses more quickly;
- Better serve existing clients;
- Develop stronger relationships with clients;
- Facilitate integration of acquired companies and in post-merger efforts;
- Reduce cross-functional and cross-location cultural barriers;
- Improve organizations' social capital;
- Reduce costs;
- And, play a significant role in merger and acquisition activities

It has also been argued that knowledge shared within a particular CoP may not get shared beyond the members of the CoP. Dorothy Leonard Barton (1995) has researched the impact of communities on knowledge sharing and has shown how isolated communities tend to get stuck in ruts, with core competencies turning into core rigidities. Her research found that external cultural stimuli are needed to help propel a CoP's or an organization's corporate culture forward. Without these external stimuli, it is very easy for CoPs to be blinded by the boundaries of their own limited view. By linking diverse communities, with different belief systems and evaluative practices, in a cohesive meld, organizations can challenge the narrow belief systems of each individual community and ensure that knowledge is moved around.

Thus, the ability to organize, capture, and disseminate the knowledge of particular CoPs throughout an organization is at the core of successful KM efforts. Increasingly, a company's ability to survive and outperform others requires the continuous linking of distinct CoPs and the synthesis of collective and organizational knowledge. By supporting or institutionalizing strategically relevant CoPs, firms can codify chunks of the knowledge carried by employees and, more importantly, promote focused organizational learning and innovation. It is a well-known fact that meaningful connections take individuals to levels of creativity well beyond what they would reach in isolation. Learning, as John Seely Brown and Paul Duguid have emphasized, is a social act (Brown & Duguid, 2000).

4. RESEARCH RESULTS

The eleven cases analyzed are quite different: in the scope and stage of their KM initiatives and the development of online knowledge-sharing communities, the size of the organizations involved (from large multinationals to strong local players), and the particular industry represented. The major results and the various lessons (from multiple perspectives) for each detailed case study has been published in a book format in October of 2002 by Butterworth Heinemann: "Realizing the promise of corporate portals: leveraging knowledge for business success" (Terra & Gordon, 2002). Despite the differences in the cases, we strongly believe that a number of commonalities have emerged. Thus, this paper provides a summary of "lessons learned" that, we believe, apply to most organizations interested in developing online communities. Indeed, we believe that there are twelve lessons that can be applied to the development and support of most successful online communities. They are the following:

4.1 Establish a sense of identity for the community

A sense of identity can be created through the establishment of a clear purpose and specific goals and objectives for the community, as well as through the development and fostering of a sense of history for the community. Let new members know how the community got started, who was involved in the beginning, etc. It is also important to create a strong messaging and branding effort (with adequate visual cues). This plays a critical role in reminding members of their affiliation and promoting the goals and values of the community. In many cases, such as Hill & Knowlton, Bain & Company, Siemens and Texaco, there is a system and personnel in place, to capture and publicize anecdotes of good knowledge-sharing within the organization. Through regular e-mails and postings in the online communities these success stories do not go unnoticed. There is a strong belief in these organizations that these actions help foster a sense of identity, expected behaviour and increase participation. We also noticed that many organizations developed a good branding strategy for their communities. Easy to remember names with strong personalities were, therefore, often introduced ("IAN, which stands for Intellectual Asset Network" - Context Integration; "GXC" or Global Exchange Network - Bain & Company; "ELVIS" - Eli Lilly; Sharenet - Siemens; PeopleNet-Texaco; Eureka-Xerox).

4.2 Online communities need a strong communications plan

We have learned that launching online communities require important behaviour changes and dedicated champions. In various successful cases, such as Texaco, ADC, Siemens and Serpro, we saw a concerted effort of the KM teams and other champions from different areas. Indeed, our research suggests that multidisciplinary teams are extremely important for successful KM implementation. In the cases analyzed, we saw multidisciplinary teams working together not only to develop the infrastructure, but also to publicize, train and motivate people throughout the organizations. They worked with employees in general, but also with a number of early-adopters and or communities that helped disseminate concepts and remind other employees. In some of the most successful cases, the rollout and key improvements (new functionality or added content areas) were also often preceded by significant internal communication, including posters, newsletters, communication booths, local training sessions and gatherings (with the presence of senior management) and e-mail communications.

4.3 Develop the rules of engagement for the community

Moving to an online community is like moving to any new environment: people need to learn the rules of participation or the "netiquette" of the community (e.g., when and how to contribute). The leader(s) of the community should curb any activity that is against these pre-determined principles or that does not belong within the context of the community (Context Integration, for instance, has a prominent section in its knowledge portal about appropriate behavior called "Social Contract". Siemens has something very similar that it calls "Quality Guidelines" and Texaco called it PeopleNet's Statement which laid out very clearly the expected behavior from users of the system). Indeed, it is clear that many organizations will need to extend

existing traditional “team dynamics training” to include “rules for online collaboration”. It is a big mistake to think that people will naturally know how to behave online.

4.4 Common language and simplicity of usage is essential for success

Investing design time on simplification for valuable knowledge sources and then to work with end users to understand further their unique personal or community requirements is a more valuable approach to execution than posting a wealth of content that no one uses. It is important to understand how employees conduct their work and when and how they look for other sources of knowledge. It is advisable to do a careful “audit” of each business process and knowledge domain before doing any development work. The end result of the audit process becomes a set of taxonomies and structures that closely fit an organization’s business and users’ needs. It also means less time and money spent on costly reworks. One of the important lessons at Bain was not to implement web applications just because it was easy to do so. For instance, the company could have easily added, for instance, chats, instant messaging and discussions forums in their knowledge portal. However, after careful analysis of how work is conducted and how knowledge is shared and created, the KM team decided that it was not the right time to implement these tools. Ideally, users should use a minimal number of “clicks” and strolling to find the information they need. Hyper-linking should provide different paths for users to find the same information. The graphical design and layout should be clean (not “crowded”) and convey the overall tone of the company’s brand-positioning or support the identity of the specific community towards whom it is geared. Regardless of the application or component being implemented, it’s highly advisable to get input from users and content- creators very early on.

The development of ShareNet at Siemens provides the best example of the above affirmations. In order to design a system that would work, ShareNet was developed in a very collaborative setting. A steering team was formed, with close to forty sales representatives and marketing professionals from many different countries and types of customers. This team started with what some managers at Siemens consider to be the foundation of KM: “Know your processes well”. In this case, the selected team developed detailed maps of the sales processes (defined as core process) and linked each step and/or aspect of the process to specific “buckets” of knowledge. These buckets of knowledge were derived after extensive interviews with sales and marketing professionals. These professional were asked directed questions such as:

- “How does your process work?”
- “What are the important sources of knowledge that you need to do your job?”
- “Why have you been successful in your projects?”

After these interviews, the ShareNet central team was able to cluster the relevant sources of knowledge into specific “Knowledge Objects” such as “Technical Solutions”, “Functional Solutions”, “Customer Knowledge”, etc. Once agreement was reached, the ShareNet team started to develop a series of prototypes while periodically asking future users how they would like the information and knowledge buckets to be presented.

4.5 Lead by example and make sure critical mass is developed rapidly

Frequent participation by community leaders in the activities of the community (especially if the leader is also a domain expert) will certainly prompt higher levels of participation by members of the community at large. Bain & Company’s successful implementation is attributed, to a great extent, to the many hours that its most senior partners have dedicated not only to planning the project, but also to contributing with content themselves. The company also focused initially in areas of content that were strategic and where a relevant mass of expertise was available within the firm.

4.6 Quality of content is more important that quantity of content

If an online community is to focus on knowledge flows, it is very important that people trust the information that they receive; otherwise users quickly disregard the tool. One of the remarkable things about the most successful online community implementations is their stringent quality focus. In large organizations, in particular, any online collaborative tool can easily become a “dump” and quickly lose credibility if employees do not trust the information available in the system. In the cases analyzed a number of practices

and policies focused on keeping only high quality references content. A few good strategies that we uncover were the following: A validation process to let employees upload content to a wide audience was basically in place in all cases; Detailed and easy to use feedback mechanisms improves the quality of existing documents and helps to quickly exclude references that have low-value (particularly important at Bain, Siemens and Xerox). By doing this, users add value to the original documents. Sometimes they disagree with the conclusions or tips of existing documents, sometimes they add new context or simply confirm its usefulness. Anyhow, after a number of iterations, the original documents usually have their intellectual capital enhanced by the contributions of others; Finally, moderators or knowledge brokers can play an important role by constantly monitoring usage and interviewing users to find ways to improve the quality of content.

Some of the most advanced companies have realized that perfect timing adds significant value to Knowledge. In order to be successful in highly competitive environments, and also to better serve customers, employees need to be able to tap the organizational knowledge very rapidly. In some cases, it might be a matter of hours; in other circumstances, the requests may be treated as routine learning. This might be a straightforward concept, but most companies do not pay as much attention to how perfect timing improves the quality of content. Perfect timing is achieved through a combination of personalized notification, quick content management process and ability of employees to direct their requests for help according to different levels of priority (Context Integration and Siemens case, in particular, are good examples).

4.7 New members need special attention: from invitation to introduction

This involves alerting users of events, reminding them of the benefits of the community and its the rules of engagement, and inviting those that are absent to contribute if they feel their participation could elevate the level of discussions. It is particularly important to greet, coach and get new members up to speed. In the online environment it is quite easy to have newcomers to come, check in a few times, and then never show up again. At Bank of Montreal (integrated with their training initiatives) SERPRO, Hill & Knowlton, Siemens, Bain & Company and Context Integration senior management and senior management of the Knowledge Management team travelled extensively through their many different offices letting people know about the communities. At Hill & Knowlton, Bain and Context Integration every new employee goes to detailed training on how to use the KM systems and participate in online communities.

4.8 Allow both centralized and decentralized community creation

Organizations deploying online communities may take two complementary approaches to foster community creation: (i) they can provide pre-defined community environments (with targeted content, list of individuals, collaboration tools, etc) that are carefully, strategically and centrally planned or (ii) they can provide the tools that allow like-minded individuals to easily set-up their own communities. ADC, Eli Lilly and Hill & Knowlton, for instance, adopted both strategies. They created a few core communities that were strategic (based on existing core competencies and/or target industries), such as the "Health Community" in the case of Hill & Knowlton, and also implemented solutions that allow communities to be easily set-up. In the case of Hill & Knowlton, for instance, communities can be created by linking emails and messages in real-time and distributing them to folders according to users' own interests (users have the ability to direct their messages and also to pre-select topics they are interested in). At ADC, they provide "plug & use" capabilities that allow almost anyone to quickly set up communities with applications such as calendars, discussions forums, whiteboards, notification, etc. Finally at Eli Lilly a number of pre-web communities were carefully studied and supported before launching the software applications to support online communities. After the launch, however, other communities could be freely created without management direct support.

4.9 Participants need to develop an online identity

Identity is key for fostering human connections. Most companies in our studies supported some kind of online identity and reputation development. Detailed, accurate, updated and meaningful profiles of users help spark connections and create the required level trust amongst participants. Firms are clearly documenting subject matter expertise, where they were, how to reach out to them, what knowledge they knew and what kind of particular interests they have. A number of organizations also realized that people tend to collaborate

more with others if the relationships become somewhat more personal. In some cases, it may even include photos and personal information such as hobbies (this is the case, for instance, at ADC, Eli Lilly and Texaco.). Expertise maps, in many instances also included databases with lists and descriptions of the competencies of individuals both within and/or outside the organization.

4.10 Recognize levels of participation and develop a reputation system

The recognition and identification of the different levels of contribution (both quantitative and qualitative) of each individual is of particular importance to knowledge exchange communities. Providing ways to gauge individual contributions to an organization's intellectual capital pool and to its online knowledge flow is, therefore, being experimented in a number of cases. At Context Integration, some people are labeled as "gurus", at Bain & Company, documents that are highly rated by the community are displayed more prominently in search results. Both Bain & Company and Hill & Knowlton include a "best-seller" list of documents (and the name of the authors) that have been most accessed by others. In fact, at Bain, a general email message is periodically sent to all consultants highlighting the "top 20" most used documents in the portal environment. This "top 20" list serves not only to direct consultants to those documents that are most useful to their peers, but, by listing the author and office, gives additional prestige to the documents' authors. At Xerox, the company discovered that the technicians were more than happy to add tips to a database because they received credit for their contributions, which enhanced their standing among colleagues. Indeed, when management suggesting attaching financial incentives to the tips, the technicians resisted the idea. They felt this would diminish the value of their contributions.

4.11 Monitor activity and satisfaction level

Active leaders keep good statistics about the participation level of users, areas of the content that are most searched and visited, frequency of contributions. They also conduct, from time to time, offline and online surveys to understand the needs and levels of satisfaction of members. With this kind of data at hand, they can direct their actions to the root causes of occasional problems and/or diminishing participation. Close monitoring was something noted in many of the cases (e.g. ADC, Bain & Company, Context Integration, Siemens, etc). At Context Integration, for instance, IAN's moderator tracks a number of items such as number of postings, number of questions, most active categories, least active categories, most active employees and offices, etc. This tracking systems is closely monitored, well focused on strategic knowledge domains and serves as the basis for rewards and for the company to gauge activity around knowledge creating processes.

4.12 Promote special online and offline events and celebrate success!

Savvy community leaders clearly understand that in knowledge-creating or sharing communities, participation is highly dependent on voluntary participation and that members can only be inspired, not forced, to participate. Consequently, promoting events and celebrating the achievements of the community (online or offline) ignites existing members and acts as advertisements for potential participants who have not already joined the community.

At Texaco's General Engineering Department, the leaders of the "Best Practice-KM" community take this task very seriously. The community achievements (usually stories on how the sharing of best practices has saved the company millions of dollars) are easily found in the community intranet and are also heavily promoted through the company's newsletters, leaflets, internal magazines, etc.

At Siemens since the formalization of the KM corporate initiative, the company has hosted a number of KM internal events. During these events hundreds of employees from different parts of the globe meet to present their own individual initiatives and, when possible, develop coordinated global efforts. One of the key activities involved in the roll-out of ShareNet was a "bootcamp" in Munich in July/August of 1999 with the participation of about 50 ShareNet managers from 15 different countries. During this bootcamp these managers learned not only about the operational side of ShareNet, but also about the "soft side" of the KM principles that were being introduced at Siemens. Each manager was also coached on how to develop a plan for the rollout of ShareNet in his or her office. Everyone left the bootcamp with a detailed job description, a

roll-out plan and, maybe, most importantly, with a trusted network of Knowledge Evangelist (many activities were geared initially at building trust amongst this core group and team building. Since then there was also a ShareNet Manager Conference in December 2000 where all “Knowledge Evangelists” came together and enjoyed the team and trust building activities on top of lots of work.

Many communities also bring special guests from time-to-time to increase participation and attract new members. Siemens is an organization that has learned this lesson. After realizing that the “chat” functionality within its ShareNet community was hardly used, it started promoting worldwide events with senior executives and leading experts.

Finally, at Bain, every six months, a KM recognition award (an Honorary Plaque for Outstanding KM Leadership) is given to outstanding performances of one large and one small office. The recognition involves some extra money for the offices to take consultants to “fun” out of the office activities. Some local offices have also created their “own” rewards and recognition for teams and individuals.

5. CONCLUSION

The lessons presented in this paper highlight that technology plays only a secondary role in the fostering of online communities. Most of the key lessons in implementing online communities are related to issues of leadership, focus, motivation, identity, etc that require detailed attention to people’s perceptions and behavior. In order to provide its members with continuous value from relevant content and the interactions with other members an online community also requires careful planning, involvement of senior management and dedicated resources to monitor performance, motivate the participants and rapidly adapt the dynamics, design and rules of the communities. Corporate sponsored online communities are a new phenomenon. The lessons presented in this paper are, therefore, exploratory in nature and need to be analyzed carefully since the understanding of the overall business and organizational impact of such initiatives is also at its very early stage.

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FOSTERING KNOWLEDGE SHARING: WHY AND HOW?

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ABSTRACT

Information Society rises the question of information overload: Too much data and information is available and can be exchanged through electronic channels. But what is about knowledge? Would it be easier to exchange and share expertise, know how, and experience in the e-Society? Empirical findings indicate that knowledge sharing is not a technical challenge, but a more sociological one. Many barriers exists to effective knowledge sharing within and between organizations; the paper shows approaches to overcome them.

KEYWORDS

knowledge management, knowledge sharing, impediments, enablers.

1. INTRODUCTION

Knowledge management is a modern term covering a broad spectrum of approaches. Creating, acquiring, capturing, sharing and using knowledge in any form to increase the performance of organizations might be a valid working definition for knowledge management, which shows some of this spectrum. Creation of (new) knowledge is one of the main directions of work in the literature, where the classical examples are within r&d and topics of innovation management and creativity techniques are tackled. Acquiring knowledge may result in advice like “hire the right people”, “engage the right consultants” or “build up alliances with others” etc. Another main stream is usage of (existing) knowledge, which must be captured, shared and used. Ways to capture valuable knowledge will depend from the type of knowledge (tacit/explicit). Sharing knowledge stands for the willing and the ability of employees to contribute to knowledge exchanges in the role of a knowledge source. Using knowledge describes the role of employees who needs certain knowledge, where recognizing the need, identification and finding any sources and being able to accept and handle knowledge of others are important issues.

We are concentrating on sharing knowledge and we are arguing for professional service firms where consultants, lawyers, accountants, auditors, tax advisors, engineers etc. work. The “product” they offer to their clients is knowledge [Kay (2002) p. 1, Ofek/Savary (2001) p. 1442, Chait (1999) p. 23]. We take this industry as an example and for the matter of clarity only, the argumentations could be easily expanded to other industries and various other areas of knowledge management, where sharing is necessary. There is a broad spectrum of situations to understand knowledge sharing, for instance sharing and disseminating knowledge across organizations [Inkpen/Dinur (1998), Loebecke/Fenema (1998)] or sharing knowledge between projects [Disterer (2002), Collier/DeMarco/Fearey (1996)].

Sharing knowledge between colleagues improves the economical benefits a firm can realize from the knowledge of their employees. This is true especially true for professional service firms [Huang (1998) p. 582, Quinn/Anderson/Finkelstein (1996) p. 75] where often broad ranges of knowledge must be kept to provide intellectual services, real-life experiences with certain questions and situations are an important asset, and the organizations and its members are spread over various offices across the country or the world. The necessity for sharing grows, because the network of professionals in most cases can arise significantly better professional advice than any individual. “We sell knowledge ... the most valuable thing we can offer is the

collective, institutional knowledge of our firm ..." [Roger Siboni, KPMG executive, cit. in Alavi 1997 p. 1]. Working together openly without holding back or protecting vital pieces of knowledge will result in more productivity and innovation than any one could reach individually. Because of increasing competition within most industries any chance must be taken to increase the quality and productivity of work.

But certain problems are known for sharing knowledge within firms, many authors signal that sharing knowledge seems to be "unnatural" [Quinn/Anderson/Finkelstein (1996) p. 22, Barua/Ravindran (1996) p. 262, Holloway (2000), Collier/DeMarco/Fearey (1996) p. 66, Murray (2000) p. 188, Andrews (2001) p. 25, Hoving (1999) p. 28, Below (1999)]. People issues are meant to be critical for successful knowledge sharing: „In fact, if the people issues do not arise, the effort underway is probably not knowledge management. If technology solves the problem, yours was not a knowledge problem" [Ruggles (1998) p. 88]. Or: „When you start talking about knowledge, it's really about people, relationships, communities, and a new way of working" [S. Beaty, Executive of Shell Oil, cit. in Whiting (1999) p. 1]. Therefore we analyze the reasons why knowledge sharing needs dedicated efforts (chapter 2) and describe possible actions to foster knowledge sharing (chapter 3).

2. IMPEDIMENTS TO KNOWLEDGE SHARING

It is often stated, that people use knowledge only for their own benefit and that they share it only grudgingly. This may be partly true because our society has deep cultural traditions which tend to discourage knowledge sharing. Even memories from school confirm the picture of knowledge as a treasury that has to be protected and hidden. During examinations the use of shared potentials is castigated as a 'crib' and as an attempt to deceive; what counts are the individual results. Through own research [Disterer (2001)] and analysis drawn from literature we categorize and discuss the various impediments that hinder people to share their knowledge.

2.1 Individual Barriers to Knowledge Sharing

Loss of Power: Knowledge can be used to take action and to enforce spheres of influence. To pass knowledge to colleagues might grant some of these potentials. Those who do not have this knowledge are deprived of the capacity to act or to influence respectively. That applies for knowledge about customers, competitors, suppliers, procedures, recipes, methods, formulas etc. In this sense someone who passes on knowledge to a colleague loses the exclusiveness of his or her influence, which might have suggested some professional respect and job security. "Knowledge is power" is the well-known citation to describe situations, where experts with rare knowledge have the highest reputation and monopolies of knowledge causes knowledge hoarding instead of knowledge sharing [Reimus (1997) p. 10, Andrews (2001) p. 25].

In industries like professional services employees are competing directly with each other through their special knowledge, gifts and talents. It might be part of the individual culture of the high performing employees that they voluntarily entering into the competition for scarce seats on the career path because they like to compete and to excel each other [Quinn/Anderson/Finkelstein (1996) p. 74]. But the drawbacks from competition are obvious: Knowledge workers would be very cautious to share openly their knowledge with colleagues, because they possibly give up an individual lead. In these organizations often competition and incentives and rewards for individual performance urge to build an unique individual expertise in a certain area and to prove that expertise for clients.

Revelation: Passing on knowledge to colleagues or entering working results into a knowledge database may be considered as a revelation, because it proclaims that this knowledge has a certain value and rareness. If this assessment is not shared by others embarrassment may happen [Rodwell/Humphries (1998) p. 31]. Additionally hasty colleagues hurry to point out and suggest „necessary" improvements just to emphasize their own expertise.

For an individual knowledge as justified true belief is of any particular concern. But in situations of knowledge sharing more than one individual is involved. At this point "... justification becomes public. Each individual is faced with the challenge of justifying his true beliefs in presence of others ... In sharing knowledge, each individual must publicly justify his personal knowledge" [Krogh (1998) p. 35].

Uncertainty: Especially younger and less experienced colleagues may feel uncertain, because they can not judge if their working results and experiences represent valuable knowledge for others. They cannot

estimate if their knowledge is too general or too well known or – on the other side - that some results are too specific for a special situation and therefore useless for colleagues in other situations. Positioning on the scale of ‘general’ to ‘specific’ is not trivial at all and, thus, results in uncertainty.

Motivation: Sharing knowledge is often seen as additional work, because of the time necessary for reflection, documentation, communication etc. Time for reflection is scarce [Haldin-Herrgard (2000) p. 362], especially if the performance of an organization is measured by billable hours only. Reflection of work and sharing experiences is more an investment for future work than a billable action in the present. „In an organization with a bias for action, the time for reflection may be hard to come by” [Dixon (2000) p. 18; Hunter/Beaumont/Lee (2002)]. Therefore professionals need incentives to find the time [Terrett (1998) p. 75].

Some employees do not expect reciprocal benefits from sharing because they do not believe in these benefits or they did not experience it. And even if people do expect payback for their contributions the somehow natural question "what's in it for me" is often not clear for employees, which are suffering from a lack of motivation. There is a need that the employees have some self-motivated creativity and some sense of "care-why" [Quinn/Anderson/Finkelstein (1996) p. 72] to share knowledge.

Part of the problem is that benefits of contributing to a knowledge database are gotten by a different stakeholder later on; the benefits won't be earned by the provider but by others [Nissen/Kamel/Sengupta (2000) p. 34]. Therefore one precondition of contributing to knowledge transfer is the assumption of an equilibrium, a balanced give and take between colleagues who are sharing knowledge. But the insight that knowledge sharing can only be beneficial if everybody provides his knowledge unselfishly may have charm theoretically only. In day to day practice the benefit is too uncertain, payback is not going to be immediate [Lauer (2000) p. 3], therefore the individual's commitment to share knowledge fails.

2.2 Social Barriers

Language: Some organizations lack a legitimate language [Krogh (1998) p. 135], which is known and acceptable for all colleagues and can carry individual knowledge. This covers the need for a common language to communicate analogies and metaphors to externalize tacit knowledge hidden in individual mental models, viewpoints, working models, schemata, paradigms and beliefs [Nelson/Coopridge (1996) p. 411, Nonaka (1994), p. 21, Haldin-Herrgard (2000) p. 361].

Conflict Avoidance: Attitudes of conflict avoidance and some conservative habits may prevent the sharing of knowledge, if this knowledge contains some new thoughts or innovative ideas. If most leading members of an organization are not comfortable with change and not willing to take risks, new ideas may be covered very easily. Different views and perspectives would be hidden. Knowledge not culturally legitimated may be suppressed ("don't rock the boat" attitude). This is the reason why Fahey and Prusak [Fahey/Prusak (1998) p. 268] call it one of the eleven deadliest sins of knowledge management not to establish, challenge and align a shared context for the members of an organization. This shared context requires engagement in open, honest, supportive, and critical dialogue to develop different and/or new views.

Bureaucracy and Hierarchy: Bureaucratic and hierarchical organizations show formal and administrative procedures, which prevent the sharing of knowledge and new ideas. Strong hierarchical organizations prevent cross-functional communication, cooperation and knowledge sharing.

Incoherent Paradigms: A lack of alignment between the personal intents of the individuals and the paradigms of the organization (which cover strategic intent, vision, mission, strategies, values etc.) can cause difficulties to articulate and justify personal beliefs which do not fit with the ruling paradigms of the organization [Krogh (1998) p. 135]. Explicating knowledge may be difficult because the articulation of knowledge and ideas may not be culturally legitimated through the paradigms of the organization. In many organizations the ruling paradigms, the vision of the future, the mission, and the main strategic issues are not known by all employees because they are not communicated instantly.

2.3 Empirical Results

There are some empirical results which indicate that cultural aspects like employee's individual and social barriers are critical for knowledge sharing. The benchmarking study of the American Productivity & Quality Center [APQC (1996)] lists culture, rewards, and support among the most important issues within knowledge

management. The well-known survey by Ernst & Young [Ruggles (1998)] list "culture" as the far most biggest impediment to knowledge sharing: 54% of the respondents marked it as an impediment. Next issue on the ranking was top management failure to signal importance (32%), which is an indicator that paradigms of the organizations are not well enough communicated or understood within the organizations. The far most biggest difficulty in managing knowledge is changing people's behavior, which is basically their behavior of sharing knowledge with their colleagues. Two German surveys show similar results: The most important key success factor of knowledge management is corporate culture [Heisig (1998)], by far the most important barriers are lack of time and disdain of the importance of knowledge management [Bullinger/Warshau/Prieto (1998)]. Cultivating trust among team members is the most important and most difficult task in building effective teams to share knowledge among the members [Govindarajan/Gupta (2001) p. 64]. These investigations show on a high level that cultural issues like individual and social barriers are the leading impediments to knowledge management. Unfortunately till now there are no studies differentiating and ranking the single barriers, also there is no measurement of the impact of possible actions which can be taken to overcome the barriers.

Additionally citations from literature indicate that a cultural shift is necessary in most organizations because knowledge sharing runs counter to the values that our society and our companies instill in individuals: "... traditionally, organizations have rewarded their professionals and employees based on their individual performance and know-how. In many organizations, a major cultural shift would be required to change their employees' attitudes and behavior so that they willingly and consistently share their knowledge and insights." [Alavi/Leidner (1999) p. 6; Davenport/Long/Beers (1998) p. 52, Ruggles (1998) p. 86, Whiting (1999) p.1].

3. ACTIONS TO FOSTER KNOWLEDGE SHARING

There is no complete methodology, no set of procedures and policies to address systematically all of the above impediments to knowledge sharing. Some approaches should be discussed further.

Concern and Trust: A precondition for knowledge sharing within organizations is a attitude of concern and trust among members of the organizations. Krogh [Krogh (1998) p. 136] calls this „care” and defines it as serious attention, a feeling of concern and interest within an organization. His concept includes phenomena like trust among the people, interest for different viewpoints and experiences, access to help, lenience in judgment, courage to voice opinions, to allow experiments and to take risks.

Necessarily, organizations have to strive for a culture of accepting mistakes [Soliman/Spooner (2000) p. 340] and not to penalize errors, a climate of constructive conflicts giving members the chance of "falling forward". Organizational development processes should develop a common set of ethical standards and values for an organization and should achieve a consensus of accepted working practices and habits. These standards and values should be stated explicitly and communicated through the organization.

Leadership: Knowledge sharing is based on consistent, reliable, plausible behavior of management. Management must positively communicate that they are thoroughly convinced that knowledge needs to be "nurtured, supported, enhanced, and cared for" [Nonaka/Konno (1998) p. 53] and that they even financially support knowledge management initiatives [Whiting (1999) p. 5]. Management must afford time for communication and reflection. There must be organizational slack that provides permission and time to allow employees to network [Krogh (1998) p. 145, Wiig (1997) p. 8].

Mutual trust is necessary among all organization members to openly share. Trust results in common expectations of reliability, consistency, and plausibility. Trust reduces the fear that others will act opportunistically. Likewise management must act as examples for knowledge sharing, they have to walk-the-talk and give up knowledge hoarding first. Members of a profession or a community accept standards of behavior and working habits from their peers [Quinn/Anderson/Finkelstein (1996) p. 72], therefore management must act as peers to give an example in knowledge sharing [McDermott/O'Dell (2001) p. 78 and p. 83].

Rewards and Incentives: Special rewards and incentive methods can act as extrinsic motivation that employees are willing to share knowledge. Organizations are successful with the provision of personal recognition and reputation when people have contributed to knowledge databases or actively participated in knowledge sharing [Hunter/Beaumont/Lee (2002)]. When being recognized as an expert within the

organization is a critical career goal, this may be used by attitudes like: Not contributing means not becoming known; contributing means to make a brand-like identity visible [McDermott/O'Dell (2001) p. 83].

Contrary to this there might be professions with quite different views: "A major concern of software engineers ... is the fear of being known as an expert" [Desouza (2003) p. 100]. Becoming known as an expert, they fear to be staffed to projects based on their past experience instead of being allocated to more challenging tasks with room for learning. In this situation the brand-like identity of an software engineer works to his disadvantage and build up a barrier to his individual professional development.

Some examples for direct rewards and how to provide chances to build up reputation and fame. Texas Instruments created an annual award named "Not Invented Here, But I Did It Anyway Award" [Dixon (2000) p. 57] to reward usage of other employees' knowledge. Buckman Labs reward the top 150 "knowledge sharers" (judged by knowledge managers) with a laptop and an incentive trip to a resort [Davenport/Long/Beers (1998) p. 54]. AMS honors contributors to the knowledge center with a bronze plaque at the headquarter and publishes regularly a top 10 list of most frequently used contributions [King (1998) p. 2]. Forum, a consultancy in Boston, holds a "World Cup Capture" to encourage its consultants to make explicit and sharable what they have learned from their latest engagements [Botkin (1999) p. 108]. An Australian law firm honors individuals who contributed the most with having named a star after them [Robertson (1999) p. 7]. These examples signal the direct impact on the individual who contributes and gets the messages, that this is valuable and valued. But this messages go to his colleagues to and example for expected positive working habits are set.

Incentives schemes may also foster knowledge sharing, although especially empirical studies on financial incentives showed different results. Nevertheless many organizations incorporate issues of knowledge sharing into their compensation plans and promotion policies. So all the big consulting and accounting firms commonly base their personal evaluations in parts on how many contributions are made to knowledge databases, how many new employees people have been tutored and how many training courses have been designed [Quinn/Anderson/Finkelstein (1996) p. 76 and 78, Whiting (1999) p. 3].

Tutoring and Mentoring: Administrative actions may define responsibilities for tutoring and mentoring within an organization. Ongoing programs which systematically develop employees (continuing education) can foster common habits and attitudes and can support communication among members of the organization.

Project experiences: On a smaller scale, at the end of bigger projects and transactions time and effort for explicitly debriefing should be provided to learn systematically by experiences. The lessons learned could be systematically analyzed and stored for access through other employees. Other actions can help to use knowledge and experiences gained in projects [Disterer (2002)].

Communities of Practice: A popular approach to foster knowledge sharing is to develop communities of practice within organizations. These groups of professionals enhance the ability of its members to think together, to stay in touch with each other, to share ideas with each other. These informal networks, sometimes also called knowledge fairs or clubs, competence centers or creativity centers, are groups of professionals, informally bound to one another through a common class of interests and problems and a common pursuit of solutions. People who are exposed to a common class of interests and problems often develop a common language to communicate and develop a sense of mutual obligation to help each other [Manville/Foote (1996) p. 80, McDermott (1999) p. 110]. This phenomena can be used to overcome some of the individual and social barriers to knowledge sharing within communities of practice.

To build communities of practice time should be given to organize and attend meetings, to create bulletins, to sample a skills directory. Communities should have the necessary tools and techniques to form, evolve and develop. At least they need a forum, either physically or electronically, to spark collaborative thinking and working not just make merely static presentations of information and ideas. In order to get acquainted with each other community members should start to discuss operational topics and problems on a regular base. The members will build up and refine a common language and common understanding of approaches and solutions. During and after this initial phase a community should decide what kind of knowledge they want to share and how to share it. In general, communities of practice are networks within an organizations, where people with common interests and problems can meet. Through their common language and work habits they develop over time more trust and openness to share knowledge openly.

Focus on codification or personalization: In special industries like professional services the knowledge of professional experts is a core asset. Therefore careful management of this asset has special importance. Management is responsible that the organization is as independent as possible from individuals. At the same time these companies are operating in a "people business", where the very personal and individual link

between clients and professionals is critical [Morris/Empson (1998) p. 614]. This special situation requires special approaches to manage knowledge. Hansen/Nohria/Tierney observed [Hansen/Nohria/Tierney (1999) p. 107] that management of consulting firms apply two different strategies which addresses cultural issues very different.

One strategy ("codification") centers on Information Technology: The knowledge is carefully codified and stored in knowledge databases and can be accessed and used by others. With the other strategy ("personalization") knowledge is tied to the person who developed it and is shared mainly through direct person-to-person contact [Hansen/Nohria/Tierney (1999) p. 107]. With a codification strategy knowledge is extracted from the person who developed it, is made independent from the individual and stored in form of interview guides, work schedules, checklists, benchmark data etc. and then searched and retrieved and used by other employees. Personalization strategy focuses on dialogue between individuals; knowledge is shared primarily in personal meetings and one-on-one conversations.

Individual barriers are significantly lower with a personalization strategy, because professionals keep the control through the whole knowledge management cycle. The individual is recognized as an expert and is cared for. In fact: Focusing on personalization could be called communication strategies, because the main objective is to foster personal communication between people. Core IT systems with this strategy are yellow pages (directories of experts, who-knows-what systems, people finder database) which show people with whom they should discuss special topics or problems. Main disadvantages with personalization strategies are a lack of standards and the dependencies from the communication skill and will of the professionals.

Organizational Design: Some organizational designs can foster intraorganizational collaboration. Partnerships and other forms of ownership by employees can be utilized to produce involvement and commitment [Hildebrand (1994) p. 35, Miles et al. (1998) p. 286]. More over, these organizational forms address the hesitation of professionals with very specialized knowledge to work within strong hierarchies and in working environments with strong regulations [Quinn/Anderson/Finkelstein (1996) p. 72]. Especially in professional service firms the alignment of individual and organizational goals remains the fundamental congruence problem. Employee ownership is often used by these organizations to overcome that problem [Boxall/Steeneveld (1999) p. 459].

Office Design and Construction: To lower disadvantages of bureaucracy and formal communications modern shop and office layouts reduce the distance between workers or professionals and executives to foster ad hoc, informal and face-to-face communication. For instance: The office space of executives are more open and easily to access for employees. Similar effects are caused by placing the offices of engineers in the middle of the production hall instead of placing them in a far distant research and development center [Soliman/Spooner (2000) p. 340, Probst/Knaes (1998) p. 39].

4. CONCLUSION

The opportunities to support knowledge management with Information Technology are manifold. For instance: IT can provide the technical infrastructure for a community of practice. Various kinds of communication systems and computer supported collaborative work systems can help to create, acquire, capture, share and use knowledge within the community. From this point communities of practice in the e-Society can expect fundamental support from IT. But certain cultural aspects of knowledge management and especially knowledge sharing must be addressed. In this paper we concentrated on these aspects and give a categorization of individual and social impediments. We describe some possible actions to overcome typical resistance which is articulated like "this is client confidential", "only I know how to use it", "what's in it for me?" "I have no time for documentation".

Because most people are trained to use knowledge for their own benefit and to share it only grudgingly they tend to hoard knowledge. A knowledge-sharing culture runs counter to the values that our society and many organizations impresses on individuals. Therefore a parading shift is sometimes called for from "individual knowledge is power" to "collective knowledge is a competitive advantage" [Fitter (1999) p. 8].

The description of the impediments and the possible actions make clear, that means knowledge management could not be seen as technical field, it is deeply social in nature. Human factors covering the behavior of individuals in organizations as well as social factors covering the cooperation in groups must be taken. Sharing knowledge is not a matter of course, but "when it comes to sharing ... a majority of the firms

agreed that their leading challenge had comparatively little to do with information or technology - and everything to do with changing behavior" [Reimus (1997) 14].

Even if knowledge management may be one of the terms, which overusage in modern literature may be called "cacophony" [Teece (1998) p. 55, see Hauschild/Licht/Stein (2001) p. 74, Ofek/Sarvary (2001) p. 1441, Gallupe (2001)] there is no doubt that the field will stay on the top of the management agenda, because intangible assets like knowledge have emerged as key drivers of competitive advantage in many industries.

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XML DATA MODELING CONCEPTS IN B2B CATALOG STANDARDS

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ABSTRACT

The transmission of electronic product catalogs using ebusiness standards belongs to the first and most common applications of XML in B2B e-commerce. Suppliers create electronic catalogs in standardized formats and transfer them to their customers. Eventually the receiving enterprises import the data into e-market places and e-procurement systems. In both cases a transformation of relational data structures to XML documents (or in reverse) is necessary. During the transformation process not only the data structures but also the power of the data modeling concepts of the respective catalog standards must be considered. Based on this knowledge the conversion could be made easier or partly automatically. This paper examines, to what extent real-world XML catalog standards make use of formal specification languages. For that purpose the relevant modeling concepts are viewed and applied to selected standards. The result is a close look at the common practice of using XML schema languages in B2B catalog standards.

KEYWORDS

B2B, E-Business, E-Catalogs, Relational Databases, Standardization, XML

1. INTRODUCTION

Electronic product catalogs have gained an important meaning in business-to-business relationship (B2B). They are a cornerstone of web-based procurement systems and form the basis for procurement decisions and the release of order transactions. Thus e-catalogs are a prerequisite for electronic markets (Baron et al., 2000). With catalog data all data is meant that is needed for the creation of electronic product catalogs. In contrast to B2C, catalog data of the catalog-creating enterprise has to be imported into an information system (target system) of the catalog-receiving enterprise. The catalogs are aggregated in the target system and made available to buyers for procurement processes.

On the supplier side, catalog data is managed by and stored in operational information systems, which are often closely coupled to ERP (enterprise resource planning) systems. The foundation of these information systems (IS) are relational databases. In contrast to this the exchange of catalog data is normally based on XML e-business standards. Thus the main tasks of a supplier's catalog data management are the extraction of catalog data from different relational IS, the transformation of this data according to catalog standards, and the transfer to the customers. Catalog data management on the buy-side has to import the incoming XML data into relational databases. In view of this processes the integration of XML and relational databases is a core task. The transformation of data from a relational database into a standardized XML document and back into another relational database is essentially influenced by the formal specifications of the data structures and its quality. While a relational database is described precisely by its conceptual schema, such a specification for XML documents depends mainly on the capabilities of the selected schema language.

2. PAPER ORGANIZATION AND RELATED WORK

This paper aims at analyzing how XML-based catalog standards apply different schema languages. The empirical analysis can help answering the question to what extent a B2B catalog standard supports the task of

integrating XML-based data in a relational database. To do so, our paper is structured as follows: First we will examine the current state of B2B catalog exchange processes in Section 2 to identify faults and starting points for an improvement. In the second step we will look at data modeling concepts for XML documents (Section 3). These concepts will serve as the foundation for our analysis of five industrial catalog standards. The standards, selected and characterized briefly in Section 4, will be examined, which concepts they implement and to what extent they are able to support the transformation and validation of documents (Section 5). Finally, we will evaluate the current state of these standards and formulate some future requirements.

Relevant research literature comes from two different areas. The first area deals with the loss-free storage of XML documents into relational databases. Many approaches for an automated transformation have been developed. A common goal is to map an XML document together with all its constraints into a relational schema. These constraints are contained in the document specifications. Thereby the semantic quality of the transformation depends on the semantic content of the schema definition used (Varlamis/Vazirgiannis, 2001). While early work was mainly based on the simple XML schema language DTD (e.g. Lee/Chu, 2001), recent work includes newer and richer schema languages like XSD (e.g. Kappel et al., 2001; Chen et al., 2002). Most of this work is rooted in the database community. Research work on syntactical and semantic aspects of B2B standardization forms a second area. It is characterized by domain-specific issues, for example exchange protocols (Leukel et al., 2002), reference data models (Kelkar et al., 2002), document integration (Wüstner et al., 2002) and semantic translation (Omelayenko, 2002).

The main contribution of this paper lies in adopting and modifying a set of criteria that describes the modeling concepts of XML schema languages for an extensive analysis of selected B2B catalog standards. The results can help to evaluate the methodical quality of these catalog standards.

3. EXCHANGING AND PROCESSING XML CATALOG DATA

Differently than data e.g. of controlling or sales, catalog data does not remain within the boundaries of an enterprise, but is supplied to and used by customers. This is contrary to most data stored in operational information systems. In B2B e-commerce more and more goods and services are procured using buy-side systems or e-markets. Buy-side systems are e-procurement systems, which are operated by large buying enterprises in order to optimize their own purchasing processes. E-markets bring several suppliers and customers together. In addition, catalog data exchange is not limited to the relationship supplier – customer. In many industries catalog data is exchanged along the entire supply-chain, e.g. manufacturer – wholesale – industry. On the other hand sell-side systems, typically e-shops, which provide only the assortment of one supplier, lose importance (Ginsburg et al., 1999).

Catalog data possesses a substantial meaning for suppliers. They describe their assortments and are an instrument for differentiation between competitors. To that extent high-quality catalog data can be regarded as a valuable economical good, which contains bundled know-how about products (Aberdeen Group, 2001). This shows up in the wholesale, which function is to provide its customers an aggregated and complete assortment, and therefore bundles the catalogs of many suppliers. The wholesale does not only aggregate catalog data, but “ennobles” this data by completing missing contents and normalizing data. At the same time catalog data represents a legally relevant offer. Insufficient or incorrect catalog data can lead to economic disadvantages.

In order to fulfill the task of creating catalog data often the introduction of new or the extension of existing information systems is necessary. A reason is that catalog data is a mixture of technical and business data stored in different and distributed operational information systems. Likewise the relevant data is managed by different organizational units of the enterprise. Often established concepts and enterprise-wide data models for the catalog data management are missing.

Enterprises that receive catalog data on their buy-side must be able to import any XML catalog documents into their information systems. Especially for e-markets, which process hundreds of supplier catalogs, the catalog import is a key task; particularly since it cannot be assumed that all catalogs use the same format and their quality is evenly high (Stonebraker/Hellerstein, 2001).

Aggravating is the size of the data that must be transmitted and processed. Extensive catalogs with up to hundred thousand products and attached multimedia objects can be, not least because of the XML tags,

several hundred MB large (Öszo/Iglinski, 2000). Parsing and importing large XML document is a time-consuming task. Hence the need for valid catalog gains a special importance. Errors and faults regarding syntax, semantic and complexity of a catalog delay these import processes and make a new extraction, transformation and validation necessary (Leukel et al., 2002).

Therefore the import has to apply two concepts: The first is based on the reuse of profiles, which define for each catalog standard (and if necessary supplier catalog), how the received catalog data has to be processed. Associated is a mapping or transformation of import data elements to the internal structure as well as the specification, which data of the supplier is required and which data from the standard cannot or should not be processed. Secondly, each catalog passes a staging process that covers different technical and content wise checks, operations and release steps. The final result is a checked catalog that is ready for the use in operational systems.

The mapping of catalog data appears both on supplier side (catalog creation) and on customer side (catalog import). Data mapping defines statements, which bring data in relationship to each other. The complexity reaches from simple direct mappings to rule definitions for different cases. However, the handling of differences in representation requires extended mapping concepts, which lead to data manipulations. The manipulations are described by one or more rules. The mapping needs not only knowledge of the syntax, but likewise of the meaning of the data (Omelayenko/Fensel, 2001). This is a problem if the format is documented little or not and an exact specification of the intended semantics is missing.

If instructions for the export and import of catalog data are once specified, then it is not already guaranteed that the created catalogs are completely correct. Concerning this a general statement can be made only in dependence on the formal specification of the exchange format. As far as individual standards have degrees of freedom or inaccuracies, errors can occur during the catalog import. This aspect is of special importance, since thereby the exchange processes must be intervened manually. This contradicts the automation paradigm of e-business. With consideration of the import errors catalog creation and catalog import must be repeated, until the catalog is regarded by the target system as valid. As a consequence the exchange processes are little automated and costing as well as time-intensively.

The described situation shows a set of weak points, which are causally determined by the used specification languages. A promising approach is to bring the specification of the catalog document types on a higher level by the use of formal XML schema languages in order to minimize degrees of freedom and interpretation spaces. Thus it is both possible to supply necessary information for the definition of mappings and transformations into relational representations and to improve the validation of documents effectively.

4. XML DATA MODELING CONCEPTS

In this section we describe the formal schema languages for the specification of XML data or documents. The languages provide a set of modeling concepts, which are used to a greater or lesser extent by catalog standards. Eventually the developed analysis schema is applied for an empirical analysis of industrial standards. Before specification languages can be selected, we have to ask, which issues of data modeling have to be considered. A comparative analysis of six XML schema languages is presented in (Lee/Chu, 2000). We adopt the criteria introduced there and form seven examination areas: specification structure, datatypes, XML attributes, elements, inheritance, being unique or key and other features.

The set of criteria mentioned is reduced by those criteria (12), which are determined implicitly by the schema language used for the specification and therefore are not dependent on the modeling of the respective XML standard. This means that not the power of the schema languages is compared, but to what extent concrete catalog standards make use of the provided modeling concepts. For example, in our analysis it is not relevant whether the vocabulary of a schema language is based on XML or not, since this question is already being answered by the selection of the schema language (for DTD: no; for all other languages: yes). Additionally, such criteria are not adopted, which are not relevant for the regarded schema languages, since the appropriate concepts do not appear in any schema language (e.g. attribute choice). The selection of schema languages takes place further down.

We introduce ten new criteria; among them are a more exact differentiation of datatypes and the structure of the specification documents. This structure shows how the instruments of modularization and reuse are

applied. In the following we describe the seven examination areas for our analysis of catalog standard specifications briefly.

- First, general modeling characteristics are examined. Here we have to ask in particular, how the concepts of modularity and change management are supported by distributing the specification content on several files.
- In the area of *datatypes* we look which modeling concepts are used, in order to model datatypes in XML catalogs. An important question is whether user-defined datatypes are used and how domains are specified. How the specification of user-defined datatypes takes place, is examined in the area of attributes and elements. Regarding the domains we refine the criterion proposed in (Lee/Chu, 2000), since it is not only examined, whether domains are limited or not, but also how (enumerations, patterns, restrictions of base types e.g. field lengths or precision).
- The next examination area deals with the specification of *attributes*. Similarly to datatypes we analyze how domains are defined. Beyond that it is checked whether attributes have to be used and whether default values for attributes have to be set.
- Within the following area *element structures* are examined, i.e. it is analyzed how the concepts of sequence and selection are used and which cardinality qualifies the occurrence of an element.
- Similarly to object-oriented modeling some XML schema languages implement the concept of *inheritance*. There is the possibility of either extending or limiting the upper type by inheritance. To what extent this concept is used to specify the selected catalog standards, is subject of the fifth area.
- In relational models *primary keys and foreign keys* are defined. A similar concept exists also in XML schema languages. This area examines, to what extent this concept is used for modeling attributes and other structures in e-catalog standards.
- Finally, we compare in the remaining area whether the catalog standards use the possibility for integrated documentation and whether the schema offers the embedding of HTML code into the XML document.

In the paper of *Lee* and *Chu* six XML schema languages are compared concerning their modeling concepts. In our analysis we confine to those schema languages only, which are used by the selected XML catalog standards. The four relevant XML schema languages are briefly introduced in the following.

At present a common language for the definition of business documents is the Document Type Definition (DTD) (Bray et al., 2000). It was already published by the W3C at the beginning of 1998. The DTD specifies XML documents by means of an own language in a document-oriented view, which forms hierarchical structures. However, the modeling concepts in XML DTD are rudimentary compared to other XML schema languages. In particular the absence of datatypes for the definition of domains limits the specification possibilities strongly.

In order to solve the type problems of DTD and to define a XML schema language, which is itself an XML document, W3C published XML-Data in 1998 (Layman et al., 1998); it was adapted by Microsoft in the form of XML-Data Reduced (XDR) (Frankston/Thompson, 1998) and integrated into the BizTalk framework. Another advancement of XML DTD was developed by CommerceOne. Compared with XDR, the schema for Object-Oriented XML (SOX) integrates additionally object-oriented concepts such as inheritance (Davidson et al., 1999). Because of a strong support in terms of software tools and applications, and the long development phase before the publication of XML Schema (XSD), XDR and SOX found a large dissemination for the specification of XML e-business standards. After a long development and evaluation, started in 1999, the language XML Schema (XSD) reached its final state and became a W3C Recommendation in May 2001 (Thompson et al., 2001). The XSD language is the official successor to XML DTD and extends its capabilities by the concepts already introduced by the other schema languages, for example syntax in XML, a data-oriented view, an extended set of datatypes, name spaces as well as object orientation. XSD offers even relational concepts, e.g. keys and foreign keys to guarantee referential integrity.

5. XML CATALOG STANDARDS

For the exchange of catalog data a number of XML-based standards are available. Before particular standards can be examined, catalog standards have to be seen in the context of B2B standardization. On the basis of a level model, standardizations can be partitioned (Li, 2000). Often the levels framework, processes,

documents, vocabulary and datatypes are formed. Catalog standards define catalog documents, which consist of a vocabulary. The vocabulary contains the elementary data objects, which are specified up to the datatype level. The highest level "processes" is only partially covered by catalog standards. A process is an admissible sequence of documents, e.g. order, order confirmation, delivery notice, invoice. Therefore a catalog process could cover: catalog request, catalog, and catalog update. Finally the level "framework" contains definitions regarding transmission and communication protocols.

With reference to the level model the following groups of applicable standards can be formed:

The group of genuine catalog standards contains those standards, whose origin is situated in the specification of catalog documents for e-procurement. To this group belong e.g. BMEcat, cXML and eCX. Meanwhile cXML expanded its scope to further business messages; BMEcat is supplemented by the transaction standard openTRANS. Transaction standards go a step further in standardizing a multiplicity of business messages; catalog documents are just a part of it. Prominent members of this group are EAN.UCC, OAGIS and xCBL. The third group consists of e-business frameworks, which standardize a complete data and communication infrastructure. The most well-known frameworks are ebXML and RosettaNet.

From the groups mentioned now those catalog standards are selected, which have a relevant spreading in practice on the one hand and cover a wide range of formal specification languages in e-business on the other hand. Anyhow ebXML is not covered, since it does not provide own catalog specifications but will integrate the document level from OAGIS in the near future, as well as RosettaNet, which is a vertical framework and thus limited to a specific branch of industry. Likewise we exclude eCX, because it is a proprietary catalog standard with a relative small spreading (Requisite Technology, 2000).

- BMEcat is a catalog standard, which was developed in Germany by a trade association, 20 large companies and research institutes. According to own statements it is the leading catalog standard in Europe. The specification takes place via DTD and XML Schema (Schmitz et al., 2001).
- cXML is the standard data exchange format used by the e-procurement solutions of Ariba, a provider of market places and desktop purchasing systems. The focus is not on the complete modeling of catalog data, but on giving a set of formats for catalog-based order processes. The specification takes place via DTD only (Ariba, 2002).
- EAN.UCC is a transaction standard that was published by the Uniform Code Council (UCC) and EAN International, which are also responsible for the development of EDIFACT in Europe. Among all standards EAN.UCC is the newest approach and it uses XML Schema exclusively (EAN International, 2002).
- OAGIS is developed by an international consortium of most diverse enterprises and enclosures over 200 XML transactions for business documents today, which are called Business Object Documents (BOD). Specification languages are DTD, XML Schema and XDR (Open Applications Group, 2002).
- xCBL (XML Common Business Library) is alike cXML developed by a large e-business software company, CommerceOne. The designation "library" shows that xCBL is an extensive collection of XML business documents. DTD, XSD, XDR and SOX are used (CommerceOne, 2002).

6. ANALYSIS OF XML CATALOG STANDARDS

Table 1 summarizes the results of our analysis according to the criteria described in Section 4. An entry "--" means that this criterion has not to be considered, since this feature is not provided by the respective schema language. In case of the selected standards all available catalog document specifications were analyzed, which make use of an XML schema language.

We discovered that DTD is no longer the language with the highest spreading, since EAN.UCC, which is the newest approach, uses XSD only, and OAGIS does not support DTD in its newest version 8.0 anymore. Four out of five standards use XSD for defining catalog documents and two standards also support other schema languages as well. But the use of these schema languages like DTD, SOX or XDR is reduced step by step. This observation is confirmed by the new standard UBL (Universal Business Language, publication determined for 2003), that is based completely and exclusively on XML Schema (OASIS, 2002). Only xCBL provides both XDR and SOX definitions.

Table 1. Comparison of selected XML Catalog Standards.

Catalog Standard	BMEcat 1.2		cXML 1.2.008	EAN. UCC 1.1	OAGIS 8.0	xCBL 3.5			
	DTD	XSD				DTD	XSD	XSD	DTD
Specification Structure									
include	-	Yes	-	Yes	No	-	Yes	-	Yes
import	-	No	-	Yes	Yes	-	Yes	-	No
external datatypes	No	Yes	No	No	Yes	No	Yes	Yes	Yes
one file per message	Yes	Yes	No	Yes	No	Yes	No	Yes	No
multiple files per message	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes
one file integrating all messages	No	No	Yes	No	No	No	Yes	No	Yes
Datatypes									
user-defined type	-	Yes	-	Yes	Yes	-	Yes	-	Yes
domain constraint: enumeration	-	Yes	-	Yes	Yes	-	Yes	-	Yes
domain constraint: pattern	-	Yes	-	Yes	Yes	-	No	-	-
domain constraint: facet	-	Yes	-	Yes	No	-	No	-	Yes
null	-	No	-	No	No	-	No	-	-
XML Attributes									
default value	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
optional vs. required	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
domain constraint: enumeration	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
domain constraint: pattern	-	Yes	-	Yes	Yes	-	No	-	-
domain constraint: facet	-	Yes	-	Yes	No	-	No	-	No
Elements									
default value	-	No	-	No	No	-	No	-	-
unordered sequence	-	No	-	No	No	-	No	No	-
choice	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
min & max occurrence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inheritance									
simple type by restriction	-	Yes	-	Yes	Yes	-	Yes	-	Yes
complex type by extension	-	No	-	Yes	Yes	-	No	-	No
complex type by restriction	-	Yes	-	Yes	No	-	No	-	-
Being unique or key									
uniqueness for attributes	No	Yes	Yes	No	No	Yes	No	Yes	No
uniqueness for elements	-	Yes	-	No	No	-	No	No	-
key for attributes	-	Yes	-	No	No	-	No	-	-
key for elements	-	Yes	-	No	No	-	No	-	-
foreign key for attributes	No	No	No	No	No	Yes	No	Yes	No
foreign key for elements	-	Yes	-	No	No	-	No	-	-
Miscellaneous									
documentation	-	No	-	No	Yes	-	No	-	Yes
embedded HTML	-	No	-	No	No	-	No	-	No

If we narrow the comparison to those modeling concepts, which can be implemented both by DTD and newer XML schema languages, then it is obvious that the specifications of catalog standards based on newer XML schema languages are more detailed and conceptually richer than specifications using DTD. For example some catalog standards model externally defined data structures, like order units, countries and currencies in their XSD, XDR or SOX version. The respective DTDs do not model this despite it is possible.

A drawback of DTD is the limited number of datatypes. Hence standards define own basic datatypes (e.g. STRING, NUMBER, BOOLEAN). These are defined as ENTITIES, which are mapped on #PCDATA. They are used during the definition of the elements to describe which datatypes are expected in the XML files. But they can not be used for a formal verification and can only help to create the XML files or build software by providing some additional information for the developers (Huempel/Schmitz, 2000).

A closer look at the definition of domains shows that all catalog standards use enumerations in order to limit these domains. However, the mapping of XML schemas to relational schemas could be difficult, since FACETs are used for detailing the base datatype only partially in the catalog specification. The application of complex datatypes is forced by some modeling weaknesses in the content model of XML schemas, though it is handled quite different. While some catalog standards get along almost without any complex datatypes, others define nearly all elements with the help of complex types (e.g. xCBL vs. EAN.UCC).

Inheritance is used only for refining simple datatypes to enumerations. Thus the potentials of object orientation are hardly opened. Even less common is the application of relational concepts like keys and uniqueness. These modeling concepts are seen in the BMEcat standard only.

7. CONCLUSIONS

All B2B e-catalog standards analyzed in this paper use the modeling concepts of XML schema languages only partially and not constantly. Especially the concepts of keys and uniqueness, which are important in reference to relational schemas, are used only by the XSD version of BMEcat. This lack within the area of catalog standards makes the transformation of XML-based catalog documents into relational databases substantially difficult, since the designation of primary and foreign keys must be added manually.

So far genuine XML database systems are hardly used for e-business applications; therefore the transformation of XML documents into relational databases (and in reverse) is still a main task in electronic data interchange between enterprises. A substantial reason is that e-business systems connect existing operational information systems, which are based almost exclusively on relational models and database systems. In order to keep XML catalogs in relational databases persistent, it is necessary to define a database schema that permits the representation of content and structures of XML catalog files as loss-free as possible. Inlining methods point out that such a transformation of documents, which are specified in a XML schema language, is possible and thus storage in relational databases can be realized (Lee/Chu, 2001). However, the quality of the transformation, especially regarding the implicit semantics, depends on the meta information that is formalized in the specification of the catalog standard. Newer XML schema languages can express more semantic information, e.g. datatypes and relational concepts, which facilitate the transformation process or even enable their loss-free execution (Shanmugasundaram, 1999).

Though XML Schema (due to its late publication in May 2001) is still a quite young XML schema language and therefore only few e-business software tools offer a complete and correct implementation of its concepts, we expect and observe that it is becoming the prime and therefore standard schema language in B2B message standardization. However, not all data modeling concepts are utilized so far and we still have to wait, whether newer specifications of XML catalog standards actually use additional modeling concepts.

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ANALYZING WEB LOGS TO IDENTIFY COMMON ERRORS AND IMPROVE WEB RELIABILITY

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ABSTRACT

In this paper, we analyze web access and error logs to identify major error sources and to evaluate web site reliability. Our results show that both error distribution and reliability distribution among different file types are highly uneven, and point to the potential benefit of focusing on specific file types with high concentration of errors and high impact to effectively improve web site reliability and overall user satisfaction.

KEYWORDS

Web errors and problems, reliability, error log, access log, file type and classification.

1. INTRODUCTION

The prevalence of the World Wide Web also spreads intended or unintended problems on an ever larger scale. The problems include various malicious viruses as well as unintended problems caused by communication breakdowns, hardware failures, and software defects. Identifying the root causes for these problems can help us understand their severity and scope. More importantly, such understandings help us derive effective means to deal with the problems and improve web reliability.

In this paper, we focus on the identification, analysis, and characterization of software defects that lead to web problems and affect web reliability. Since the 80:20 rule (Koch, 2000), which states that the majority (say 80%) of the problems can be traced back to a small proportion (say 20%) of the components, has been observed to be generally true for software systems (Porter and Selby, 1990; Tian, 1995), the identification and characterization of these major error sources could also lead us to effective reliability improvement.

For web applications, various log files are routinely kept at web servers. In this paper, we extend our previous study on statistical web testing and reliability analysis in (Kallepalli and Tian, 2001) to extract web error and workload information from these log files to support our analyses.

The rest of the paper is organized as follows: Section 2 analyzes the web reliability problems and examines the contents of various web logs. Section 3 presents our error analyses, with common error sources identified and characterized, followed by reliability analyses in Section 4. Conclusions and future directions are discussed in Section 5.

2. WEB PROBLEMS AND WEB LOGS

We next examine the general characteristics of web problems and information concerning web traffic and errors recorded in the web server logs, to set the stage for our analyses of web errors and reliability.

2.1 Characterizing web problems and web site reliability

Key to the satisfactory performance of the web is acceptable reliability. The *reliability* for web applications can be defined as the probability of failure-free web operation completions. Acceptable reliability can be

achieved via prevention of web failures or reduction of chances for such failures. We define web *failures* as the inability to obtain and deliver information, such as documents or computational results, requested by web users. This definition conforms to the standard definition of failures being the behavioral deviations from user expectations (IEEE, 1990). Based on this definition, we can consider the following failure sources in this process of obtaining and delivering information requested by web users:

- *Host or network failures*: Host hardware or systems failures and network communication problems may lead to web failures. However, such failures are no different from regular system or network failures, which can be analyzed by existing techniques. Therefore, these failure sources are not the focus of our study.
- *Browser failures*: These failures can be treated the same way as software product failures, thus existing techniques for software quality assurance and reliability analysis can be used to deal with such problems. Therefore, they are not the focus of our study either.
- *Source or content failures*: Web failures can also be caused by the information source itself at the server side. We will primarily deal with this kind of web failures in this study.

The failure information, when used in connection with workload measurement, can be fed to many software reliability models (Lyu, 1995; Musa, 1998) to help us evaluate the web site reliability and the potential for reliability improvement. In this paper, we use the Nelson model (Nelson, 1978), one of the earliest and most widely used input domain reliability models, to assess the web site's current reliability. If a total number of f failures are observed for n workload units, the estimated reliability R according to the Nelson model can be obtained as:

$$R = 1 - r = 1 - f/n = (n - f)/n$$

Where $r=f/n$ is the failure rate, a complementary measure to reliability R . The summary reliability measure, mean-time-between-failures (MTBF), can be calculated as:

$$MTBF = n/f = 1/r$$

If discovered defects are fixed over time, its effect on reliability (or reliability *growth* due to defect removal) can be analyzed by using various software reliability growth models (Lyu, 1995). Both the time domain and input domain information can also be used in tree-based reliability models (Tian, 1995) to identify reliability bottlenecks for focused reliability improvement.

2.2 Web logs and their contents

Two types of log files are commonly used by web servers: individual web accesses, or hits, are recorded in *access logs*, and related problems are recorded in *error logs*. Sample entries from such log files for the `www.seas.smu.edu` web site are given in Figures 1 and 2.

```
148.233.119.16 - - [16/Aug/1999:03:38:25 -0500] "GET /ce/seas/ HTTP/1.0" 200 10670
"http://www.seas.smu.edu/" "Mozilla/2.0 (compatible; MSIE 3.01; Windows 95)"
```

Figure 1. A sample entry in an access log.

```
[Mon Aug 16 00:00:56 1999] [error] [client 129.119.4.17] File does not exist:
/users/csegrad2/srinivas/public_html/Image10.jpg
```

Figure 2. A sample entry in an error log.

A "hit" is registered in the access log if a file corresponding to an HTML page, a document, or other web content is explicitly requested, or if some embedded content, such as graphics or a Java class within an HTML page, is implicitly requested or activated. Most web servers record the following information in their access logs: the requesting computer, the date and time of the request, the file that the client requested, the size of the requested file, and an HTTP status code. In this paper, we use this information together with error information to assess the impact on web reliability by different types of web sources.

Although access logs also record common HTML errors, separate error logs are typically used by web servers to record details about the problems encountered. The format of these error logs is simple: a timestamp followed by the error message, such as in Figure 2. Common error types are listed below:

- permission denied
- no such file or directory
- stale NFS file handle
- client denied by server configuration
- file does not exist
- invalid method in request
- invalid URL in request connection
- mod_mime_magic
- request failed
- script not found or unable to start
- connection reset by peer

Notice that most of these errors conform closely to the source or content failures we defined in Section 2.1. We refer to such failures as errors in subsequent discussions to conform to the commonly used terminology in the web community. Questions about error occurrences and distribution, as well as overall reliability of the web site, can be answered by analyzing error logs and access logs.

2.3 Web log analyses for `www.seas.smu.edu`

In this paper, we analyze the web logs from `www.seas.smu.edu`, the official web site for the School of Engineering at Southern Methodist University, to demonstrate the viability and effectiveness of our approach. This web site utilizes Apache Web Server (Behlandorf, 1996), a popular choice among many web hosts, and shares many common characteristics of web sites for educational institutions. These features make our observations and results meaningful to many application environments.

Server log data covering 26 consecutive days recently for this website were analyzed. The access log is about 130 megabytes in size, and contains more than 760,000 records. The error log is about 13.5 megabytes in size, and contains more than 30,000 records. These data are large enough for our study to avoid random variations that may lead to severely biased results. On the other hand, because of the nature of constantly evolving web contents, data covering longer periods call for different analyses that take change into consideration, different from the analyses we performed in this study.

Some pre-existing log analyzers were used by us previously in (Kallepalli and Tian, 2001) to analyze the access logs. However, these analyzers only provide very limited capability for error analysis. Therefore, we implemented various utility programs in Perl to count the number of errors, number of hits, and to capture frequently used navigation patterns therein. In this study, we extended these utility programs to support additional information extraction and analyses.

3. WEB ERROR ANALYSIS AND CHARACTERIZATION

With the information extracted from our web server logs, we can perform various error analyses to obtain desired results, as presented in this section.

3.1 Analysis of error types

For the 26 days covered by our web server logs, a total of 30760 errors were recorded. The distribution of these errors by error types is given in Table 1. The most dominant error types are “permission denied” and “file does not exist”. The former accounts for unauthorized access to web resources, while the latter accounts for the occasions when the requested file was not found on the system.

Table 1. Error distribution by predefined error types.

Error type	Errors
permission denied	2079
No such file or directory	14
stale NFS file handle	4
client denied by server configuration	2
file does not exist	28631
invalid method in requests	0
invalid URL in request connection	1
mod_mime_magic	1
request failed	1
script not found or unable to start	27
connection reset by peer	0
Total	30760

There are two scenarios in the denied access situations: The first is for denying unauthorized accesses to restricted resources, which should not be counted as web failures. The second is wrongfully denied accesses to unrestricted resources or to restricted resources with proper access authorization, which should be counted as web failures. Consequently, further information needs to be gathered for this type of errors to determine whether to count them as failures. Only afterwards, these properly counted failures can be used in web reliability analyses.

File-not-found errors usually represent bad links, and should be counted as web failures. They are also called “404 errors” because their error code in the web logs. They are by far the most common type of problems in web usage, accounting for more than 90% of the total errors in this case. Further analyses can be performed to examine the causes for these errors and to assess web site reliability.

3.2 Identifying error sources

For 404 errors, or “file does not exist” errors, the obvious questions to ask are: “What kind of files are they?” and “How often do they occur?” Fortunately, our log files include information about requested files. From this information, we can group requests leading to 404 errors by the requested file types, to examine which kinds of files are the major sources for such errors. To do this, we can simply classify the errors by the corresponding file extensions, which usually indicate the file types. We need to keep in mind that different variations of file extensions may exist for the same type. For example, “.html”, “.htm”, “.HTML”, etc., all indicate that the requested file is an HTML file or of HTML file type. However, this did not turn out to be a real problem, because typically there is a dominant file extension for each major file type for our web site.

Table 2. File types and corresponding errors caused by such files.

File type	Errors	% of total
.gif	12471	43.56%
.class	4913	17.16%
directory	4443	15.52%
.html	3639	12.71%
.jpg	1354	4.73%
.ico	849	2.97%
.pdf	235	0.82%
.mp3	214	0.75%
.ps	209	0.73%
.doc	75	0.26%
Cumulative	28402	99.20%
Total	28631	100%

For our web site, there are more than 100 different file extensions, with most of them accounting for very few 404 errors. We sorted these file extensions by their corresponding 404 errors and give the results for the top 10 in Table 2. These top 10 error sources represent a dominating share (more than 99%) of the overall 404 errors. In fact, only four file types, “.gif”, “.class”, “directory”, and “.html”, represent close to 90% of all

the errors. Our results generally confirm the uneven distribution of problems, or the 80:20 rule mentioned earlier, and point out the potential benefit of identifying and correcting such highly problematic areas. The top error sources indicate what kind of problems a web user would be most likely to encounter when her request was not completed because of 404 errors. Consequently, fixing these problems would improve the overall web site reliability and thus improve overall user satisfaction. Furthermore, root cause analysis can be carried out to understand the reasons or causes for these high defect file types, and corresponding follow-up actions can be carried out to prevent future problems related to the identified causes.

On the other hand, the effort to fix the problems may not be directly linked to the total number of 404 errors corresponding to each file type, because a few missing files may be requested repeatedly with high frequency, resulting in high error count for the corresponding file type. In fact, the effort to fix the problems is directly proportional to the actual number of such missing files. This number can be obtained from the error log by counting the unique 404 errors, i.e., an error is counted only once at its first observation, but not counted subsequently.

Table 3. File types and corresponding unique errors or missing files.

File type	Unique errors	% of total	Errors	% of total
directory	1137	40.46%	4443	15.52%
.html	897	31.92%	3639	12.71%
.gif	274	9.75%	12471	43.56%
.ico	122	4.34%	849	2.97%
.jpg	106	3.77%	1354	4.73%
.ps	52	1.85%	209	0.73%
.pdf	42	1.49%	235	0.82%
.txt	25	0.89%	32	0.11%
.doc	23	0.82%	75	0.26%
.class	21	0.75%	4913	17.16%
Cumulative	2699	96.05%	28220	98.56%
Total	2810	100%	28631	100%

Table 3 gives the top 10 missing file types and the corresponding numbers of such missing files, with the corresponding total errors also presented for comparison. These top 10 file types are almost identical to that in Table 2, with the exception that “.mp3” is replaced by “.txt”. Similar to Table 2, there is an uneven distribution of missing files, with the top 10 file types representing 96.05% of all the missing files, and three types, “directory”, “.html”, and “.gif”, representing more than 80%. However, the relative ranking is quite different. The most striking difference is for the “.class” files, where 21 of such missing files, which represent only 0.75% of all the missing files, were requested 4913 times (or 17.16% of the 404 errors). Similar difference is also observed for “.gif” files, with relatively few missing files requested relatively more often. The directories and “.html” files demonstrate the opposite trend, where relatively more missing files or directories were requested less often. These differences also confirmed the usefulness of obtaining unique errors or missing file counts: Such information as in Table 3 could help us properly allocate development effort to fix missing file problems.

4. WEB RELIABILITY EVALUATION

The number of errors and the number of unique errors obtained above give us a general indication of the quality of a given web site. However, such error counts are generally more meaningful to the web site owners and maintainers than to the general web users. From a web user’s point of view, it doesn’t matter how many errors or non-existent files are present in a web site, as long as she can most likely get what she requested, the web site quality is good. In other words, even if there are many 404 errors related to a specific type of files, if the vast majority of requests for files of this type can be found and delivered, it is not much of a problem. Conversely, even if there are just a few 404 errors for a file type, if most of the corresponding requests result in “file does not exist”, it is a serious problem. Therefore, the number of errors needs to be viewed in relation to the number of requests. This characterization of web quality from the users’ perspective is captured in various reliability measures, to be analyzed in this section.

4.1 Assessment of overall web site reliability

As mentioned in Section 2, the reliability of a web site can be defined as the probability of failure-free (or error-free, in the terminology used in the web community) user request completions. Consequently, we also need to characterize the user requests, or the workload for the web site, for web site reliability assessment. This kind of workload characterization and measurement is a common activity for all reliability analyses, where appropriate workload measurement can typically lead to more accurate reliability assessments and predictions (Tian and Palma, 1997). For web applications, the number of accesses, or the “hit count” (or “hits”), directly corresponds to user requests, and can be used to measure the overall workload for a web site (Kallepalli and Tian, 2001).

To evaluate the web site reliability, we need to obtain the hit information, in addition to the error information above, and then apply various reliability models. As mentioned in Section 2.1, we can directly use the Nelson model (Nelson, 1978), to obtain the web reliability R and other related reliability measures, such as error rate r and mean-time-between-failures $MTBF$. For the web site `www.seas.smu.edu`, the total number of hits over the 26 day period is 763021 and the total number of 404 errors is 28631, giving us the following:

- Error rate $r = 0.0375$, or 3.75% of the requests will result in a 404 error.
- Reliability $R = 0.9625$, or the web site is 96.25% reliable against 404 errors.
- $MTBF = 26.66$, or on average, a user would expect a 404 error for every 26.66 requests.

If we count all the errors (not just 404 errors), the total is 30760, giving us slightly worse reliability numbers, as follows:

- Error rate $r = 0.0403$, or 4.03% of the requests will result in an error.
- Reliability $R = 0.9597$, or the web site is 95.97% reliable.
- $MTBF = 24.81$, or on average, a user would expect a problem for every 24.81 requests.

Table 4. File types and corresponding reliability (error rate).

File type	Hits	% of total	Errors	% of total	Error rate
.gif	438536	57.47%	12471	43.56%	0.0284
.html	128869	16.89%	3639	12.71%	0.0282
directory	87067	11.41%	4443	15.52%	0.0510
.jpg	65876	8.63%	1354	4.73%	0.0199
.pdf	10784	1.41%	235	0.82%	0.0218
.class	10055	1.32%	4913	17.16%	0.4886
.ps	2737	0.36%	209	0.73%	0.0764
.ppt	2510	0.33%	7	0.02%	0.0028
.css	2008	0.26%	17	0.06%	0.0085
.txt	1597	0.21%	32	0.11%	0.0200
.doc	1567	0.21%	75	0.26%	0.0479
.c	1254	0.16%	5	0.02%	0.0040
.ico	849	0.11%	849	2.97%	1.0000
Cumulative (or average rate)	753709	98.78%	28249	98.67%	0.0375
Total (or average rate)	763021	100%	28631	100%	0.0375

4.2 Reliability by file types and potential for reliability improvement

The above analyses gave us the overall reliability assessment for the web site. However, when a user requests different types of files, she may experience different reliability. To calculate this reliability for individual file types, we can customize the Nelson model (Nelson, 1978) by using the number of errors and the number of hits associated with the specific file types only. This gives us the reliability analysis results in Table 4, ranked by the number of hits for each file type. We only calculated error rate for those file types with relatively large hit counts in order to minimize random variations due to small number of observations.

The subsets with extremely low reliability (or high error rate) are the types “.ico” and “.class”, where every request for “.ico” files has resulted in a 404 error, while close to half (48.86%) of the requests for “.class” files have resulted in 404 errors. Further analysis can be carried out to understand the root causes for these low reliability file types, and corresponding follow-up actions can be carried out to prevent future reliability problems related to the identified causes.

Relative to the average error rate of 0.0375, we can categorize these 13 major file types into four categories by their reliability (error rate) below:

- *good* reliability category, with error rate $r < 0.01$, includes “.c”, “.css”, “.ppt” files.
- *above-average* reliability category, with error rate r between 0.01 and 0.0375 (average), include “.txt”, “.html”, “.gif”, “.jpg”, and “.pdf” files.
- *below-average* reliability category, with error rate r between 0.0375 (average) and 0.1, include directories and “.doc” and “.ps” files.
- *poor* reliability category, with error rate $r > 0.1$, include “.ico” and “.class” files.

This reliability categorization also helps us prioritize effort for reliability improvement: The file types with the *poor* reliability should be the primary focus for reliability improvement, because they represent the reliability bottleneck. Improvement to their reliability will have a large impact on the overall reliability. In this case, fixing the 122 missing “.ico” files and 21 “.class” ones (see Table 3 for unique errors or missing files) would result in reducing 5762 (= 849 + 4913) errors and improving the overall web site reliability from an average error rate $r = 0.0375$ to $r = 0.0300$. This significant reliability improvement of 20% can be achieved with relatively low effort, because these 143 (= 122 + 21) missing files only represent a small share (about 5%) of all the 2810 missing files. After fixing these problems, we can focus on the *below-average* file types, then *above-average* ones, before we start working on the *good* ones. This priority scheme gives us a cost effective procedure to improve the overall web site reliability.

5. CONCLUSION

By analyzing the unique problems and information sources for the web environment, we have developed an approach for identifying and characterizing web errors and for assessing and improving web site reliability based on information extracted from existing web logs. This approach has been applied to analyze the log files for the web site at the School of Engineering at Southern Methodist University.

Our results demonstrated that the error distribution across different error types and sources is highly uneven. In addition, missing file distribution, workload distribution, as well as reliability distribution for individual types of requested files are all quite uneven. These distributions generally follow the so-called 80:20 rule, where a few components are responsible for most of the problems or effort. Our analysis results can help web site owners to prioritize their web site maintenance and quality assurance effort and to guide further analyses, such as root cause analysis, to identify problem causes and perform preventive and corrective actions. All these focused actions and efforts would lead to better web service and user satisfaction due to the improved web site reliability.

The primary limitation of our study is the fact that our web site may not be a representative one for many non-academic web sites. Most of our web pages are static ones, with the HTML documents and embedded graphics dominating other types of pages, while in ecommerce and various other business applications, dynamic pages and context-sensitive contents play a much more important role. To overcome these limitations, we plan to analyze some public domain web logs, such as from the Internet Traffic Archive at ita.ee.lbl.gov or the W3C Web Characterization Repository at repository.cs.vt.edu, to cross-validate our general results.

As an immediate follow-up to this study, we plan to analyze web site reliability over time for different types of error sources, and perform related risk identification activities for focused reliability improvement. We also plan to identify better existing tools, develop new tools and utility programs, and integrate them to provide better implementation support for our strategy. All these efforts should lead us to a more practical and effective approach to achieve high quality web service and to maximize user satisfaction.

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THE CRITICAL MASS PROBLEM OF MOBILE AD-HOC NETWORKS

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ABSTRACT

Mobile ad-hoc networks have become increasingly popular in the last years and promise a huge potential for the future. Ad-hoc networks allow users to communicate without a fixed network infrastructure, thus are interesting for many mobile communication scenarios. Multi-hop ad-hoc networks extend the communication range of individual nodes with the help of ad-hoc routing protocols. Many researchers focused on lower communication layers and developed several protocols in the past. In this paper, we want to abstract from the physical layer, the data link layer and routing issues and want to measure the quality of an ad-hoc network independently from network and hardware issues. For this, we first introduce a formal network model and a set of metrics. With the help of a simulation tool, we then measure the quality of ad-hoc networks in specific scenarios. We especially want to discover the prerequisites for sufficient connectivity, stability and coverage. We call the number of nodes to form a reasonable network the *critical mass*. As a result of our simulations, we get a considerable high critical mass for realistic usage scenarios.

KEYWORDS

Mobile computing, wireless communication, ad hoc networks, evaluation metrics

1. INTRODUCTION

Mobile ad-hoc networks are self-organizing structures in which mobile nodes are temporarily connected without the aid of any fixed infrastructure or centralized administration. Mobile ad-hoc networks promise a high potential for mobile and ubiquitous computing scenarios. As they do not need any fixed infrastructure, they even work in environments where a pre-installed wired network is too cost-intensive or even impossible. Typical areas for ad-hoc networks are public places such as airports, fieldwork areas, disaster areas or military battlefields. In addition, ad-hoc networks may serve as access networks for commercial (e.g. cellular phone) networks.

As mobile devices and wireless networks get increasingly powerful, many researchers expect ad-hoc networks to play an important role for mobile users in the future. Many encouraging simulations affirm this view. Having a closer look however, these simulations are often based on idealistic assumptions. Often, a wide radio communication range (e.g., 250m) and a homogeneous distribution of nodes are assumed. In reality, we often have restricted communication ranges of 10 to 30m. As users usually walk on specific ways (e.g. streets or sidewalks) and assemble at interesting places, we have a strongly inhomogeneous distribution among the observed area.

In this paper, we want to investigate the prerequisites to form a reasonable ad-hoc network for a certain realistic environment. For this, we abstract from specific routing protocols, packet throughputs, network hardware etc. and measure the quality of a network with the help of a set of metrics. We applied our metrics to a realistic scenario - the *Minneapolis Skyways* with its shopping levels and ways for pedestrians. Simulating this scenario leads to a discouraging observation: we need more than 2000 nodes in an area of about 500m x 500m to establish a reasonable network. Compared to approx. 50 nodes under idealistic assumptions, this is a very high number, thus the whole idea of ad-hoc networks may be questionable.

2. RELATED WORK

In this paper, we follow the IETF definition of mobile ad-hoc networks (in the following called *MANETs*) [10]: MANETs are wireless multi-hop networks which organize themselves. Especially, the topology may change rapidly. To enable communication between nodes which are not directly connected via the wireless communication technology (e.g. Wireless LAN IEEE 802 or Bluetooth), networks use ad-hoc routing protocols such as LMR [5], Link Reversal [6], DSR [13], OLSR [11], DSDV [17], or TORA [16] to find routes to a receiver.

A number of approaches have been published in the last years, which deal with quality analysis of MANETs. Gupta and Kumar [8] assume n randomly located nodes, each capable to transmit with W bit/s over a wireless channel. Their analysis show that the throughput obtained by each node is $\Theta\left(W / \sqrt{n \cdot \log(n)}\right)$ bit/s, i.e., the throughput dramatically decreases with higher number of nodes. Jinyang et al. [12] examine the throughput of WLAN 802.11 networks. They find out that the capacity of long chain of nodes inside an ad-hoc network is 1/4 of the channel capacity obtainable from the radio connection. Glossglauer and Tse [7] show that inside an ad-hoc network the per-session throughput can increase when nodes are mobile rather than fixed. However, they made several idealistic assumptions and use loose delay constraints. Santi et al. [18] investigated, which wireless communication range ensures a strongly connected network. They assume an n -dimensional region with a homogeneous distribution of nodes. Their analysis focuses on a strong connected network, i.e. each node is connected to each other. This is a very hard requirement, usually not achieved in real ad-hoc network.

In contrast to the approaches above, we do not have the assumption of homogeneously distributed users among the observed area. As we do not have a simple model to describe the movement of mobile nodes (e.g. the random waypoint model), a closed analytical or probabilistic approach is very difficult to achieve. In this paper, we thus specify the metrics and restrict the analysis on simulations.

Compared to other approaches, we introduce a number of new metrics that measure the quality of a MANET; especially the combination of *reachability*, *vulnerability* and *coverage* is new and reflects the end-user's demand of a stable network with a high degree of connectivity.

3. MEASURING MANET'S PROPERTIES

In the following, we introduce a network model, which does not deal with physical aspects. We assume that two nodes, which are in communication range, are linked together with a maximum throughput without any errors. Beyond a certain distance, the communication breaks down immediately, i.e. the communication quality does not smoothly decrease when the distance between two nodes gets larger.

We observe a specific MANET in a time interval $[t_1, t_2]$ in an area A . Let $N = \{N_1, \dots, N_n\}$ denote the set of all network nodes, which have been active at least once in the area A . Every node $N_i \in N$ has a position, denoted by $p_i(t)$.

Let $O(t) \subseteq N$ denote the set of network nodes, which are active (i.e. online) at a certain time $t \in [t_1, t_2]$. Active nodes can send, receive and route packets. We introduce O for two reasons: first, nodes may participate in the MANET, but are temporarily switched off. Second, nodes may only pass through the MANET, i.e. only participate for a short time and then disappear. N does not change over time, thus we use O to model the behaviour of such nodes. For every node $N_i \in O(t)$, we introduce the sets $c_i(t)$ and $r_i(t)$:

- $c_i(t)$ denotes the set of *directly* connected nodes. Only active nodes can be connected, i.e. $c_i(t) \subseteq O(t)$. We only consider bi-directional connections, thus $N_i \in c_j(t) \Leftrightarrow N_j \in c_i(t)$.
- $r_i(t)$ denotes the set of nodes reachable by *multiple hops*. $N_j \in r_i(t)$ if either $N_j = N_i$ or $N_j \in c_i(t)$ or N_i and N_j can communicate with the help of directly connected intermediate nodes.

This model implies an important simplification of real MANETs: after a topologic change, both $c_i(t)$ and $r_i(t)$ *immediately* contain the correct sets of communicating nodes. In reality, changes have to be propa-

gated via the network with a finite speed and inactive or unreachable nodes could be falsely viewed as reachable.

Based on this network model, we introduce a number of metrics. Our metrics should not be confused with metrics used to find optimal routes from sender to receiver in routing protocols (e.g. hop counts). Our metrics measure particular characteristics of the entire network. We asked ourselves following questions:

- When a new node enters the area of a MANET, how high is the probability to be instantly connected?
- Once a node is connected to the MANET, how many nodes can it access, or in turn, how many nodes can access the new node?
- Once a node accessed another node, how stable is the communication link?

If we knew the surface or volume covered by the MANET, the first question could be answered, using p_i and the communication range. Examining the sets r_i leads to an answer to the second question. The third question is more difficult to answer: moving specific nodes may disable an ongoing communication where other nodes are less important to existing communication links. We measure this effect by introducing so-called *important* nodes later.

Segmentation

The first metric is called the *Segmentation*, which is used as a basis for further metrics. The Segmentation S denotes the number of segments in the MANET. Nodes inside a segment can only communicate to nodes inside the same segment. Equation (1) shows how S is related to r_i .

$$S = \sum_{N_i \in O} \frac{1}{|r_i|} \quad (1)$$

To get a measurement, which is independent from the current number of nodes, we introduce the *Normalized Segmentation SN*:

$$SN = \begin{cases} \frac{S-1}{|O|-1}, & \text{if } |O| > 1 \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

SN has values between 0 and 1 where $SN = 0$ means *no segmentation* and $SN = 1$ means *maximum segmentation* (all nodes are separated).

Coverage

To measure the surface or volume a MANET covers, we first introduce the *Coverage Area*. The Coverage Area CA is the area inside A where an inactive node can become active without increasing the number of segments. Note that activating a node inside the Coverage Area does not necessarily mean to be connected to *all* nodes in the MANET. We define the *Coverage C* to get a value, which is independent from the size of the area A :

$$C = \frac{vol(CA)}{vol(A)} \quad (3)$$

Here, vol denotes the size of a volume or surface.

Reachability

We now define how reachable nodes are inside a network. Let $R(N_i)$ for $N_i \in O$ (called *Reachability* of N_i) denote the ratio of active nodes which N_i can access:

$$R(N_i) = \begin{cases} \frac{|r_i|-1}{|O|-1}, & \text{if } |O| > 1 \\ 0, & \text{otherwise} \end{cases} \quad (4)$$

We use $|O|-1$ as denominator, since we do not count the node N_i itself as reachable. To measure the reachability of all nodes, we define the *Average Reachability AR*:

$$AR = \frac{\sum_{N_i \in O} R(N_i)}{|O|} \quad (5)$$

AR is only defined, if $O \neq \{ \}$, i.e. we have at least one active node in the MANET.

Importance and Vulnerability

Inside a MANET, some nodes are more important for communication than others are. Some nodes in the 'centre' of a MANET may disable an ongoing communication when they are moved or switched off, as they may separate nodes from each other. On the other hand, some 'peripheral' nodes can be turned off without affecting the rest of the network. We want to formalize this issue.

Let $I(N_i)$ denote the *Importance* of $N_i \in O$. The Importance returns, how many new segments are caused by a turning off N_i :

$$I(N_i) = \begin{cases} S'(N_i) - S, & \text{if } S'(N_i) > S \\ 0, & \text{otherwise} \end{cases} \quad (6)$$

$S'(N_i)$ denotes the number of segments, if we remove N_i from O . To measure the entire network, we define the *Vulnerability* V , which returns how the network reacts on average to deactivating nodes:

$$V = \begin{cases} \frac{\sum_{N_i \in O} I(N_i)}{|O| - 2}, & \text{if } |O| > 2 \\ 0, & \text{otherwise} \end{cases} \quad (7)$$

We can easily proof that the maximum value of the numerator is $|O| - 2$, thus the value of V is in the interval $[0,1]$. Our list of metrics is now complete.

4. EVALUATIONS

The metrics provide a tool to measure the quality of a specific MANET, i.e. a network where nodes reside at specific positions at a specific time. We now want to abstract from a specific MANET and want to examine general prerequisites for 'good' MANETs, which offer a sufficient connectivity for end-users and applications.

In principle, we could use physical nodes in real environments for this. The *Ad hoc Protocol Evaluation (APE)* test-bed [14], e.g., follows this approach. To evaluate MANETs with APE, users with mobile nodes have to move in real environments. Initial experiments were carried out with only 37 nodes.

Since real experiments are very cost-intensive and time-consuming, we use a simulator in our approach to evaluate a reasonable number of nodes (e.g. some hundreds). There exist a huge number of network simulators (e.g. NS-2 [20]). Broch et al. extend NS-2 to address mobility issues [2]. *Adhocsim* [1] is especially designed to simulate ad-hoc networks. These tools, however, focus on MAC or network level. They can simulate packet delays or errors, which is too fine-grained for our intended goals. To measure our metrics, we developed a new simulation tool.

The tool easily allows a user to specify the number of nodes, the communication ranges and the observed area. Running a simulation, the nodes move randomly across the area. The tool presents current and average metric values.

In principle, the tool is able to simulate three-dimensional networks. Nevertheless, even in buildings, where a three-dimensional network could be formed in principle, ceilings are often impenetrable; thus, MANETs fall apart to independent, two-dimensional MANETs. The following simulations are thus only two-dimensional.

Often, smaller locations such as aircrafts, busses or apartments are considered as locations for MANETs. In these scenarios however, it is more sensible to install a low number of access points connected via a fix network, rather than using a MANET. Thus, the following simulations examine larger areas. We carried out two types of simulations: the first type simulates moving nodes in an unstructured plain area. In the second, more realistic example, we simulate a shopping centre.

4.1 Simple Areas

In the first scenario, we put a number of mobile nodes in a square area. The nodes choose a random direction and speed and move straight forward until they reach the border. They then choose a new direction and move again. All nodes are active all the observed time.

Although this scenario is very artificial, it is a first step towards a more realistic example in a later section. We use this simple scenario to derive first results. It especially leads to a definition of the *critical mass* – the number of nodes that form a reasonable MANET.

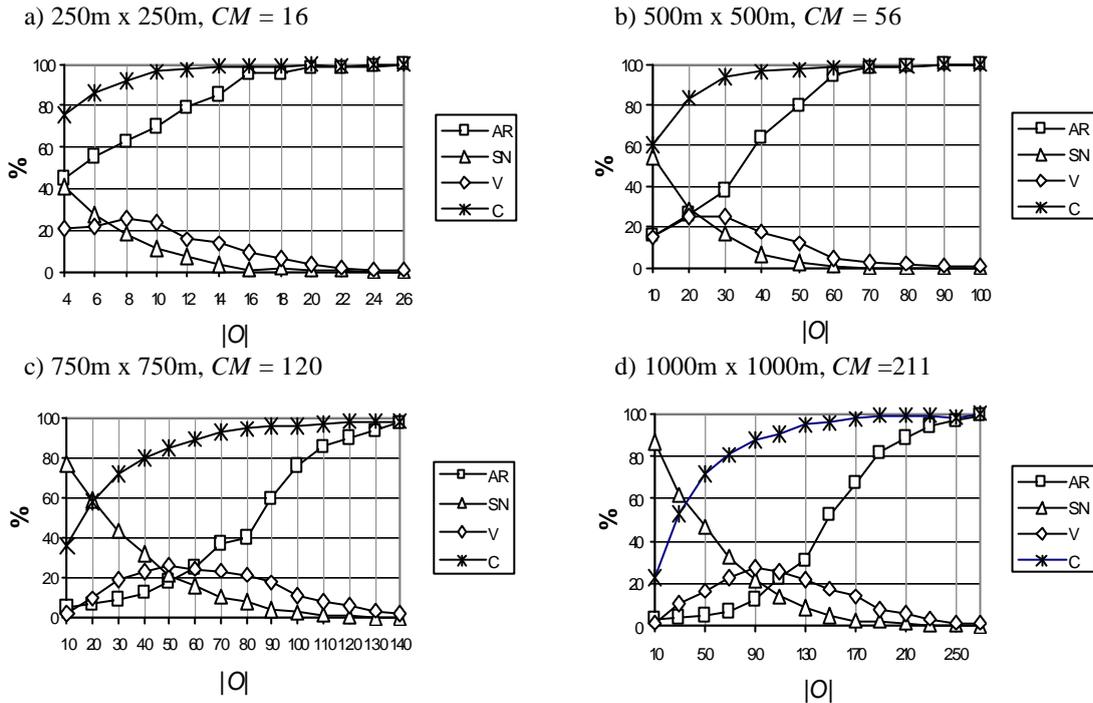


Figure 1. Evaluation of MANETs in simple areas

We chose 100m as the transmission range. The range of *Wireless LAN IEEE 802b*, e.g., is between 30m and 300m, where the latter only occurs under ideal conditions [9]. Low power Wireless LAN adapters for handhelds often only reach 90m even in open environments [22].

We carried out the simulations for a number of areas: 250m x 250m, e.g. a yard of a small company; 500m x 500m, e.g. a university campus; 750m x 750m, e.g. a pedestrian zone; 1000m x 1000m, e.g. a city centre. We simulate the MANETs for different number of nodes. Fig. 1 presents the results. Not surprisingly, *C* and *AR* are monotonic increasing and converge to 100% for increasing $|O|$. *SN* is monotonic decreasing and converges to 0% with nearly the same speed as *C*.

V starts at 0%, reaches a maximum of approx. 30% and then converges to 0% for higher number of nodes. *V* has values of about 0% for low number of nodes, since we have a high segmentation, thus there is no multi-hop routing in the network. Values of more than 30% are rare in real networks, as only very specific constellations cause nodes with high importances *I*.

After the metrics reach a specific value, we can increase the number of nodes without a significant change. Basing on this observation, we define what we mean by a 'good' MANET:

- values of *C* and *AR* have to be greater than 90%,
- values of *SN* and *V* have to be lower than 10%.

We now define the *Critical Mass CM* of a specific scenario: *CM* is the minimum number of nodes, which are necessary to reach values of *C* and *AR* greater than 90% and *SN* and *V* lower than 10%.

Note that at this point, we assume that each node is continuously active. In reality, nodes often are switched off, which significantly increases the critical mass. We discuss this issue in a later section.

4.2 Minneapolis Skyways

The simple area scenario gives a rough impression of the capabilities of MANETs. Thus, we conducted a more realistic simulation: the shopping centre in the downtown of Minneapolis. Towers in the centre of Minneapolis are connected via so-called *Skyways* in the first floor. Skyways and shopping levels form a network of ways for pedestrians. This scenario has several advantages:

- We have an exact map of all skyways (fig. 2a) and can easily put this map into the simulator (fig. 2b).
- Users and the corresponding ad-hoc nodes follow simple paths, thus it is easy to simulate a realistic behaviour of users going from one shop to another.

From all skyways, which have a total length of some kilometres, we chose a part of nine towers. These nine towers cover an area of 440m x 408m. From this area, only the ways, which are open for the public, are used to compute *C*. Other areas, e.g., offices, hotels and museums, are not taken into account. In addition, we restrict the area to the first floors of each tower.

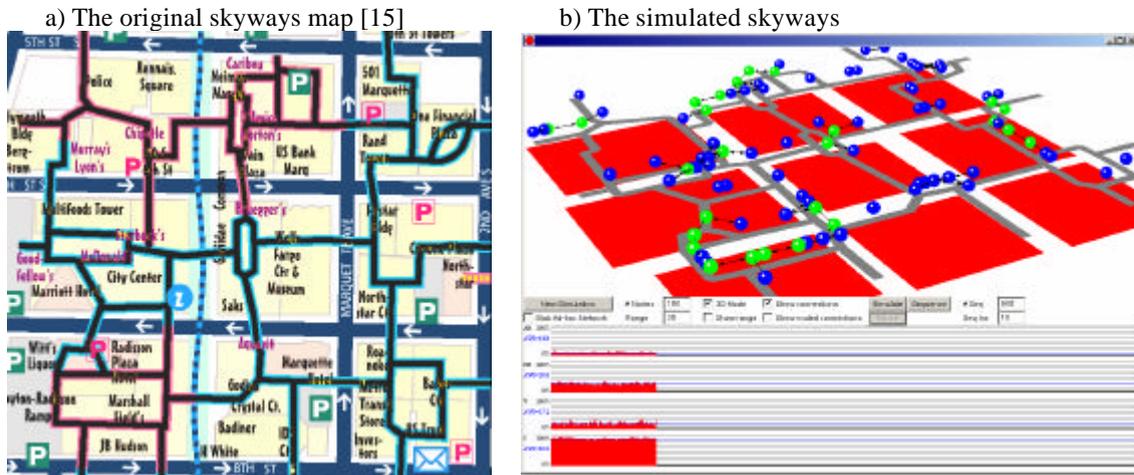


Figure 2. The Minneapolis Skyways

All nodes are indoors, thus we assume a communication range of 30m (which is the communication range of Wireless LAN IEEE 802b inside buildings). In our first simulation, we further assume that all nodes are continuously active. Fig. 3a shows the results. In this scenario $CM = 510$.

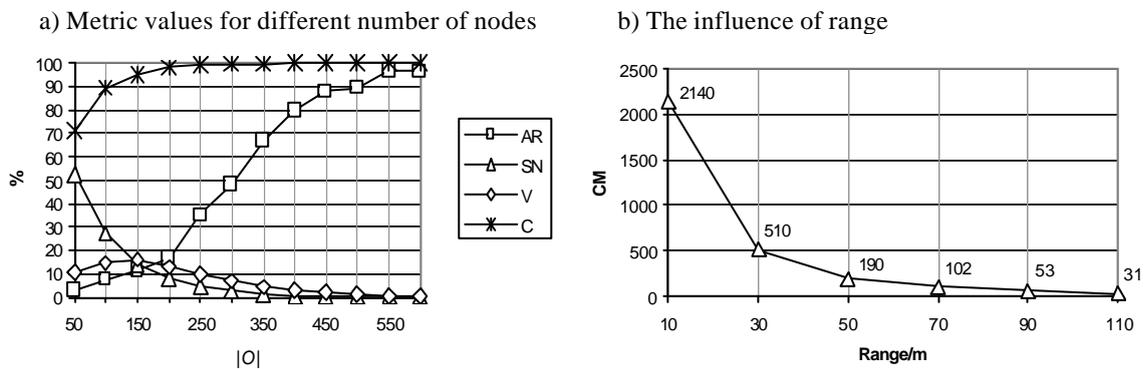


Figure 3. Results of the skyway simulation

4.3 The Role of the Online Time

Until now, all nodes in our simulations are continuously active. In reality, power consumption is a limiting factor of mobile nodes, thus the operating system or the user often switches a mobile node off to save valuable battery power. This problem becomes even worse, if battery is drained by wireless network connections used to transfer foreign packets.

Batteries of current PDAs have capacities of 2Wh (PalmOS device) to 10Wh (Windows CE device). Wireless LAN adapters consume about 2W when transmitting packets. In addition, the Wireless LAN hardware, CPU and memory consume power to perform the ad-hoc routing protocol. Some Wireless LAN adapters have separate batteries to save power of the PDA's battery, however they typically have power for 2 hours network activity [22]. Notebooks have battery capacities of about 50Wh, but have to supply much more power-consuming parts. Typically, notebooks can be active for 2-3 hours. Assuming an online time of two hours in an observation time of 10 hours, we have a five times greater value of CM . In our skyway example, we have a CM value of 2550.

During the last few decades, mobile battery technology has made only moderate improvements in terms of higher capacity and smaller size [3]. There exist approaches addressing the battery problem especially in MANETs (e.g. [21]). However, if the battery technology does not significantly improve in the future, it will be a high barrier to introduce MANETs into a wider community.

4.4 The Role of the Communication Range

To examine the influence of the communication range, we carried out a number of simulations with different ranges in the skyways scenario and measure CM . Fig. 3b shows the results.

We start the simulation with a range of 10m, which is the range of Bluetooth transmitters [19]. One observation is that the communication range has a very high influence on the critical mass. Using, e.g., Bluetooth instead of Wireless LAN, we have a four times greater value of CM .

As an important output, the communication range plays an important role for ad-hoc networks. Assuming unrealistic communication ranges, we can easily form a reasonable MANET. However, as we can see in our simulation, the critical mass dramatically increases when the communication range goes below a certain value. One could argue that the communication range for radio transmitters will increase in the future. Having a larger communication range however, more nodes use the same radio resources (e.g. frequencies), thus the number of unwanted collisions increases. As a result, the communication range cannot go beyond a certain value, depending on the potential number of communicating nodes.

5. CONCLUSION AND FUTURE WORK

In this paper, we introduced a number of metrics to measure the quality of MANETs. These metrics can be used as a tool to answer questions such as '*How many nodes are necessary in a specific area to obtain a reasonable MANET?*' or '*What communication range is required if we have a specific number of nodes?*'. These metrics together with the simulation tool could help people who plan to form a MANET to investigate the effects of relevant parameters.

We carried out a number of simulations in different scenarios. One observation is that a relative high number of nodes is required to get a useful connectivity among the users. This number is even higher, if we take into account that mobile nodes may not be active all the time or that we have smaller communication ranges (e.g. with Bluetooth). As a general result, the whole idea of ad-hoc networks may be questionable for many scenarios. The work has currently an analytical character. We can find out, if a specific network scenario leads to an acceptable MANET or not. This is a starting point to explore alternatives and variations of MANETs.

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WORKERS ON THE MOVE: NEW OPPORTUNITIES THROUGH MOBILE COMMERCE

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ABSTRACT

A key factor affecting today's workplace is mobility. This trend creates new challenges to both companies and their employees. Requirements of workers on the move, in terms of information and support, are different from those of employees operating in a stationary work environment. Thanks to the convergence of telecommunication and data communication, new work applications will rely on seamless wireless networking and will thus be inherently mobile. Mobile commerce (m-commerce) is expected to add value to the organization and its employees by bringing information, communication, and collaboration to them instead of their having to go to the source themselves. In the following pages, I will discuss the characteristics and challenges of mobile work practices and how m-commerce can provide more freedom and support to workers when they are away from their stationary work setting. First, I will identify the characteristics and challenges inherent in mobile work practices. Then, I will briefly describe the key characteristics of m-commerce that are relevant to an effective support of mobile workers, which leads to discussion of m-commerce opportunities for workers on the move.

KEYWORDS

Work mobility, mobile commerce, information mobilization, and virtual corporations.

1. INTRODUCTION

Ann Smith, a senior consultant at "xyz petroleum consulting" is at her office in Helsinki. She is conducting a project review with her client Thomas who is the vice president of a major Norwegian Gas production company. They are preparing a bid for Gas supply to a major European Gas retailer. Ann is leading Thomas through the bid report to discuss possible changes before flying in the afternoon to Copenhagen where she will present the project on behalf of Thomas's company. They are using Net meeting. Ann is interrupted by her secretary Jane. Jane informs Ann that the car, which will take her to the airport, has arrived. So Ann picks up her GPRS enabled Personal Digital Assistant (PDA) and leaves in hurry the office. Once in the car, her PDA starts beeping. It is her colleague Vladimir from Russia. Vladimir informs Ann that he has identified a new source of natural Gas in Siberia that would make their bid much competitive. He also forwarded electronically to both Ann and Thomas a summary report containing more details about the new natural Gas source. Ann connects wirelessly, using her PDA, to the meeting with Thomas and they start evaluating the impact of this new information on their bid, based on Vladimir's report. They feel that the new Gas source will give them a clear competitive advantage in winning the bid but they still need to evaluate more deeply its impact. Also they will need to update the spreadsheet that they have already prepared for the bid. Ann's PDA starts beeping again, it is an SMS message from Finnish airways alerting her of an hour and half delay of her flight to Copenhagen. So Ann informs Thomas about such delay and they decide to carry on the meeting for an additional hour. Once in the airport, Ann checks in and connects her PDA to the Internet via wireless LAN and resumes her Netmeeting session. At this point, Ann hears her PDA beeping. It is an alert, pushed by a Petroleum research company, about a rise in Gas future price. In the light of the recent information, Ann and Thomas discuss and confirm the changes to the bid report. Then Ann updates the spreadsheet and sends

wirelessly the file to Jane, her secretary. She then calls the secretary and explains to her how to reflect the modifications in the bid's PowerPoint presentation. Jane promises that the final presentation will be in Ann's electronic mailbox before the plane lands in Copenhagen airport. Ann looks at her watch; there are still ten minutes available before the boarding. She feels the need for entertainment. So she connects wirelessly her PDA to the Internet, downloads a song and starts playing her most favourite game.

The above scenario is based on many real life situations that mobile workers face during the course of their everyday work life. It illustrates some key points of how mobile technologies can provide more freedom to workers while on the move. Indeed mobile commerce thanks to its unique attributes such as ubiquity, reachability, convenience and localization can provide new forms of support to mobile workers. M-commerce built on the wireless devices makes the information comes to the user. This means that m-commerce makes the user the center of the information and communications in relationships and business operations that create new freedoms for the user (Keen P. et al, 2001).

The paper aims to discuss the characteristics and challenges of mobile work practices and how m-commerce can provide more freedom and support to workers when they are away from their stationary work setting. First, I will identify the characteristics and challenges inherent in mobile work practices. Then, I will briefly describe the key characteristics of m-commerce that are relevant to effective support of mobile workers, which leads to discussion of m-commerce opportunities for workers in action.

2. MOBILITY AND MOBILE WORK

The western mobile and remote workforce is growing, driven by both business necessity and technological innovation. One explanation for increased work mobility is the emergence of service industry as a dominating occupation in the post-industrial society. Service work is often performed, where the customer is, and thus making many services mobile. It is not like manufacturing work; which takes place where the machinery is located. Another factor is the increased cooperation in and between organizations. Some forms of cooperation can take place remotely, but people still need to meet physically. A third important factor for increased mobility is the extensive adoption of mobile technologies. Mobile technologies enable people to be mobile and yet accessible. As people have become accessible independent of place, new ways of working have emerged in many organizations. To describe the mobile worker, new concepts have been coined. Some examples are "road warriors" and nomads (Dahlbom, B. et al, 1998).

Mobility has long been a contested notion. (Fagrell, H, 2000) argues that all work can be seen as mobile, since all the employees move around their work place, meet customers and other workers, and often travel between different work locations. (Bellotti and Bly, 1996) report from an ethnographic field study of distributed work at a design-consulting firm and coin the term of local mobility: short term distance mobility in the local environment, such as walking between rooms or buildings. They found that local mobility gives a certain level of access to colleagues that made people aware of what was going on in the workplace. However they found that local mobility penalizes the way long distance collaboration is conducted and coordinated. By identifying what they call "typical instances" of a type of mobility', (Kristoffersen and Ljungberg, 1999) create a classification with three distinct types of mobility: travelling, visiting and commuting. Travelling denotes the kind of mobility where you move from one place to another using a vehicle, like commuters. Visiting denotes the type of mobility where you spend a temporary period of time at one physical location before going somewhere else, e.g. consultants. Wandering denotes local mobility within a smaller area such as a building with very little time spent in any one place. (Kakihara and Sørensen, 2002) have sought to develop a conception of mobility which rejects the traditional view of mobility as seen "in terms of human" independency from geographical constraints. Instead they maintain "being mobile" is not just a matter of people travelling but relates more to the interactions they perform, the way in which they interact with others in their social lives. By relating mobility to interaction, they expand the concept to embrace spatial, temporal and contextual mobility.

When on the move, workers often find themselves in a changing and unpredictable context. (Perry and O'hara, 2001) conducted a behaviour study of 17 mobile professionals from a variety of professions (management personnel, sales staff, consultant, medical workers, civil servant and media) and coined the term of "planful opportunism" as an essential feature of a mobile worker's job practices They found that mobile workers face unpredictability with respect to the nature of information and artefact that they need

during a trip. As a result, they plan ahead to take things that they just feel they would need. The purpose is to make sure that documents and information are available in the appropriate form when and where needed to support unanticipated information and communication need. They also found that given the form of laptop carrying behaviour (i.e. size, weight, insecurity, etc.), laptops were regarded as subject to planning by mobile workers (should they be taken or not?). Perry and O'hara's study also uncover that work during dead times was recognized as increasingly important by mobile workers in managing the growing number of tasks waiting for them at home and at the office. However they observed that mobile workers rarely used dead time as efficiently as could be.

Mobile workers' informational requirements are different from those of stationary work. Alas, Most of knowledge management approaches of knowledge repositories and intranets have been designed to support stationary work and not mobile. (Keen and Mackintosh, 2001) consider that current knowledge management systems and tools fail to mobilize the required knowledge to support workers in action. Workers often have to be in a specific place (typically the office), use a specific tool (their personal computer) and adapt to how the knowledge is stored and organized. Mobile workers are often away from their desktop computers and faced with unpredictable need of both relevant and actionable information to perform the task at hand.

3. MOBILE COMMERCE

There are many definitions of mcommerce with differing emphases. Keen and Mackintosh define mcommerce as the extension of electronic commerce from wired to wireless computers and telecommunications, and from fixed locations to anytime, anywhere, and anyone. (May, 2001) argues that when something is mobile it means that its primary usage environment is a mobile one. On the other hand, mobility in itself and mobile technology is not necessarily a value; the freedom created and supported with the technology is the key issue. Durlacher define m-commerce as "any transaction with a monetary value that is conducted via a mobile telecommunication network". The focus in this definition lies on the exchange of products and services that is associated with a monetary value. (Skiba, et al, 2000) take a slightly different approach and define m-commerce as the "use of mobile hand-held devices to communicate, inform, transact and using text and data via connection to public or private networks". They specifically list any kind of service that can be provided by the mobile device, thus expanding the mere commercial character through communicative and informative services.

A mobile device is a small smart device. It can be a mobile phone, a communicator or a PDA. It communicates and transfers data (convenience). It is used only by its owner (personalization). It can provide information anytime, anywhere (ubiquity). Capturing the concept of mobility, a user can be contacted anywhere (reachability). A mobile device can provide users' locations (localization). Knowledge of users' precise geographical location allows customized, relevant content to be delivered to them when and where they need it. It can also be used to connect to the Internet (instant connectivity). Ubiquitous interactivity (figure 1) is what makes mobile devices unique. Wireless devices enable users to send, receive, and act on information in real-time, independent of their location.



Figure 1. Ubiquitous Interactivity

4. DISCUSSION

Mobile commerce may impact both mobile workers and their enterprises in the following dimensions.

Location: The post-industrial workers work at various locations: in their office, at clients' office, at colleagues' office, in the train, hotel rooms, etc. We can thus imagine that during this extensive geographical movement, mobile workers are often away from the "benevolent dictator", their desktop computers, which contain most of the information they need and impose rigid constraints on how and where they can be used. With m-commerce the user is put in the centre of information and communication. Information comes to the user instead of the user looking for it. This makes mobile workers able to receive actionable and useful information on demand at the moment of relevance and regardless of their location and extensive movement. Sales reps are examples of workers who are constantly on the road while their effectiveness depends to a large extent on their ability to have immediate access to account information, current prices, order status and market conditions. The importance of immediate access to information by salespeople is well recognized in the personnel selling literature. Sujan et al (1988) suggest that salespeople's effectiveness can be enhanced by providing them with market research information and encouraging them to utilise information. With vast amount of relevant information about client's orders, product's profitability, promotions at their fingertips regardless of their locations, sales reps can adjust their call schedule to adequately target those customers with the highest potential at the right time. Additionally, receiving time-sensitive alerts about customers' latest orders, industry indicators and competitors' actions, may enable sales reps to tailor their sales messages to a specific customer, adapt to opportunities that arise during the sale call and overcome objections. Indeed, many empirical studies find a strong effect of adaptive selling on salesperson performance (Weitz and Sirpo, 1990), (Sujan, et al, 1994). Furthermore, M-commerce can enable mobile workers to use more efficiently their dead time. This time generally occurs between tasks and between meetings, in which workers usually have little control over the resources available to them. For instance, pharmaceutical sales reps often visit doctors to provide them with information on what is available as order brochures on products in which the doctor is interested. Frequently the doctor is not available and the representative wants to find a nearby alternative contact. If there is no alternative contact to visit, then the time for waiting for the doctor to become available may turn to be dead time for the sales representative. With m-commerce, the sales reps can turn this dead time into a productive one by performing non-selling tasks such as completing and sending expense reports to their company, preparing invoices or writing and sending thanks letters to customers. These reduce the time that sales reps have to spend in the office to perform routine tasks and thus allow them to spend more time selling. Indeed, McGraw Hill's study of 239 salespeople across 198 different companies reveals that salespeople spend on the average about 25% of their time waiting for interviews with clients and travelling. Using dead time more efficiently may occur in a variety of locations (i.e. trains, airports, airplanes, hotels rooms, office buildings, etc). Additionally, mobile workers spend considerable portion of their time on the road, Awareness of their geographical position by the network can allow relevant support and alerts be sent to them. Examples of such alerts are "*there is a traffic jam two kilometres ahead, use the alternative highway*", "*there is a restaurant offering 10% discount in avenue X*", "*I have a breakdown, in nowhere, send me a tow truck*", "*your client X is in the avenue ahead to you*".

Interaction: Asynchronous communications enabled by emails has made co-workers interactions with others more flexible. However, as (Kakihara and Sorensen, 2001) notice, asynchronous communication inevitably creates time lag. Until a receiver of an email actually goes to his computer and read the email, the communication does not come into effect in practice. Moreover, email communication requires a computer and software, which are mostly fixed to a certain location such as an office and home. M-commerce may enhance interaction among distributed workers and others by enabling them to have access to corporate resources, send and receive emails regardless of their location. For instance journalists on the move are often faced with situations in which they have to report events on topics on which they are not fully profound with (Fargell and Ljunberg, 2000). Also reporting is often conducted away from editorial staff and radio TV / station's resources. In such a case M-commerce can provide support to journalists by enabling them, irrespective of their locations, to connect to their TV/Radio station's intranet. The system can then provide them with the list of resources available on the topic they want to cover together with contact details of colleague who have expertise in such topics. The journalists can then either use the available resources to get an understanding of the topic or elect to contact their colleagues for more interaction.

Additionally, ubiquitous access to e-mails and corporate data by mobile workers may enable them to make themselves readily available to address customer problems and questions. Reducing the time it takes to deal with a client's concern or difficulty may have a positive impact on customer orientation, the degree to which the seller is perceived by the buyer to put customer's need first (Keillor and al., 1997). Indeed, customer orientation is a key enabler of buyer-seller relationship developments (Lawler, 1992).

Operations: we are witnessing the emergence of new forms of organization, in particular virtual corporations. Virtual corporations could not exist without an effective information exchange and efficient coordination of the members (Carlsson, 2002). This applies also to other management initiatives such as project team or task force. But it is sometimes challenging for corporations to ensure fast coordination among co-workers while they are on the move even if they introduced Internet technologies such as email in their work practices. M-commerce can act as the "glue" among distributed members, by connecting them more tightly regardless of their locations. This may for instance make it possible for marketing managers to use real time data flowing from the field to evaluate the results of promotions and new product introductions more rapidly and communicate their reactions (i.e. promotions) to the field force. Manufacturing may also use real time field information to reduce overproduction and the incidence of stale products. Additionally, Top executives often need information on market and competitors issues before they make big decisions. Real time information flowing from the field would enable executives to make decisions based on accurate information, which may enhance the quality of their decisions. Indeed the best source for top executives with regard to both market and competition watch is the field force (Sinclair, 1996).

5. CONCLUSION

In this paper, I have discussed the characteristics of mobile work practices and the challenges that they impose on workers while on the move. I have also explored how m-commerce with its unique attributes can provide mobile workers with more freedom and support through minimizing non-productive time, enhancing interaction with other members and improving the quality of decisions. It is worth mentioning that m-commerce may result in some consequences that workers may not welcome. Perhaps the most immediate drawback of extensive use of mobile technologies by workers is the problem of "interaction overload". Anytime and anywhere connectivity may become everywhere/all-the-time connectivity; which may result in the danger of users becoming "too connected". But in the other hand, access to information at the point of relevance may make it possible for mobile worker to work smarter and to minimize their unproductive time, which may enhance their life / work balance as the case of Ann. Thanks to the Gas source identified by Vladimir and her wireless discussion with Thomas, her proposal was so attractive that the Gas retailer accepted to sign with her a preliminary supply agreement without the need for further negotiations, which were scheduled in the next day. So Ann cancelled her hotel reservation in Copenhagen, took the plan back to Helsinki and spent a peaceful evening with her small family.

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KNOWLEDGE SHARING AND ONLINE ASSESSMENT

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ABSTRACT

We describe an online assessment system that enables users, teachers and students to generate, share, and manage knowledge items for learning, teaching and assessment. The system “QSIA” – Questions Sharing and Interactive Assignments is designed to harness the synergy of communities of practice in the design and implementation of online learning, teaching, testing and questioning processes. QSIA promotes collaboration in authoring and use via accessible and accumulating history, online recommendations and the generation of communities of teachers and learners. At the same time, QSIA is designed to foster individual learning and enhance high order thinking skills among its users. QSIA's community, pedagogical and technological aspects, possible usage, and implementations are discussed.

KEYWORDS

Online assessment; recommendations; knowledge sharing; knowledge management.

1. INTRODUCTION

Online systems to support education attempt to do so through impacting communication. Traditionally, the communication flows from author and teacher to the student (Dori, Barak, & Adir, 2003; Gal-Ezer, & Lupo, 2002; Light, Nesbitt, Light, & White, 2000; Rafaeli, & Ravid, 1997). Online systems that allow peer-teaching and student-to-student communication are beginning to appear, and new systems that allow teachers to share lesson plans are gaining prominence (Berg, 2001; Nachmias, Mioduser, Oren, & Ram, 2000; Pear, & Crone-Todd, 2002; Sheremetov, & Arenas, 2002). Generally, the new generation of online, web-based systems can now aim not just at delivering content from author and teacher to student, they can aim at multilevel 'peer-to-peer communication' such as teacher-to-teacher and student-to-student communication. We describe here a system for the communities of teachers and students that address two of the main points of students' and teachers' joint practice: online assessment and teaching.

One of the earliest contexts of use of computers in teaching and learning was the online test (Rafaeli and Tractinsky 1991). Computerized administration of tests is attractive for a variety of substantive, convenience,

efficiency, aesthetic and pedagogic reasons (Rafaeli and Tractinsky, 1989). Though available for many years, testing online has not yet been as widely adopted as early predictions expected. Online testing has traditionally been a very centralized, closely guarded and tightly controlled enterprise. This project is about implementing network based online assessment in an entirely new perspective. Here, we investigate the design and use of a network based system for online assessment and learning that emphasizes the sharing, community potential of the network in what, heretofore, was considered mostly an individual task. The tasks of developing tests and marking them are part of the educational processes for assessing students' performance, providing feedback and facilitating motivation. Online assessment systems could offer considerable scope for innovations in testing and assessment as well as a significant improvement of the process for all its stakeholders, including teachers, students and administrators (McDonald, 2002).

QSIA is an acronym for **Q**uestions **S**haring and **I**nteractive **A**ssignments, but also an eponym for "question" in Hebrew. QSIA was designed as an online question and assignment authoring and application tool. It was also designed as an arena for student-to-student and teacher-to-teacher information sharing. The core idea is that of sharing elements of information. QSIA is designed to share the authoring of test items, their contents and psychometric accumulated history, as well as the process of constructing assignments and tests. The system runs the administration of assignments and tests under a variety of contexts: online as well as offline, proctored as well as individual, with or without time limits, open or closed book, etc. More importantly, though, the system enables joint ranking and evaluation of items, collections of items, and maintains a process of ongoing accumulation and a constantly improving collection of such items in a shared domain. QSIA is an attempt to reap the benefits of synergy in communities of practice in teaching. QSIA can be accessed at <http://qsia.haifa.ac.il>, using 'qsiaguest' as both username and password.

This paper describes the QSIA online system and its educational goals. QSIA's innovative development, its structure principles, applications and future investigations are detailed.

2. THEORETICAL BACKGROUND

2.1 Collaboration in education

Collaboration has become a dominant mode of organizing, conducting work, and learning (Gal-Ezer, & Lupo, 2002; Jones, & Rafaeli, 2000; Sudweeks, McLaughlin, & Rafaeli, 1998; Sudweeks, & Rafaeli, 1996). Teachers and students enrich their knowledge through social interaction with peers, through applying ideas in practice, and through reflection and modification of ideas (Bruner, 1990; Solomon, 1987; Tobin, 1990; Vygotsky, 1978). The notion of communities of learners is gaining much traction in the contemporary understanding of work (Wenger, 1998).

Online communities are difficult to generate because they have high social and material requirements. Online communities that attempt to engage in long-term participation require access to specialized information, to practitioners, to relevant data and analysis tools (Pringle, 2002; Rafaeli, & Ravid, 2001; Sudweeks, & Rafaeli, 1996). One of the aspects of implementing data collaboration among peers involves the process of seeking and providing experience-based recommendations across users communities. We propose that collections of teachers defined by common teaching subjects are a prime example to form groups that can benefit maximally from the formation of online sharing contexts. Such teachers can be drawn at any educational level: primary up to post graduate, so long as the subject matter of their courses overlap or are close enough. Teachers may not work for the same organization, and may even be in competition over resources or status, but since they are charged with teaching the same or adjacent topics, they are very likely to benefit from such system-enabled sharing.

2.2 Recommendations

When they encounter a large number of resources or choices, people tend to seek recommendations for sorting and selecting the suitable data (Resnick, & Varian, 1997; Shardanand, & Maes, 1995). Recommender systems are computer systems which seek to provide guidance in making choices among relevant resources. QSIA incorporates recommendation processes and subsystems. Recommendation of resources may be motivated either by preference or similarity (Herlocker, Konstan, & Riedl, 2000; Resnick, & Varian, 1997;

Shardanand, & Maes, 1995). The core task of a recommender system is to recommend, in a personalized manner, interesting and valuable items and help user make good choices out of a large number of alternatives, without sufficient personal experience or awareness of the alternatives (Oard, & Kim, 1998; Resnick, & Varian, 1997). This task is implemented by QSIA. The core idea is that, in the world of learning, choosing among available items is one of the organizing tasks required of both students and teachers. In the preparation of a learning assignment or test, and in the course of studying for a test teachers and students need to rank and choose the items to which they will devote limited time and attention resources. One of QSIA sub-tasks is 'matching mates' viewed as the recommender system capability to make matches between recommenders and those seeking recommendations (Resnick, & Varian, 1997).

2.3 Online assessment

The Internet is not only becoming a valuable resource of information, it also has a significant role in offering assessment and feedback tools. Online assessment is beginning to have an impact on large-scale testing, particularly in higher education and occupational selection (McDonald, 2002; Schwarz, Brusilovsky & Weber, 1996). Bennett presents three possible generations of online assessment systems (Bennett, 1998). The first generation involves assessment systems that are very similar to the established paper-and-pencil tests, and take limited advantage of technology. The second generation incorporates automatic item generation and includes some new item formats such as interactive features and multimedia. In the third generation, the difference between instruction and assessment becomes blurred as continuous assessment occurs throughout the learning process. The QSIA online assessment system incorporates all the above: items can be easily generated, and interactive features and multimedia can be included. QSIA not only integrates instruction with assessment but also integrates differential combinations of access and use authorizations so teachers can become students and students can play the role of the teachers (see Figure 1).

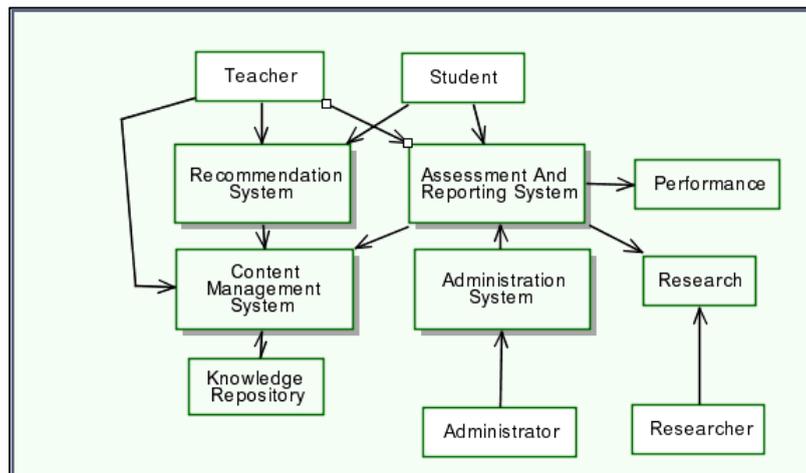


Figure 1. The QSIA online system internal structure

3. STRUCTURAL PRINCIPLES OF QSIA

QSIA is composed of several technological components (see Figure 2). Users can access the QSIA environment using any HTTP compliant Web browser, such as Microsoft Internet Explorer. The QSIA Web Server handles HTTP requests from web browsers. Java Application Server is an application container that runs the java components, including the scriptable Java Server Pages components. Java Server Pages hold the presentation layer of the system. Java Beans hold the business logic components that determine the behavior of the system. JDBC communicates between the system and the database. MySQL, a relational database, holds the system's data including the system's content, users' logs, and administrative information.

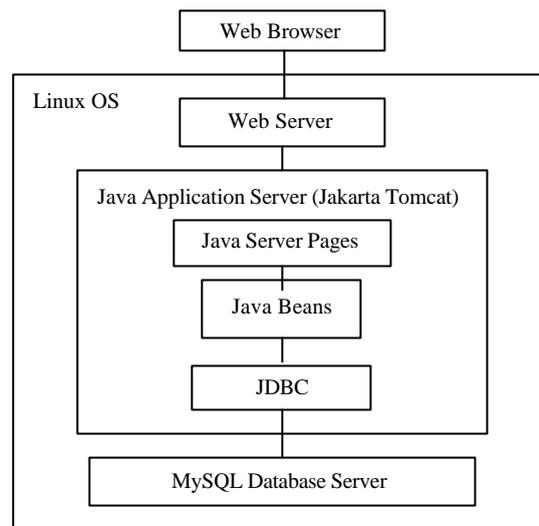


Figure 2. QsIA's technology components

QsIA's structure and functionality are based on a set of principles, determining its construction. The structural concept consists of six principles: Open strands, Flexibility, Privacy, Open source, Ease to use, and Multi community.

Open standards - The system is built around open and acceptable standards, both in the software engineering aspect and in the functionality aspect. The system is based on Java technology, using JSP as the presentation layer and object oriented Java Beans technology as the business logic layer. These foundations enable the system to operate in any standard operating system and application server environment. The relational MySQL database serves as a data repository for the system. Because of the seamless SQL support, the database could be switched easily for any SQL database.

In order to communicate with external learning system, and in order to assimilate the system in the world of educational systems, the system supports the Question & Test Interoperability (QTILite) specification, which defines an XML scheme for learning items and events.

Flexibility - The system uses a set of design patterns enabling it to support a varied set of item types. These types include different questions such as multiple-choice, matching questions and more. The system allows the installation of new question types, without making any change to the system itself. The same method is applied to grading strategies, which determine the grading each student would receive for an assignment.

Privacy - The open nature of the system obliges a strong protection of the privacy of users who do not want to share their information. The system allows users to configure the sharing level of each of their items, and assignment, on the single object level or on the folder level. Users can keep the object totally private; can open it to a set of learning groups, for different roles (instructor, students) or for a set of specific users. The system makes sure that no user would get access to an object, get a recommendation for an object or see an object without the right permission.

Open source - The basic idea of sharing which initiated QsIA, also stands behind its technology. The system is based on open source technology and contributes back to the open source community. The system uses an open source application server (Apache Tomcat) and an open source database (MySQL) which are based on an open source operating system (Linux). Some of the software infrastructure built for QsIA is shared with the open source community under the GNU public license.

Ease of use - The system was designed to have an easy to use interface. The home page interface consists of four parts: a blue toolbar that includes all the operations the users can perform; a personal library that includes a recycle bin and personal folders. There are colorful icons that indicate the folders, the recycle bin, the knowledge items, and the editing. Figure 3 illustrates QsIA's interface that includes a blue toolbar, active red buttons and colorful icons. This figure presents a list of questions in Pathology.

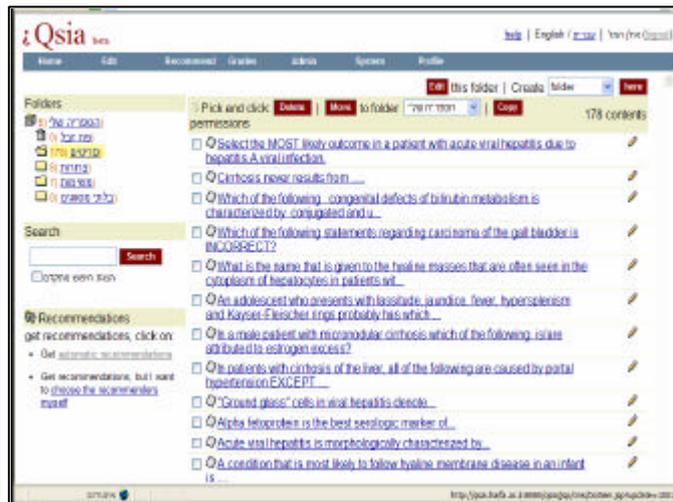


Figure 3. An example of a list of questions in Pathology on QSIA

Multi Community – QSIA users, instructors and students belong to a large array of educational organizations such as universities colleges and high schools. The system allows organizations to manage themselves independently by generating users' templates, adding new learning groups (courses or classes) and assigning new disciplines. QSIA is designed to support life long learning and communities of practice, by allowing users to share information.

4. THE FOUR CONCEPTUAL PILLARS OF QSIA

Our goal was to develop a generic data driven system, for the collection, retrieval and use of knowledge items within a knowledge discipline, shared across organizations and beyond boundaries. The QSIA system is based on four conceptual pillars that support its goal. The four conceptual pillars are: Knowledge Generation, Knowledge Sharing, Knowledge Assessment, and Knowledge Management.

4.1 Knowledge generation

The QSIA system enables users to create and edit different knowledge items such as questions or learning tasks. The knowledge items can range from simple low order thinking skill questions that requires memorizing or seeking straightforward information, to complex high order thinking skills assignments that requires analysis and synthesis of the learning material. QSIA knowledge items include multiple choice questions, matching questions, true/false questions or content items.

QSIA as a Web-tool permits easy accessibility to a variety of knowledge databases that includes written text and interactive multimedia such as music, video films, special simulations and virtual tours to museums. It is a multilingual system and has been used in English, Hebrew, Arabic and Turkish.

4.2 Knowledge sharing

QSIA system focuses on knowledge sharing among participants, while maintaining a secure and private working environment. One of the QSIA sub-tasks is 'matching mates' viewed as the recommender system capability to make matches among recommenders and those seeking recommendations. Sharing knowledge via the QSIA includes three aspects:

Uploading knowledge items – composing a question and allowing others to use it. There are four different access levels at the QSIA: private (opened only to the owner), personal (opened to a selected set of users), partial (opened only to the selected set of learning groups) or public (opened to everybody). In each of these levels, the user can choose to restrict the access to a specific role (teachers, for example).

Ranking knowledge items – answering a question and then grading it on a scale of 1-5, so others could benefit from ones' professional opinion, and

Receiving recommendations – looking at the average rank other participants (instructors or students) gave to a certain question. This way one benefits from the expertise of others. The recommendation system enables instructors and students to get targeted suggestions of knowledge items.

Other measures for sharing information include a search facility and an access control system that allows users to define sets of groups or users.

4.3 Knowledge assessment

QSIA offers new prospects for individual assessment and system evaluation based on computerized follow-up and monitoring of the individual answering path chosen by each student. The QSIA online assessment activities, quizzes and self-tests, are called assignments and have a number of applications, as the system is able to capture all the information required by the actors of the educational process.

The QSIA assignments can be seen both as a formal evaluation of the students' knowledge at the end of a course, and as an informal and flexible method for self-evaluation. The formal evaluation is a quiz student's need to carry out simultaneously but not necessarily at the same place. The informal evaluation is a self-test, that students can carry out any time and any place for detecting their difficulties and misunderstanding. Figure 4 demonstrates a typical question, and the use of color and image capabilities of the web. Figure 5 shows the type of feedback students can receive after answering an item as part of a quiz or a self-test. This particular item is part of a set of items used in a Pathology class in medical school. The student is shown the question that includes a color slide, after answering it, he is given the correct answer, and information about his response and grading (if applicable).



Figure 4. An example question, taken from a set of Pathology questions.

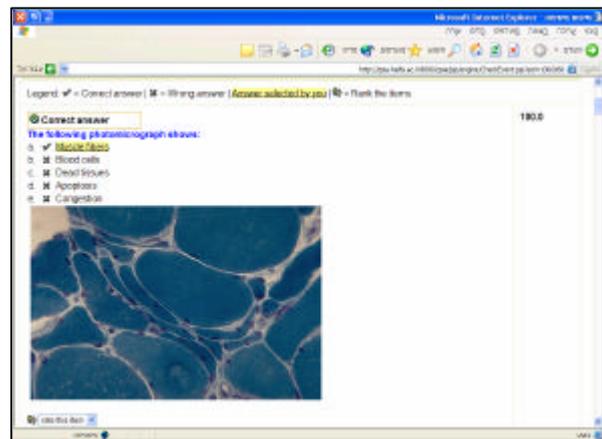


Figure 5. An example of the feedback students receive after performing a quiz or a self-test

QSIA assignments can be reviewed by the instructor before distribution to the students. A hard copy of the assignment can be printed or exported to common word processor formats. The QTI standard also allows importation and exportation following XML standards.

4.4 Knowledge management

The educational line of work produces masses of learning material for both instructors and students. After years of learning and teaching, educators possess valuable lecture notes, working sheets, written projects, exercises, assignments and more. Scholars often have trouble organizing their papers, files and folders. QSIA helps solve this problem, in the context of encouraging sharing among teachers in adjacent or overlapping disciplines. QSIA allows managing educational content using folders, search facility and editing tools. It enables users to create and manage a set of folders that includes all of the content owned by them. The folders allow users to manage their content's properties using centralized and time-saving methods. As all these folders are available online, they can be shared, used from a distance, merged, and otherwise used more flexibly. Content such as knowledge items, created by the QSIA user, can be indexed under a certain

disciplines. The list of disciplines can be used afterwards in order to retrieve the contents. The system keeps a list of disciplines appropriate for each user. Since QSIA is an online system, users can retrieve their personal educational contents any time and any place providing there is a computer with a connection to the Internet.

5. QSIA SYSTEM OVERVIEW

The QSIA four conceptual pillars: Knowledge Generation, Knowledge Sharing, Knowledge Assessment and Knowledge Management, are enabled and supported by four technical pillars which are the systems' engines (see Figure 1). Each engine or subsystem is responsible for different components and manages different areas of interaction. The subsystems include: Content Management System, Recommendation System, Assessment and Reporting System, and Administration System.

I. *Content Management System* is responsible for managing the Knowledge items and assignments created by the instructors. The system serves as a content gateway, offering services such as object caching, security policy enforcement, and folder management. The knowledge repository is this subsystem's outcome. It includes knowledge items and assignments. The external repository includes database of questions, online quizzes, and self tests.

II. *Recommendation System* is responsible for gathering ranking information from the user, generating the 'friends' group, running the recommendation algorithms and retrieving the recommendations.

III. *Assessment and Reporting Systems* are two subsystems that allow students to perform their assignments, and to learn independently using the database of knowledge items. The heart of the system is the Arena component which allows secure real time testing, as well as online grading using a varied and adjustable set of grading strategies. The system also generates grading reports for learners and instructors. The performance data is one of the Assessment and Reporting subsystems outcomes and it includes a list of the students' grades. The research data is the second outcome and it includes a list of the users, the disciplines, the groups and logs.

IV. *Administration System* allows administrators to manage the users in the system, manage disciplines, learning groups and action logs. Hierarchical and secure administration is supported in order to allow various learning organizations to use the same system securely.

6. CURRENT EXPERIMENTS

QSIA was first launched on the Internet in May 2002. Since then it has already been implemented in several universities and high schools. During the seven months that QSIA has been operating, more than 650 users logged on and about 2,000 knowledge items have been uploaded. Roughly 10,000 additional questions are being converted to QSIA at the moment. The institutions and courses that implement assessing via QSIA:

- Neshet High school, Neshet, Israel;
- Electronic Commerce course, Graduate School of Business, the University of Haifa, Israel;
- Electronic Commerce course, Industrial Engineering and Management, Technion, Haifa, Israel;
- Organizational Behavior course, Technion, Haifa, Israel;
- MIS course, the school for practical engineering, Ruppit college, Israel;
- Turkish Language course, the Faculty of Humanities, University of Haifa, Israel;
- General and systematic pathology course, The Faculty of Medicine, Tel-Aviv University; Israel;
- Electronic Commerce course, The Cyprus International Institute of Management, Nicosia, Cyprus;
- Electronic Commerce course, the University of Michigan, USA.

We have interviewed the instructors and teaching assistants in order to learn about their attitudes towards the use of QSIA and online assessment. All expressed positive attitudes towards integrating QSIA as part of their teaching and assessing environment. The feedback was used for making improvements so the system would meet the Instructors needs as best as possible. Relevant changes in the system's interface were conducted and some new applications were added.

A feedback questionnaire was given to a sample of 60 students from the General and Systematic pathology course. The questionnaire was given at the end of the course, after the students experienced

responding to three online quizzes during the semester and one online final examination at the end of the semester. All the online tests were administered by QSIA. The feedback questionnaire contained 12 attitude items. The attitude items were presented as statements with a Likert-type 5-point scale response (5-strongly agree to 1-strongly disagree). Five experts in science and computers education validated the questionnaire. The questionnaire's internal reliability, Cronbach's Coefficient Alpha, was 0.86. Overwhelmingly, the students reported strong positive affective attitudes toward the use of QSIA (Mean = 4.38, SD = 0.93). Students enjoyed using QSIA during the course and noted they would like to use the system in other courses.

Another format of QSIA's usage is being investigated. Here students are required to contribute items related to the subject matter that is being studied. In this question-posing format students are actively engaged in generating knowledge items and contributing to the systems' database. The students are told that these items will be used as part of the final examination in their courses. They are then asked to review, react and recommend items contributed by their classmates. This process allows students to assimilate and internalize new learning materials. It is, too, an implementation of the sharing construct within online assessment.

7. DISCUSSION AND FURTHER INVESTIGATION

Although still in its first stages, the QSIA online assessment system already shows promise. The first finding is that it works. Tests can be run simultaneously or in a delayed fashion, to groups of many dozens of students concurrently, comprised of many dozens of items, and of a variety of item-types. The efficiency gains, cooperation potential, and positive feedback from the instructors and students who use QSIA and the growing demand for web-based educational assessment tools suggest the significance of developing such a tool. QSIA exploits the opportunities of interactivity and multimedia for composition of questions. Hyperlinks, color pictures and animations may be used as parts of questions for concretizing abstract concepts and visualize complex ideas. More importantly, the process of sharing, among teachers and among students is made possible through several avenues: items, recommendations, and the statistics of results that can be shared in a variety of creative manners.

We propose that collaborative tools like QSIA provide instructors with important opportunities to share "craft wisdom" and a professional culture. A Web-based knowledge sharing system, which allows instructors and students to exchange information and evaluate peers work, can enhance better teaching and learning.

Future research tied to QSIA and the online sharing of assessment items and tools will follow three tracks: pedagogical, recommendation oriented, and studies of communities of practice. First, there are pedagogical implications of large scale repositories of items, available online alongside classifying and prioritizing data. Education oriented research into the opportunities, advantages and problems of online web-based testing and construction of shared repositories is already dipping into the data collected by QSIA. The recommendation infrastructure that accompanies QSIA is the target of our second research track. How can online recommendations be done best? Who are the appropriate recommenders? What needs to be done in constructing the recommendation algorithm to improve the use and acceptance of recommendations? Finally, the success of systems and communities of practice like QSIA depends on a deeper understanding of the process, motivations and rewards in sharing information. What are the system-based incentives for people to contribute? How can the design of the item repository and the recommendation engine improve the tendency to contribute?

Through its implementation and very rich dynamically collected data set of logs and records of use, QSIA offers a wide range of research opportunities including qualitative and quantitative assessment of: formation of online communities, the evolution of knowledge items markets, Transitional process from traditional learning to modern technology online-learning, and more.

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USING COLLABORATIVE LEARNING TOOLS IN A MULTI-INSTITUTIONAL APPROACH FOR TEACHING PROFESSIONAL ISSUES

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ABSTRACT

Collaborated learning management tools (CLMT) were used as part of the teaching and assessment process with a cohort of computer science students from three universities in Ireland, England and the USA in the area of professional issues (the legal, ethical and social aspects of computing). Students in the cohort used asynchronous communication tools to work in virtual groups to solve a moral/legal dilemma case study. They were originally assessed on a written report based on the content of their postings to a discussion board. Subsequently a framework for the assessment of critical thinking developed by Anderson et al (2001) was used to analyse the discussion threads produced by the same learners. This paper describes the nature of this study, discusses the use of computer-mediated communication (CMC) in the teaching and assessment of professional issues and reflects on the possible links between the use of CLMT in a collaborative learning situation and the development of higher order critical thinking skills in tertiary level students.

KEYWORDS

Collaborative learning, critical thinking, computer ethics.

1. INTRODUCTION

The development of critical thinking skills is one of the main objectives of university level education. One reason for teaching computer ethics, it could be argued, is that it is a way in which critical thinking can be developed. But there is a perennial question of how to measure whether the pedagogical methods adopted contribute to this development. It has been argued (Sotto, 1996) that what constitutes 'good teaching' in higher education is not well understood and how it relates to students' learning is a complex issue.

One method, which is often used, is the traditional essay/report where students are expected to provide evidence that they have met the learning outcomes for a particular unit of study. These learning outcomes are normally produced based on a specific taxonomy. For example, Bloom's hierarchy of learning objectives (Bloom et al, 1956) identified six levels of learning which represented increasing levels of cognitive complexity from the lowest level of Knowledge (or remembering) through Comprehension, Application, Analysis, Synthesis and Evaluation. Specific assessment tasks are then produced to measure the level of success students have in reaching particular learning outcomes.

In this study a different assessment method was used, namely getting students to work together in virtual groups using a collaborative learning management tool and then to produce a written report based on a moral/legal dilemma. There were a number of reasons for adopting this pedagogical approach.

At the University of Limerick (UL) an increasing numbers of students taking this module (130 in the last cohort) has raised significant management and pedagogical issues. For example how does the tutor ensure that students are working towards developing the concepts of personal and professional codes of ethical conduct (the dialectical process)? Are higher order learning outcomes (Bloom et al 1956) being achieved? Are learners developing critical thinking skills? Does the use of asynchronous communication as opposed to synchronous communication (e.g. chat rooms) encourage reflection.

However, a major driving force for the idea of international collaboration was the fact that students who had worked previously at UL in virtual groups did not feel they were involved in an authentic learning process. Feedback from an earlier study (Griffin 2001) indicated that the use of a CLMT would be more realistic if it actually allowed students who were not geographically co-located to work together.

In an attempt to deal with these concerns a Collaborative Learning Management Tool, Blackboard (www.blackboard.com) was used as part of the teaching/learning process.

2. MULTI-INSTITUTIONAL APPROACH

The study involved students from three institutions, University of Limerick in Ireland (UL), de Montfort University in England (DMU) and Sacred Heart University in the USA (SHU). It is the author's understanding that this is the first time a multi-institutional collaborative learning project in the area of computer ethics has been undertaken.

All three institutions offered a similar course to final year undergraduate students focusing on the ethical, legal and social implications in the design and use of computer systems. Central to the pedagogical approach adopted in all three colleges had been the use of group work in the teaching/learning process. The importance of working collaboratively is discussed below.

All three modules were similarly structured. Following a series of core lectures, where students are introduced to the main concepts in this area, students produce a group based written report based on a legal/moral dilemma scenario as part of their assessment. Throughout the module students meet face to face with module tutors in a tutorial setting as well as collaborating using synchronous and asynchronous tools. However, groups could only operate as functional units by meeting 'virtually'.

Due to there being smaller cohorts of students at DMU and SHU it was only possible to have seven groups in this study and it was decided that the groups would be comprised of 2 students from each institution. Students were told in advance that their postings would be analysed and their agreement to take part in this study was gained before the project began.

3. COLLABORATIVE LEARNING AND ASSESSMENT

The use of a problem based collaborative teaching/learning strategy has been shown to help develop deeper understanding of subject domains (Dukerich et al, 1990). Research also shows that teamwork encourages social facilitation, better learning and higher cognitive skills (Hiltz, 1994). As part of this module students have to work in groups to produce assessed solutions to a legal/moral case study.

One reason for assessing this part of the learning experience was to provide motivation to students to work collaboratively. As Fahraeus et al (1999) state "teachers motivate students to contribute ... by giving them credit for contribution". Students in this study were given a percentage of the total marks for individual contribution as well as achieving a grade for the group work.

Research has also shown that deeper understanding of moral dilemmas can often occur by working collaboratively (Peek et al, 1994) and that the collaborative approach to learning, supported by instructional technology can lead to deeper understanding and new knowledge creation. (Mäkitalo et al. 2001, Cravener, 1999, Harasim et al, 1995).

There are also practical advantages to using CMC, as it is easier to measure individual contributions than in face-to-face situations because an audit trail is created. This in turn makes it easier to deal with situations where some individuals gain more from the process than they input, a term that has been called 'free-riding' (Shepperd, 1993), as individual contributions can be identified.

4. COMMUNITY OF INQUIRY

Garrison et al (2001) have proposed a model, the Community of Inquiry as a "framework for analysing critical thinking in computer conferences". Using this model "deep and meaningful learning, ostensibly the

central goal of higher education, takes place in a community of inquiry composed of instructors and learners as the key participants in the educational process". The model proposes that by the interaction of three elements this learning takes place. These elements are social presence, teaching presence, and cognitive presence.

Teaching presence, focuses on the design and management of learning sequences, provision of subject matter expertise, and facilitating active learning. It does not refer the 'teacher presence' as the learners themselves can provide some of the foci.

Social presence is defined as the ability of learners to project themselves socially and emotionally in a community of inquiry. Garrison et al (ibid) describe this element as "having the function of supporting the cognitive and affective objectives of learning" Cognitive objectives are support by social presence "through its ability to instigate, sustain, and support critical thinking in a community of learners" while affective objectives are supported by "making the group interactions appealing, engaging, and thus intrinsically rewarding" which can lead to a more successful completion of units of study by getting the learner to become more involved in the whole process.

Cognitive presence is defined as "the extent to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication."

The research group which has proposed this model argues that it is a framework that can be used to analyse the effectiveness of CMC in "supporting critical thinking in higher education" Archer et al, (2000).

The application of the framework was used in this study in the analysis of cognitive presence to examine whether there is a link between use of the CMC and the development of critical thinking.

5. THE BLACKBOARD SYSTEM

The Blackboard (www.blackboard.com) Collaborative Learning Management Tool (CLMT) is an integrated set of web-based tools designed for the creation, management and use of a learning environment. Using the tools provided the following facilities: publication of learning materials (including links to module related websites); publication of announcements; collaboration using bulletin boards and chat rooms; communication tools such as email.

This tool enables a tutor to build up a course site with different types of learning materials. The tutor can also use a range of communication tools to assist with the management and assessment of the module. Students can share files and use communication tools to contact other students and the lecturer(s) either synchronously or asynchronously

Analysis of usage of the available tools following the completion of the module showed that the majority of users made most use of the collaborative part of the system. Table 1 shows the functional areas of the Blackboard system with the level of usage for each. (Note:usage is measured by the number of page hits and recorded automatically by the statistical analysis part of the Blackboard system.)

Table 1. Functional use of the Blackboard system

Function area	%
Content	47.1
Communication	30.34
Groups	21.65
Student tools	0.8
Total	

The Content functional area gives the level of use for accessing learning resources. The Communication and Groups functional areas show levels of use for cohort wide and group communications Student tools, such as the facility to create personal web pages were almost totally unused.

Within the Groups functional area four tools were available to users. Table 2 below shows the level of use of these tools and it can be seen that over 70% was for the group discussion board tool. Analysis of the postings to these boards is discussed in the next section.

Table 2. Details of usage of Group Pages tools

Area Name	%
Group Pages	15.61
Group Discussion Board	70.09
File Exchange	2.11
Email	0.66
Virtual Chat	Unused

6. ANALYSIS OF COGNITIVE PRESENCE

There are four categories in the cognitive presence element within the model of critical thinking and practical enquiry proposed by Garrison et al (2000) for the analysis of critical thinking. These are: triggering events, exploration, integration and resolution. (There is a fifth category to represent non-cognitive interactions such as arranging meeting times etc. This was not used in this study.)

Each category is defined using a set of descriptors. The following table shows the categories, their descriptors and indicators.

Table 3. categories for analysis of cognitive presence in community of inquiry

Category	Descriptor	Indicator
Triggering events	Evocative	Recognising the problem
		Sense of puzzlement
Exploration	Tentative	Divergence within community
		Divergence within single message
		Information exchange
		Suggestion for consideration
		Brainstorming
Integration	Provisional	Leaps to conclusions
		Convergence among group members
		Convergence within single message
		Connecting ideas - synthesis
Resolution	Committed	Creating solutions
		Vicarious application to real world solutions
		Defending solutions

Before using these four categories to analyse the data a further consideration needed to be given to the unit of analysis. This can be defined as the discrete element of data that enables text to be identified, categorised and recorded for analysis and there are a number of possible levels which can be used from syntactical units such as phrases, sentences and paragraphs to thematic units. Garrison et al (ibid) identified that the most appropriate unit of analysis was the messages as this combined "the flexibility of the thematic unit, which allows coders to capture a unit in its natural form, with the reliable identification attributes of a syntactical unit". In this study I have used the same unit of analysis.

6.1 Examples

Triggering

I think this is important, as it states exactly what we need to focus on... but I can't figure out the implications of this... please help! Do we just consider the situation BEFORE the bug was fixed?

Exploration

In the ten commandments on Computer Ethics by the Computer Ethics Institute, the following is rule number 7.

"Thou shalt not use other people's computer resources without authorization or proper compensation."

In the Scenario would this imply that the consortium were unethical as they made amendments to Entwhistle's product without authorization? What do you all think?

Integration

Okay, let me explain. Firstly to recap, what exactly is a patent?

"A patent is an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem."

Resolution

So far, this is how I have interpreted this thread...

We all agree that the consortium modified and distributed Entwhistle's patented product and as such they did break the patent. BUT we are arguing that the exception quoted above protects the consortiums actions and hence no breach legally took place.

7. RESULTS

Seven groups of students from the three institutions were established with 6 members in each. Each group submitted a written report for assessment based on the contents of the threaded discussions. Table 4 below gives details of each group's postings and the mark awarded for the written report.

Table 4. Analysis of postings

Group	Triggering	Exploration	Integratation	Resolution	Total Posted	Mark awarded %
1	3	28	36	7	75	60
2	3	21	51	7	82	78
3	5	35	54	18	112	75
4	1	12	8	1	22	50
5	3	8	3	0	14	36
6	6	31	9	10	38	56
7	10	22	13	3	48	52

The first column in shows the group numbers. This is followed by four columns indicating the number of each type of posting that were submitted for each group using the categorisation proposed by Garrison et al (ibid). Then the total number of postings for each group is shown. The final column in Table 4 shows the mark the groups were awarded for the legal/moral dilemma case study report. The scoring rubric for this is shown in Appendix A. Marking was carried out independently by each of the tutors and following some minor adjustments the marks listed above were agreed.

The data shows a broad correlation between the marks awarded and the occurrences of messages in the integration and resolution categories. Groups who received higher grades in recognition of their problem analysis and solution were assumed to have achieved higher levels of critical thinking. The results of the analysis of cognitive presence, and particularly the occurrence of messages in the integration and resolution categories, appears to correlate with the original marking scheme and points to the fact that there is a link between the use of this collaborative approach and the development of critical thinking skills. However, it is not clear that there is a definite correlation between the types of postings and the overall mark awarded by the tutors.

8. CONCLUSION

The data collected in this study appears to go some way to supporting the hypothesis that working collaboratively in virtual groups can contribute to the development of higher order critical thinking skills as measured by the Cognitive Presence framework. However in order to confirm this a further study is planned where the Moral Judgment Test (Lind 2001) will be used to measure improvement in moral reasoning and to examine what, in any, correlation might exist between this and the types of messages posted to the discussion boards as analysed using the cognitive presence measure.

During the study some other advantages of using the Blackboard CLMT were also been identified:

- Class management. The onus of forming groups, selecting topics and identifying slots for tutorials and presentations has been significantly eased. Posting of paper topics and reading questions were timely as were threaded discussions.
- Communication between instructor and student was greatly enhanced with the use of the discussion board and course announcements
- Inter- and intra-group collaboration took place and the system enabled these to be observed by the instructor, who could join in discussions as required
- The virtual chat tool enabled virtual tutorials to take place thus facilitating involvement for students who had difficulty always attending on campus.

However, these were some of the problems that were encountered:

- Participants were attaching all their documents until they learned to use the file exchange.
- Some participants wanted synchronous communication using Chat, which was difficult because of the time differences.
- If participants used instant messenger, it was impossible for the instructors to know this or to track the groups, so its use was discouraged.
- Different school holiday schedules

Father research is currently being carried out with a multi-cultural element. In this study students from non-western cultural backgrounds are also part of virtual groups. It is hoped that by the IADIS International Conference e-Society date further results will be available from this study. The author is also anxious to work with students and faculty from Asian institutions.

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Appendix A

Scoring Rubric

Objective	Unsatisfactory	Satisfactory	Meets Expectations	Above Average	Exceeds Expectations
Students will be able to demonstrate effective communication skills and solid ethical reasoning: Writing ethics papers	<=39%	45%	55%	65%	75%
Purpose <ul style="list-style-type: none"> ▪ <u>Focus</u> ▪ <u>Significance</u> (shows an awareness of main ideas) • <u>Assignment topic</u> 	Objective not clearly stated, paper lacks central focus Lack of awareness of main ideas or wrong interpretation of main ideas Doesn't write on topic	Satisfactory attempt at stating the objectives and focusing the paper. Covers basic subject matter adequately but insufficiently analytical. Some irrelevancies/ omissions evident	Objective adequately stated paper has central focus Some awareness of main ideas and some critical analysis Mostly sticks to assigned topic	Objective clearly stated, paper has good central focus Good awareness of main ideas. Clear evidence of critical judgment Meets all assignment criteria	Objective very clearly stated, paper has strong central focus An authoritative grasp of the main ideas, significant originality and insight Exceeds all assignment criteria, giving significant originality and insight
Discussion Contributions <ul style="list-style-type: none"> ▪ <u>Structure</u> (Individual Postings) ▪ <u>Coherence</u> (Group Discussion) ▪ <u>Paragraphing</u> (transitions f/one idea to next) (Group Discussion) 	No clear structure or pattern to contributions. Irrelevant postings that do not add to/further the debate. Entire discussion lacks clarity; story lacks coherence overall. Lack of transitions between ideas	Covers the basic subject matter adequately and is appropriately organised. Attempts to further the debate. Some limitations in the ability to select and present relevant material in a coherent way. Some attempt at transitions between ideas posted	Adequate structure or pattern evidencing ability to structure and organise arguments. Adds to the debate and evidences some individual reading and research. Discussion is generally clear; coherent overall Adequate transitions showing some evidence of extending the discussion	Clear evidence of critical judgment in selecting, ordering and analysing content. Good contribution to the debate supported by relevant references. Discussion demonstrates some ability to synthesise material. Good transitions evidencing good awareness of the issues to be addressed and the contributions of the group	Clear structure or pattern. Material synthesised effectively. Excellent contribution to the debate fully supported by relevant references. Entire discussion is very clear; story is very coherent Excellent transitions evidencing thorough research and critical evaluation of group contributions.

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<p>Organization</p> <ul style="list-style-type: none"> ▪ <u>Audience</u> ▪ <u>Introduction and Conclusion</u> 	<p>Inappropriately targeted.</p> <p>No clear Intro and/or Conclusion</p>	<p>Some awareness of audience evidenced.</p> <p>Satisfactory attempts at providing an Introduction &/or Conclusion</p>	<p>Guides reader</p> <p>Clear Introduction &/or Conclusion provided</p>	<p>Shows a good awareness of audience</p> <p>Good Introduction & Conclusion that reveal insight and some originality</p>	<p>Knows audience</p> <p>Strong Introduction & Conclusion evidencing critical/analytical thinking</p>
<p>Evidence</p> <ul style="list-style-type: none"> ▪ <u>Accuracy</u> (statements) ▪ <u>Support</u> (opinions are adequately supported) ▪ <u>Documentation</u> ▪ <u>Counterarguments</u> ▪ <u>Social/Ethical Analysis</u> 	<p>Sources are inadequate Inaccurate statements made.</p> <p>Lack of support for statements/opinions</p> <p>No sources identified in the body</p> <p>Missing counterarguments</p> <p>Doesn't make use of ethical & social analysis and theories</p>	<p>Sources adequate. Some minor inaccuracies.</p> <p>Satisfactory attempt to support opinions</p> <p>Some sources are identified and referenced appropriately in the body</p> <p>Counterarguments presented but not fully analyzed</p> <p>Minimally & unconvincingly uses ethical & social analysis and theories</p>	<p>Most statements are accurate.</p> <p>Adequate support for statements/opinions</p> <p>Most sources are identified and referenced appropriately in the body</p> <p>Counterarguments presented,</p> <p>Makes good use of ethical and social analysis and theories</p>	<p>Statements are very accurate</p> <p>Good support for statements/opinions</p> <p>All sources are identified and referenced appropriately in the body</p> <p>Counterarguments presented and some analysis undertaken</p> <p>Uses ethical and social analysis and theories convincingly.</p>	<p>Statements are very accurate</p> <p>Strong support for statements/opinions</p> <p>All sources are identified and referenced appropriately in the body.</p> <p>Counterarguments strongly presented and analyzed</p> <p>Critically evaluates and uses ethical and social analysis and theories convincingly.</p>
<p>Mechanics</p> <ul style="list-style-type: none"> ▪ <u>Sentence structure</u> (grammar, sentence structure, spelling, punctuation) ▪ <u>Appearance</u> (Paper, References) 	<p>Many errors in grammar, spelling, and/or punctuation. Mechanics interfere with reader's understanding of the text</p> <p>Poor appearance of Paper, No References included or References incorrectly laid out.</p>	<p>Acceptable standard of grammar, spelling and punctuation.</p> <p>Acceptable appearance of Paper, References included and correctly laid out.</p>	<p>Few errors in grammar, spelling, and/or punctuation. Minimal distraction.</p> <p>Good appearance of Paper, References included and correctly laid out.</p>	<p>Good use of grammar, spelling, and punctuation. Clear mechanics.</p> <p>Very Good appearance of Paper, all References suitably included and correctly laid out.</p>	<p>Excellent grammar, spelling, and punctuation. Clear mechanics.</p> <p>Excellent appearance of Paper, all References presented in standard, consistent format.</p>

Comments:

WEB-MULTICAST CHAT SYSTEM FOR COLLABORATIVE LEARNING

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ABSTRACT

Due to the increasing numbers of student in the universities and the limited tools to support the lectures, the individual student is receiving less guidance, which results in either a longer study time or a lower quality of their education. In this paper, we are concerned with the use of Information Technology especially the use of World Wide Web (WWW) in education to improve the learning efficiency. We present the use of a Web-multicast chat system as a prototype to improve the learning process for a large number of students. Web-multicast is a concept that uses a standard Web-browser to communicate between multiple users. The web-browser uses the multicasting method, and no Web server is needed for the communication. The system has the advantages of availability, portability, familiarity, scalability, and performance. This paper describes the extended three-tier architecture, the system implementation and performance results.

KEYWORDS

Multicast, World Wide Web, Web browser, multi-users, CSCW, collaborative learning.

1. INTRODUCTION

According to Encarnao et al. (1998), in order to meet the requirements of our society, increasing numbers of students are populating the universities. Due to high personnel costs for both educators and students, education at universities has become a very expensive task for society. Presently, students are confronted with stagnating numbers of educators. Furthermore, most of the education is based on teaching and learning in large classes, using paper, chalk, transparencies, some slides, a few videos, and nearly no animation and simulation. Books, articles, conferences, and proceedings, are used to exchange and distribute the knowledge. Learning in groups is limited by the amount of personal tutoring support that is affordable. As a result, the guidance for the individual student is lower than before, which results in either a longer study time or a lower quality of their education.

It is time to improve teaching and learning efficiency. To improve teaching efficiency, more effective teaching support for the lecturers is needed. Increasing learning efficiency means better learning tools by providing better support for lecturers, by using better media for knowledge transfer, by profiling learners in order to serve them individually, or by providing a wide spectrum of learning scenarios including group work; the quality of studies can be increased and their length shortened.

We are concerned with use of Information Technology especially the use of World Wide Web (WWW) in education to increase the learning efficiency. WWW offers an attractive platform for developing collaborative applications for education. Although WWW technology is insufficient in several areas (stateless server/client architecture, and insufficient support for synchronous communication) (Chiu and

Griffin, 1995), it has the potential to become the primary infrastructure for network computing. This fact is supported by the plethora of several tools, commercial or not, implementing various features needed by an environment for collaboration. Well-known tools are Microsoft Netmeeting, Netscape Conference, Lotus Notes, and Novell Groupwise. In this paper, we present the use of a Web-multicast chat system as a prototype system to improve the learning process in a large number group of students.

The system has the advantages of availability, portability, familiarity, scalability, and performance. Web-multicast is a concept that uses a standard Web-browser to communicate between multi-users. The web-browser uses the multicasting method, and no Web server is needed for the communication. The system was developed using the Java language. The system implements hybrid architecture (client/server and peer-to-peer). Client/server architecture is used for user authentication and to "join" a session, and peer-to-peer architecture is used for chat communication. The benefit for this system is multiple diverse users can be connected without need of a Web-server. This paper also describes the extended the three-tier architecture, the system implementation and performance results in following sections.

2. RELATED WORKS

In this section, we briefly review several related works that use multicasting on web browser for different applications.

The Multicast Backbone (MBone) (Erikson, 1994), the set of multicast-capable routers on the Internet, provides the infrastructure for efficient multipoint data delivery in the Internet. mMosaic (Dauphin, 1996) was one of the first tools for sharing web documents over the MBone. mMosaic is based on a modified version of the NCSA Mosaic browser, which processes incoming resources and multicasts them along with formatting instructions.

WebCanal (Liao, 1997) is a proxy-based synchronous browser program written in Java. Changes in the current URL displayed by the master browser are detected by a proxy, which parses files to identify inline image, and transmits the data to the set of receivers. Since WebCanal operates only as a proxy, local control operations (such as Back and Forwards browser commands, and loading of local files) present difficulties.

mWeb (Parnes et al., 1997) is an ongoing project that uses the web browser as a multimedia slide presentation medium. mWeb is similar to WebCanal in that it is proxy-based and uses IP multicast to distribute web resources.

Shin (1997) has extended the World Wide Web architecture to include protocols, addressing scheme, and page format to merge multicast capability into the Web using the HotJava protocol handler. Previous work has been extended by Shin and Lee (1998) and Shin et al. (1998) by integrating other protocols to allow Web users to join a session and receive audio/video seamlessly.

Although, much work has been done with Web browsers, most has concentrated on real-time stream transmission using multicasting on the WWW. Little discussion has been found using the Web browser for cooperative work, especially in a learning environment. Thus, this paper has developed a prototype system of a Web-multicast browser or Web-multicast Chat System to increase efficiency in a learning environment.

3. ARCHITECTURE

3.1 Web-multicasting Architecture

A three-tiered architecture is normally used for most of the Web-servers (Bouras et al., 2000). However, the architecture is not suited to collaborative web-multicasting because the three-tiered architecture only supports client-server communications. This paper extends the three-tiered architecture, so that it also supports multicasting communication between clients directly without referring to the web-server. Figure 1 shows three levels of the extended three-tiered architecture. In the first level, clients use Web browser to access a "join" page on a Web-server to join the group discussion session either remotely or locally. The users need to enter their login and password as the authentication for the group session. The authentication is required because in a learning process only certain students are allowed to join the class. Once the users have been

authenticated, they can communicate with other students without referring to the Web server again. In the second layer, a Web server provides response to client's requests during the joining phase. The CSCW application prototype resides on the Web server. The client does not need a copy of the CSCW application on their local machine to join. In the third layer, a database and file system are responsible for providing the response to the request from the Web server, during the joining phase. During joining, a copy of the CSCW application is transferred from server to the users' local machine. Once joining is complete, only layer 1 is required for full communication.

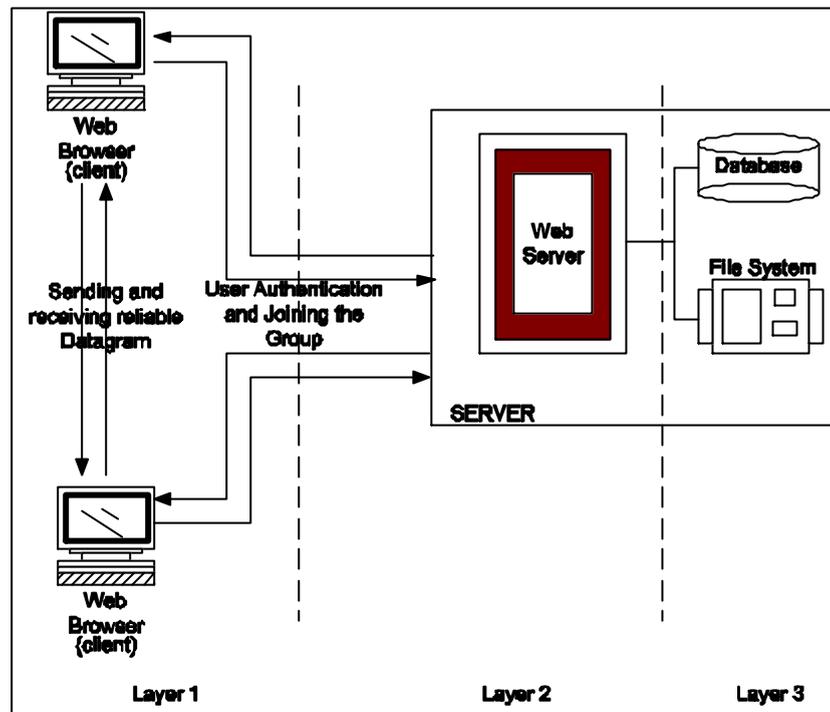


Figure 1. Extension for Three-tier Architecture

The benefits for the extended architecture are:

- Reduced bandwidth consumption on the link from the server to the network.
- Reduced bandwidth consumption within the network as a result of the bandwidth aggregation inherent in IP multicast routing.
- Reduced server processing since the server will maintain fewer and shorter TCP connections with individual clients

3.2 Protocols

Amongst the multicast protocols that exist, there are several in particular that deals with scalability, reliability, real time constraints, quality of service, and session management. There a number of multicast protocols such as Hierarchically Partitioned Reliable Transport Protocol (HPRTP) (Chen, 1999), Real Time Streaming Protocol (RTSP) (Columbia et al., 1998), Scalable Reliable Multicast (SRM) (Floyd et al., 1997), Real Time Transport Protocol (RTP) (Schulzrinne et al., 1997), Real Time Control Protocol (RTCP) (El-Marakby and Hutchison, 1998), Session Announcement Protocol and Session Description Protocol (SAP/SDP) (Shin and Lee, 1998), and Light-weight Reliable Multicast Protocol (LRMP) (Liao, 1998).

In our prototype, requirements to ensure the data are transferred without error and with acceptable speed for the collaborative learning are considered. LRMP (Light-weight Reliable Multicast Protocol) (Liao, 1998) is one of the protocols that meets this requirement. It also has a number advantages such as reliable and source ordered data delivery service for group communications, no prior configuration and no router support are required by providing a random expanding probe scheme that is used for local error recovery, it works

in heterogeneous network environments and support multiple data senders, and provides a flow and congestion control mechanism to fairly share the network bandwidth with other data flows.

4. IMPLEMENTATION AND RESULTS

4.1 Prototype Implementation

The prototype has been developed using the Java programming language to take advantage of its platform independent capability. Developing applications using multicast technology disassociates it from the need of a central server, thus preventing the situation of paralyzing the whole system when the server breaks down. The prototype uses the LRMP protocol for multicast environment.

The users need to access a Web-server for joining the group discussion. It is advantageous to allow the diverse users to join the discussion from anywhere. The users also can be connected without accessing the Web server by having the application inside their PC. Since the application was built using the Java language, so it has the advantage of being executable from any platform. Once the users are connected, they can communicate each other. Figure 2 shows the user name entry and Figure 3 shows the appearance of the Web-multicast Chat System.



Figure 2. The User Session

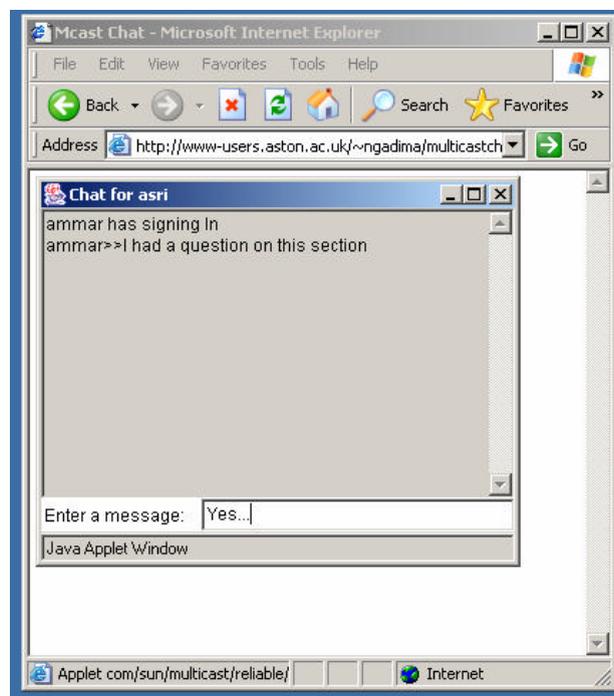


Figure 3. The User Interface on Web-browser

4.2 Some Results

The prototype is tested in order to test the efficiency of Web-multicasting to the collaborative learning. All the testing has been done using Windows 98 SE operating system and Internet Explorer. A number of machine between 10 to 20 PCs with speed of 500MHz and 750MHz have been used. Each result is recorded from the average of five readings.

The purpose of the testing is to show what factor will effect the response time to the end-user as a client of a collaborative learning. Some factors that can affect the performance are:

- size of the data sent
- number of recipient
- computer capabilities on client includes PC speed, cache and RAM space
- network traffic

In this paper, we only consider datagram size and number of recipients. The factor has been chosen because these factors can be controlled more easier in the collaborative learning environment either by limiting the participant or limiting the size of the data being sent.

According to (Steinmetz, 1996), there are three different categories of time delay that being acceptable for most applications:

- For video and audio of a person speaking (lip synchronization) must be presented within 80 milliseconds.
- For synchronization time -dependent (audio/video) must be presented within 250 milliseconds.
- For time-independent (text/graphics) media must be presented within 500 milliseconds.

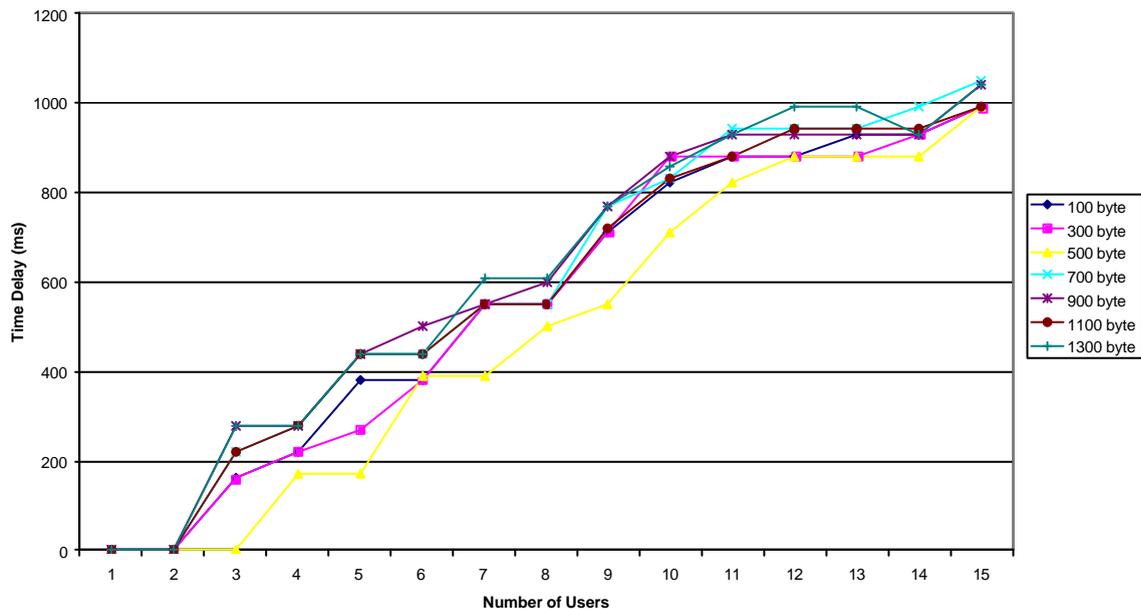


Figure 4. Time Delay vs. Number of users with different datagram size

Figure 4 shows the effect of number of users on the time delay with different datagram size. It shows that the delay time is increasing with the increasing number of users. The graph also shows that the size of datagram does not have much effect on the time delay at receivers. The datagram size that tested is up to 1300 bytes. This size is approximately equal to 160 words. In chat system, the messages are normally small and 160 words are reasonable for the testing.

As mentioned before, the acceptable time for the text transmission is within 500 ms. Based on this range, the result shows only within seven users will give an efficiency to the chat system. The testing assumes all

users are communicating at the same time. This will normally not be the case, so the system will function within acceptable delays.

5. CONTRIBUTION TO THE COLLABORATIVE LEARNING

The advantage of having a collaborative learning environment is well known. A usual learning process can be in a form of discussion, lecture, or presentation between students and students or between a teacher and students. By collaborative learning, the learning processes become more efficient and easier for both teacher and student. The use of computer technology is useful to enable the collaborative learning more efficient.

This paper was proposed a method using Web-multicast to implement CSCW application in collaborative learning. A CSCW application prototype called a Chat System has been chosen to test the ability of Web-multicast to provide the collaborative learning. The application was tested in different environment such as Local Area Network, and small Wide Area Network that involves two or three different networks. The objective of the test is to get a performance result of latency and response time. While other objectives such as availability, portability, scalability, and familiarity are obtained by testing the application in different platforms, browsers, and number of users. The performance issue is crucial because an application that gives high delay and late response times, the users will leave unsatisfied and this will lead to the application's failure.

From the test result, it shows that the Web-multicast method has potential, particularly with modern faster machine to provide an alternative collaborative learning implementation. A number of advantages for the collaborative learning can be pointed out from the test are:

- Application Advantages:
 - A student does not need to install the application in their PC, he/she just accesses the Web server to join the group discussion or class and the application is automatically downloaded; and can leave the group any time they want.
 - The application is web based and no requires a special training to use it.
 - The student can use the application in any platform.
- Network Advantages:
 - The performance of Web-multicast communication is adequate for collaborative work.
 - Size of the data being sent is appropriate to the collaborative work.
 - The server can fail and work can continue among those who have joined.

As a summary, Web-multicast gives the advantages of availability, portability, familiarity, scalability, and performance to the collaborative learning.

6. CONCLUSION AND FUTURE WORK

In this paper, we are concerned with the use of Information Technology especially the use of World Wide Web (WWW) in education to improve the learning efficiency. Due to the increasing numbers of student in the universities and the limited tools to support the lectures, the individual student is receiving less guidance, which results in either a longer study time or a lower quality of their education. We present the use of Web-multicast as an alternative way to improve the learning process in a large number of students.

We present the use of Web-multicast chat system as a prototype to improve the learning process in a large number of students. Web-multicast is a concept that uses a standard Web-browser to communicate between multi-users. The prototype has been developed using Web-multicast to test the suitability of Web-multicasting for CSCW applications. This paper has proposed extension to the three-tier architecture to be used for the application.

Some experiments have been done to test the implementation of a CSCW application in Web-multicast. The experiment also has carried out with the performance testing that shows the crucial issues in this paper i.e. receiver delay in Web-multicasting for multiple users. The test has been done on Pentium III with speed 500MHz and 750MHz that run Windows 98 SE operating system and Internet Explorer. The test is done within 15 users in a Computer Lab. In performance testing, two features are tested i.e. effect on time delay by

data size and client size. From the testing, it shows that the delay time is increasing gradually with the increasing number of users. But, the size of data does not give much effect on the time delay at receivers.

From the test result, it shows that the Web-multicast method has a potential to provide an alternative to the collaborative learning implementation. A number of advantages for the collaborative learning can be achieved by implementing in the Web-multicast environment such as provide an easy an environment without need training, can be used in any platform, and give an adequate performance.

As a summary, Web-multicast gives the advantages of availability, portability, familiarity, scalability, and performance to the collaborative learning. In future work, this method can be used to implement the collaborative work for wider spectrum such as using different data types as a mean of communication, for example using video, audio, simulation, and images.

ACKNOWLEDGEMENT

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SPECIFICATIONS OF A MOBILE ELECTRONIC VOTING SYSTEM AND A MOBILE AGENT PLATFORM

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ABSTRACT

This paper provides the specification of a mobile electronic voting system (MEVS) using Mobile UML [1]. We also introduce a new platform for the management of mobile agents that supports security and fault tolerance. The platform is used to develop the MEVS. Using the platform's APIs, other mobile applications can be efficiently developed and deployed on the internet.

KEYWORDS

Fault-tolerant mobile platform, Mobile electronic voting, Mobile platform, Mobile UML.

1. INTRODUCTION

A mobile agent is a software component that is able to move across computer systems at which it can execute the code it carries [3]. Typical applications of mobile agents include electronic commerce [4, 5], network management, computer games [6], and collaborative processing applications among others. Furthermore, a family of computer applications in electronic government can be suitably carried out using a combination of mobile and stationary agents, reducing network traffic by allowing the least number of interactions across platforms. An example of such application is electronic voting.

Mobile agents are created by a distributed application at a computer site and launched to another site using an underlying mobile agent platform. An instance of the platform running at the remote site can receive the mobile agent and dispatch it to the distributed application running at that site. There are already some existing platforms like Aglets, Concordia, and Odyssey [6]. However, none of these platforms take care of two important aspects needed in mobile applications, that is, security and fault-tolerance, in addition, these platforms are not interoperable. Those aspects are of greater importance and relevance in applications requiring a higher degree of privacy, authenticity and reliability such as electronic voting.

In mobile electronic voting, voters will be able to securely publish their votes on their computers, and a mobile vote collector agent in coordination with a stationary vote manager would visit each of the voters site and collect their encrypted and authentic published vote.

In this work, we report on our experience in: 1) developing a prototype platform for mobile agents, and 2) developing the MEVS that uses the developed platform. Our platform considers the guidelines described by the Foundation for Intelligent Physical Agents (FIPA) that allows the interoperability between agents running on different agent platforms [2]. Our platform specifications provide the application developer with an application programming interface (API) that allows the launching of mobile agents with two optional features, security and fault-tolerance. Using our API, new mobile applications can then be efficiently developed and deployed on the internet.

The rest of the paper is organized as follows. Section 2 describes briefly the functionality of the mobile agent platform. Section 3 describes the MEVS that uses the mobile platform. This application is specified using Mobile Unified Modeling Language (M-UML). Finally, we conclude the paper and discuss some future extensions to this work.

2. MOBILE PLATFORM SPECIFICATION

This section describes the Mobile Agent Platform (MAP), its sub-modules, and its upper and lower interfaces. Two types of applications will be executing on the top of the MAP layer, namely, user applications like games, and management applications. Mobile Agent Applications (MAA) are responsible for requesting the creation and managing the participation of mobile agents involved in the mobile application. Platform Management Applications (PMA) are programs responsible for the overall supervision control and administration of the mobile platform. The MAP layer consists of several modules: the Agent Management System (AMS), the Agent Registry (ARg), the Agents Repository (ARp), the Security module and the Fault Tolerance module. This layer design conforms to the design recommended by the Foundation for Intelligent Physical Agents (FIPA) platform specification. Figure 1 shows the MAP layer and its lower and upper interfaces, in addition to the intra-layer interfaces. In this paper, we refer to MAP's upper layer interface as the Application Programming Interface (API). Figure 2 shows the structuring of the AMS within the MAP.

The functionalities of each of the MAP interfaces are described and their input and output specifications are listed. A complete M-UML specification and design of the platform is provided in [8].

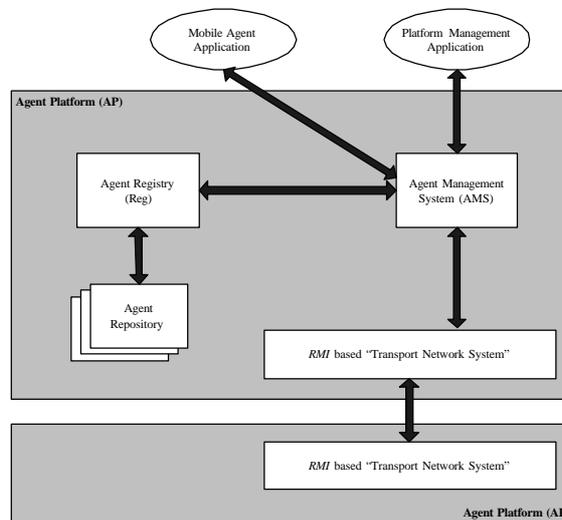


Figure 1. The MAP, its sub-modules and its upper and lower interfaces.

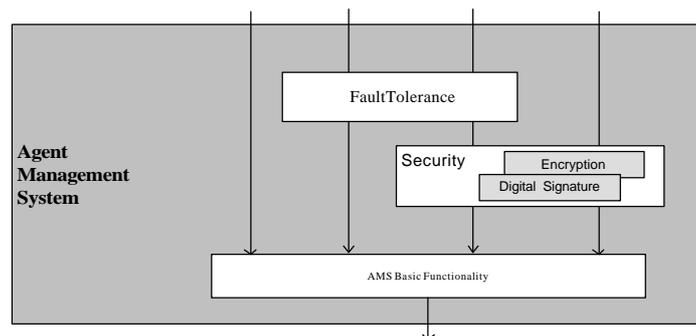


Figure 2. Structure of the AMS.

3. MOBILE ELECTRONIC VOTING

In this section, we first provide a brief informal description of mobile electronic voting system (MEVS) that uses the MAP specified in Section 2. Then, we specify the MEVS using M-UML.

3.1 Brief description

MEVS consists of several interacting agents, the Vote Collector, the Vote Manager, the Vote Authority, the Candidate, and the Voters. The Vote Authority (VA) is responsible for registering candidates for elections and commissioning Vote Managers. The Vote Collector (VC) is a mobile agent mandated by a stationary Vote Manager (VM) agent to collect votes from stationary voting agents (VOs). Because of its hierarchical tree-structure, the system can be easily expanded to have more VMs and more VCs dealing with one VM. Prior to the election, voters will have to register themselves with the VA, and those interested candidates would also register themselves with the VA. The lists of candidates and voters are sent by the VA to the VMs, which in turn send them to their registered voters via their assigned VCs. Once the candidate list is received by a VO, the VO will instantiate its stationary agent with a voting choice. On election time, Each VC will visit the VOs on its list and get their votes, and once done, they return back to their base station reporting to the VM the votes collected from the available voters. The VM will then dispatch the results of the votes to the VA. Finally, the VA informs the VMs and the voters of the official results.

The messages that are exchanged and carried over the network during the progress of this voting procedure are both encrypted and carry a digital signature. Only the VA is able to decrypt and authenticate the votes received from the VMs.

3.2 M-UML specifications

In this section, we will describe the basic specifications of the MEVS using M-UML. Due to the limited space, we will only provide the use case, sequence and statechart diagrams.

3.2.1 Use case diagrams

In the following, we show three basic use case diagrams needed for the registration, vote collection and termination of the voting process. Four use cases are used to support the voter and candidate registration (Figure 3). Voters and candidates have to register themselves with the Voting Administrator (VA). The Vote Administrator (VA) will initiate the voting process by sending the voters and candidates lists to the Voting Managers (VMs) which in turn send them to their respective Vote Collectors (VCs) (Figure 4). Finally, the use case diagram in Figure 5 shows the vote collection and reporting process, in which the VC collects votes from voters (VOs), then forward the votes to the VM which in turn forwards it to the VA. The VA verifies the votes and deliver the results to the VMs, voters and candidates. These diagrams show only the VC as the only mobile actor in the electronic voting model.

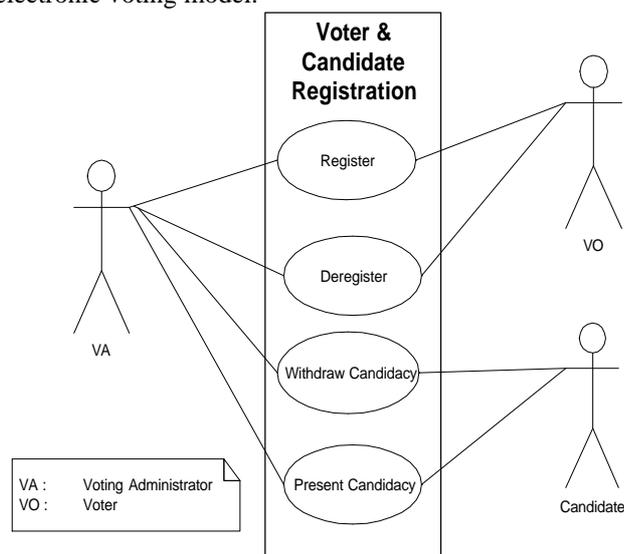


Figure 3. Use case diagram for voter and candidate registration.

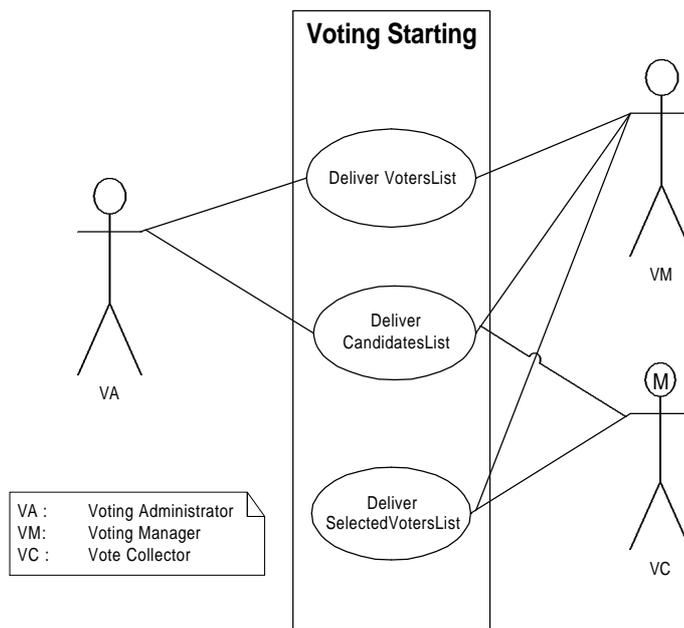


Figure 4. Use case diagram for the voting.

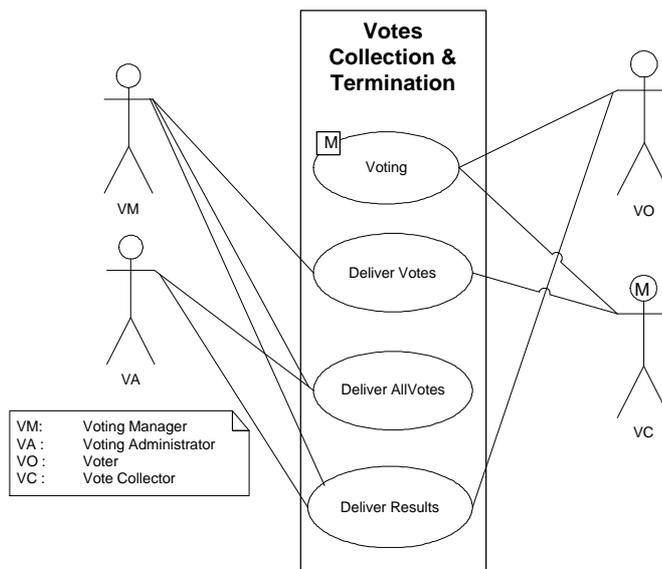


Figure 5. Use case diagram for vote collection and termination.

3.2.2 Sequence diagrams

Figure 6 shows a sequence diagram describing an optimistic scenario in which all the phases of initiating the voting process, and vote collection and termination are involved.

Additional non-functional requirements are provided by the MAP and are to some extent application-independent. In the following, we show one sequence diagram related to the application fault-tolerance. Figure 7 shows the behavior of the VC when a voter’s platform is unreachable (i.e., is down). Finally figure 8 shows the behavior of the VM when a VC is lost.

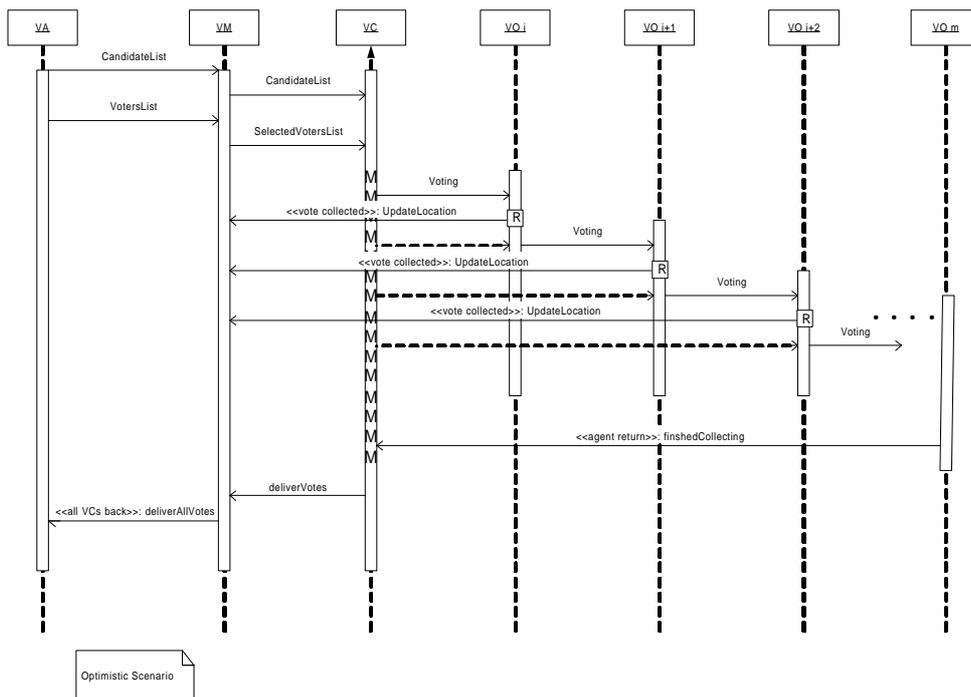


Figure 6. Sequence diagram for an optimistic scenario for the voting process.

3.2.3. Statechart diagrams

In the following, we show three statechart diagrams in Figures 9-12, describing the behavior of each of the agents involved in the voting, namely, the VA, VC, VO and VM.

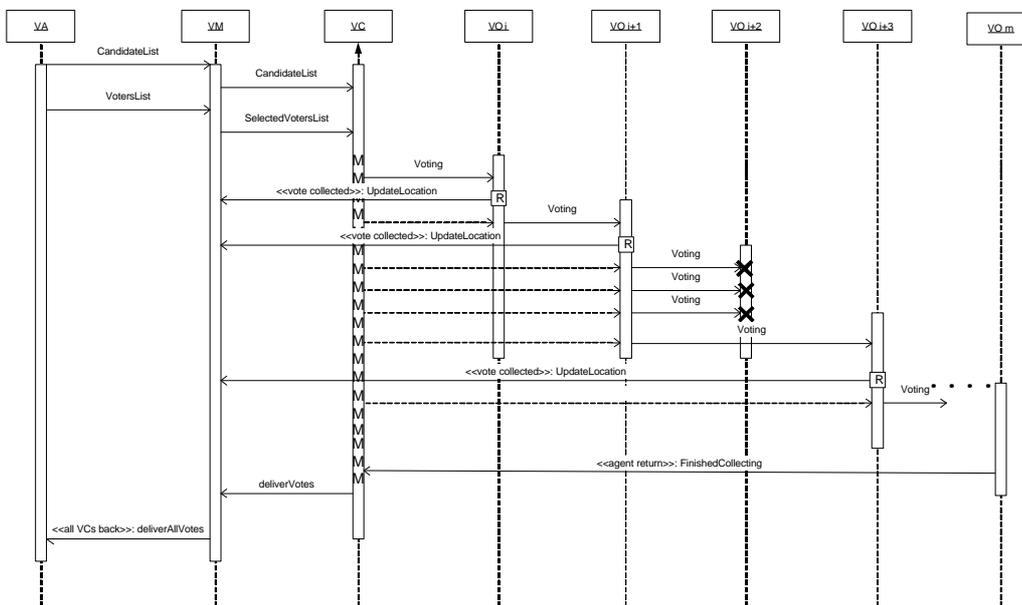


Figure 7. Voter's platform is down.

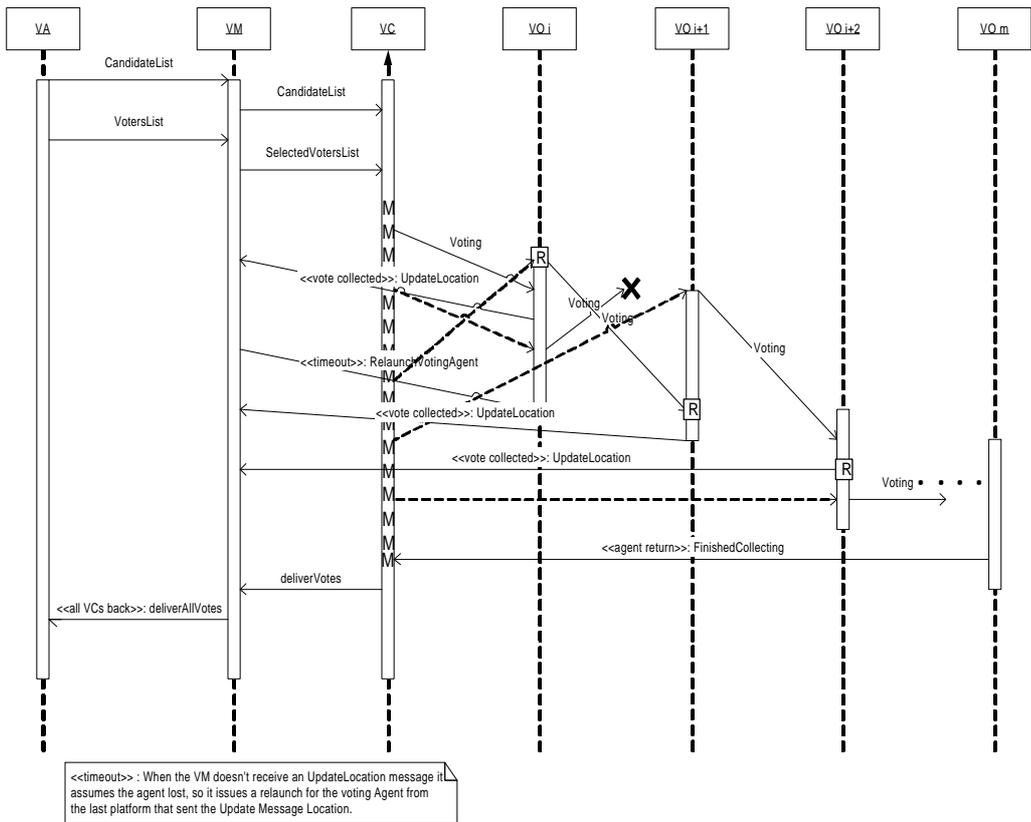


Figure 8. VC agent is lost

<<voting started>> / Vmi.DeliverVotersList, Vmi.DeliverCandidateList
 VO.Deregister / VO.RemoveVoter
 VO.Register / VO.RegistrationConfirm
 Candidate.PresentCandidacy / Candidate.CandidacyConfirm
 Candidate.WithdrawCandidacy / Candidate.RemoveCandidate
 Vmi.DeliverAllVotes / Vmi.DeliverResults, VO.DeliverResults



Figure 9. VA's statechart.

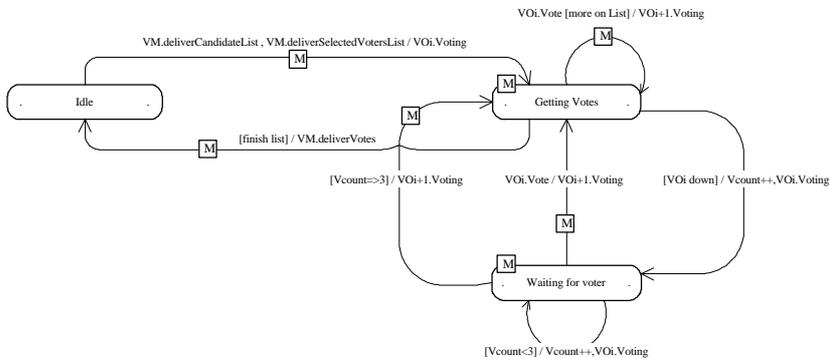


Figure 10. VC's statechart.

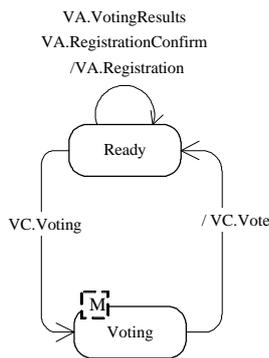


Figure 11. VO's statechart.

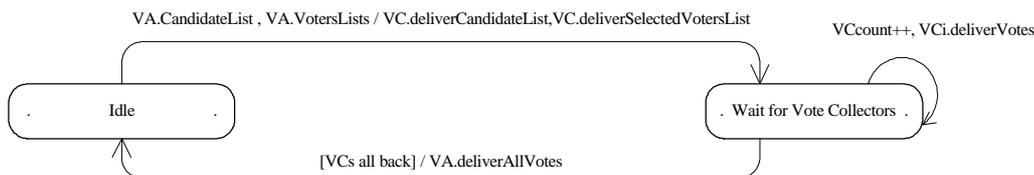


Figure 12. VM's statechart.

4. CONCLUSION AND FUTURE WORK

In this paper, we have described the specification and architecture of a mobile agent platform for launching and controlling mobile agents created by mobile agent-based software applications. We have then described using M-UML a mobile agent-based electronic voting application that takes advantage of the mobile platform. Various fault-tolerance and security issues are delegated to the platform itself, therefore relieving the application designer from accommodating these features in the application design itself. This approach allows for the easy development and deployment of mobile applications. In the future, we plan to experiment with different application categories, such as mobile games and mobile e-commerce, in which more agent mobility is present. This will allow us to examine the robustness of our platform under various application scenarios.

ACKNOWLEDGEMENT

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A NEW APPROACH TO E-INSURANCE BROKERING

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ABSTRACT

The insurance industry appears to be lagging in the rapid evolution of financial services and e-commerce, as it faces strategic challenges in utilising the Web. The majority of insurers continue to build sites that are structured on a corporate orientation rather than customer needs. Customers are left on their own to figure out where they should find useful information.

In this paper we propose an agent-mediated insurance brokering system using a flexible negotiation model that includes multi-attribute bidding as well as some kind of learning capabilities. Moreover, in the core of the provided brokering facility, we are using conceptual clustering procedures as an approach to better match customers and insurance product offers, providing a valuable add-on to both customer's and sellers' sides. Particular attention is paid to the interpretation of the generated communities. For this purpose, we use a metric to identify the representative insurance product configuration of each community.

To improve broker's bid evaluation we propose the construction of the customer's profile, reflecting its preferences on the attributes of an insurance product.

KEYWORDS

Brokering, Multi-criteria negotiation, customer communities, stereotypes, profiles

1. INTRODUCTION

Despite e-commerce's huge impact on business in general, the insurance industry has yet to fully embrace it. The insurance industry faces several obstacles to e-commerce, including customer attitudes, complex insurance policies, state regulations and the traditional agency distribution system. However, with the rapid growth of information technology infrastructures, online insurance offers immense opportunities for insurance companies.

The success of the sale of an insurance policy depends on how good the requirements of the insurer have been matched with the terms of the policy. In the conventional insurance industry, the insurance company initially informs its customers through advertisements. Advertisements are made either through passive channels like newspapers, magazines, billboards, radio and television, or through active channels like human insurance agents. E-insurance employs the Internet to reach customers through advertisements more effectively since it integrates the traditional passive and active channels of advertisement into one. Advertisement banners, e-mail notifications and coupons are used to replace passive media, while software agents can replace their active human counterparts.

However, it's a much difficult task to match the insurance requirements of a customer with appropriate financial complex products than, for example, finding those shops that sell a specific book. An insurance policy has benefits, conditions and exclusions that add detail to the high-level coverage features advertised by the insurer.

The system BIAS (Brokerage for Insurance - an Agent-based System) described in this paper presents a new approach to insurance products brokering and has the potential to improve the quality of customer service by ensuring that individual customer needs are reflected in the products offered.

2. THE CURRENT STATE OF ONLINE INSURANCE

Despite the increasingly rapid advances made in computer technology, companies in the insurance industry are making the most use of the new technical possibilities offered today in their internal operations only, while hardly employing them at all when negotiating with their customers. A recent comparative study of 25 web-based Internet sites offering comparative term life insurance information from Consumer Federation of America has showed us that not all sites are useful for getting quotes. Some of them are too difficult to use and others are little more than referral services where the customer is put in touch with a human agent, something that customers, most of the time, do not need the Internet to achieve. Several of the exiting quote services do not include no commission insurance companies, because many of this sites make money through commissions on sales and do not show this companies in their service since it would reduce their incomes [Hunter and Hunt, 2001].

Most web sites offering online quotation and purchase of insurance products are implemented by insurers and sell directly to the customer, excluding the broker. Brokers, however, provide a valuable service and are widely used by customers. Yet, online brokerage is rare.

Those sites, which do offer a brokerage service, do so by drastically simplifying the problem: they standardise the products which insurers are permitted to offer through the site. The broker's role is then reduced to collect a standard set of information from the customer and negotiate standard coverages. This gives no advantage for any of the players because:

- Customers are provided with a more limited choice of products, which may not meet all their requirements.
- Insurers have limited flexibility in product design, targeting and pricing.
- Brokers lose their traditional role.

3. AGENT MEDIATED INSURANCE BROKERAGE

3.1 Our Proposal

It is our belief that intelligent agents are well suited to deal with the insurance brokering problem in a distributed manner. By configuring a society of intelligent agents, each one charged with autonomously carrying out different specific functionalities, the insurance broker system will not only be able to analyse products being offered, but will also deduce useful information regarding the current state of the market.

In [Nogueira and Oliveira, 2003] we have presented a distributed, intelligent agent-based system, making it possible the electronic commerce of insurance products. Our approach for an agent-based insurance products assisted electronic market includes an agent representing each of the insurers, an agent representing the customer and a broker agent for intelligent brokering services. Each insurer has full ownership of its agent, ensuring that all strategic information remains confidential. The goal is to support distribution of a full range of insurance products from several different insurers without the need to modify or constrain them in standard rigid formats for electronic commerce purposes.

In the core of the provided brokering facility, we are using conceptual clustering procedures as an approach to better match customers' requirements and insurance product offers, providing a valuable add-on to both customers' and insurers' sides. Our insurance brokering system is then using COBWEB as a tool for grouping potential customers in meaningful classes we call *communities*. The question is whether there is any meaning in the generated communities, that is, if they associate users with a limited set of common interests. For this reason we use a metric to decide which preferences are most representative for each community. We try to construct a prototypical model, that we call *stereotype*, for each community, which is representative of its users and significantly different from other communities of users. This approach allows the insurance

company to target product configurations at specific market segments, and avoids the need to ask all customers the same typically large number of product specific questions.

In order to reach an agreement about a particular insurance product a negotiation process is started by the broker. This negotiation process comprises several rounds, starting when the broker sends an announcement for all the insurer agents in the market. We have adapted the Q-Negotiation algorithm [Rocha and Oliveira, 2000][Rocha and Oliveira, 2001] to the insurance brokering problem. This algorithm uses a reinforcement learning strategy based in Qlearning for the formulation of new proposals. The broker negotiates an insurance product configuration with insurers, trying to fulfill the specific needs of the customer. This configuration, defined by the customer, includes several, possibly dependent, components. At each round, bids' evaluation is done through a multi-issue function that encodes the customer's preferences.

The broker helps insurers' agents on their task of formulating new proposals by giving them some hints about the direction they should follow in their negotiation space. The response to proposed insurance configurations is formulated by the broker as a qualitative feedback, which reflects the distance between the values indicated in a specific proposal and the best one received so far. Insurer agents will use this feedback information to its past proposals, in order to formulate, in the next rounds, new proposals trying to approach the customer's preferences. The negotiation ends when a deadline is reached or a satisfactory proposal is received.

A customer agent coordinates the dialogue between the customer and the broker, passing on information as appropriate. Besides learning the customer profile, it offers the customer a flexible navigation tool that allows the exploration of the received proposals. This is particularly useful because the customer may wish to express product feature preferences and view the corresponding proximity of each offered product. The result is a ranking of products, which can be tuned by the customer by varying the preferences and viewing the consequent effect on the ranked list [Stolze, 1998]. Such a navigation tool encourages the user to consider non-price related features and helps the customer to explore the trade-off between product features and price. This is not just of benefit to the customer, because insurers have also the means of drawing attention to their products' distinguishing features other than price [Guttmann et al, 1998]. This helps the customer to make an informed purchase decision.

3.2 Phases of the Brokering Problem

Our model for the insurance brokering activities divides the interaction process aiming at solving the problem into the phases represented in figure 1. Besides relevant services like negotiation protocols and ontology-based services, the Broker Agent provides a facility to build up, memorise and exploit customer's stereotypes. Although this concept will be elaborated later on section 5, the reader can see a stereotype as a classification of a set of features and characteristics associated with a specific sub-set of customers.

In phase 1, the user sends, through its Customer Agent (CA), his personal characteristics and needs. The Broker Agent (BA), in phase 2, replies with the stereotype of the customer's community, indicating the representative preferences of its users. Based on this received stereotype the user defines the allowed range for the insurance product attributes' values. This definition includes attaching a degree of importance (weight value) for each one of the product's attributes (in a range from *low* to *high*) and the increasing order of preference for the attributes' values. The CA sends this request to the BA (phase 3).

In phase 4, the BA sends an announcement to each Insurer Agent (IA), starting a negotiation process. Each IA replies with bids to BA, which are then evaluated according to customer preferences, extracting relevant features from these bids (phase 5). This bids, plus relevant information, is sent to CA (phase 6). CA offers the customer a flexible navigation tool that allows the exploration of the received proposals.

The customer has now the opportunity to define a counter-proposal and select the insurers he wishes to continue to negotiate (phase 7). The response to proposed bids (phase 8) is formulated by the Broker Agent as a qualitative feedback, which reflects the distance between the values indicated in a specific proposal and the optimal one received so far. The reason why the BA compares a particular proposal with, not the optimal values for the customer, but the best one received so far can be explained by the fact that it's more convincing to say to an Insurer Agent that there is a better proposal in the market than saying that its proposal is not the optimal one.

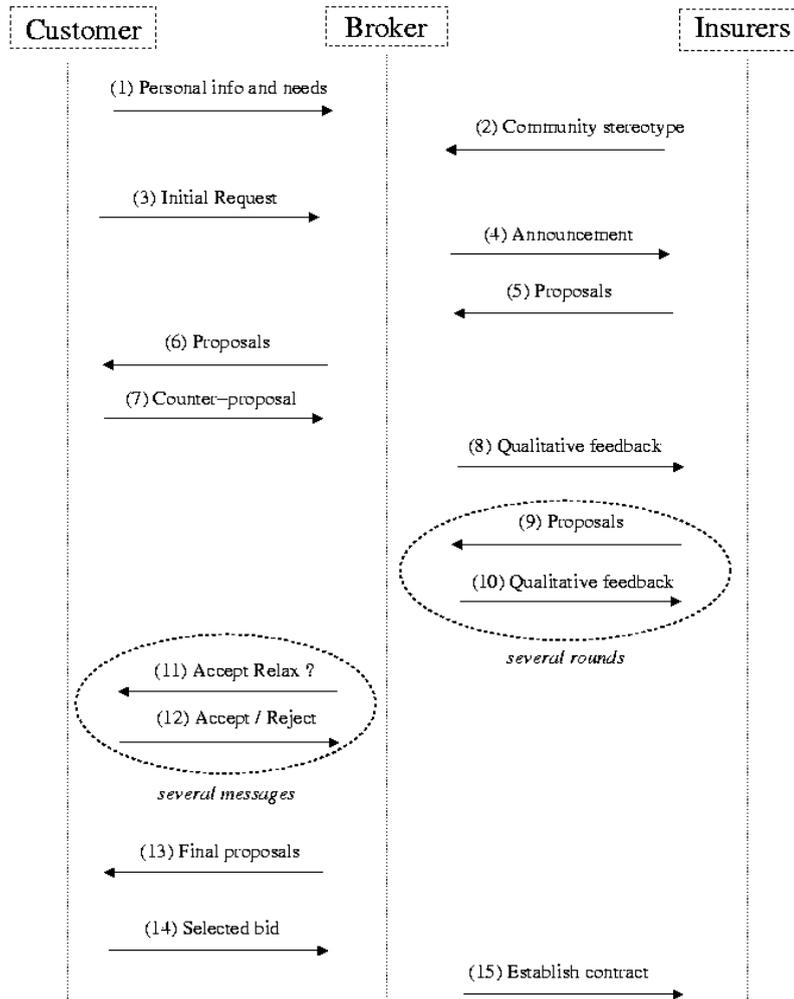


Figure 1. Phases of the brokering problem

At each negotiation round bids are evaluated and the one with the greatest evaluation value is considered the winner (phase 9 and 10). When this negotiation process ends, BA starts a new interaction with CA. This interaction will ultimately direct the system to a suitable solution through a constraint satisfaction process (phase 11 and 12). This conversation takes the form of a sequence of questions whose aim is to reduce alternatives rather than simply sort them. This dialogue is detailed in [Nogueira and Oliveira, 2003].

If this conversation has produced a valid number of alternatives, BA initiates phase 13 by ranking selected proposals according to the user utility function results, and send them plus relevant information to CA. The user either rejects or agrees with one of the received proposals (phase 14).

If the user has selected one of the proposed insurance products, BA starts phase 15, establishing a contract with the winning IA.

4. LEARNING CUSTOMER COMMUNITIES

Customer communities can be constructed automatically using an unsupervised learning method. The COBWEB algorithm [Fisher, 1987], which we use in this work, performs conceptual clustering. Conceptual clustering is a type of learning by observation that has as its goal the unsupervised classification of a set of

objects. Classification is unsupervised in the sense that there are no *a priori* target classes used during training.

COBWEB is an incremental conceptual clustering algorithm that represents concepts probabilistically. The term *incremental* means that objects are incorporated into the concept structure as they are observed. An object is a vector of feature-value pairs. In our system, objects are user's characteristics. COBWEB is designed to produce a hierarchical classification scheme. It carries out a hill-climbing search through a space of schemes, and this search is guided by an heuristic measure called *category utility* [Gluck and Corter, 1985]. The category utility of a partition is measured by the following equation:

$$CU = \frac{\sum_k (P(C_k) \left[\sum_i \sum_j P(A_i = V_{ij} | C_k)^2 - \sum_j P(A_i = V_{ij})^2 \right])}{k}$$

where k is the number of categories or classes, C_k is a particular class, A_i refers to one of the I attributes and V_{ij} is one of the J values for attribute A_i .

COBWEB incorporates objects into the concept hierarchy using four clustering operators: placing the object in an existing cluster, creating a new cluster, combining two clusters into a new one (merging) and dividing a cluster (splitting). Given a new object, the algorithm applies each of the previous operators and selects the hierarchy that maximises category utility.

5. LEARNING COMMUNITIES STEREOTYPES

Our insurance brokering system is then using COBWEB as a tool for grouping potential customers in meaningful classes we call communities. But, besides the customer data used for incrementally build up customers communities, a customer is characterised by its own preferences and by the insurance configuration chosen in the negotiation process. In order to help customers defining their needs, the broker must associate a "typical" insurance configuration to each constructed community. Thus, the natural way to define meaningful stereotypes associated to the existing customers communities is by trying to identify patterns that are representative of the participating users' preferences. We try to construct a prototypical model for each community, which is representative of its users and significantly different from other communities of users.

Our system is using a metric to measure the increase in the frequency of a specific preference or negotiation result within a given community, as compared to the default frequency in the whole number of available observations [Paliouras et al, 1998]. In [Paliouras et al, 1999] and [Weinberg et al, 1998] the increase in frequency was used as an indication of the increase in the predictability of a feature (a given preference, for example) within the community. Given a component c (a user preference), with the default frequency f_c , if the frequency of this component within a community i is f_i , the frequency increase is defined as a simple difference of the squares of the two frequencies:

$$FI_c = f_i^2 - f_c^2$$

When FI_c is negative there is a decrease in frequency and the corresponding component is not representative of the community. A community's representative characteristic is found through $FI_c > \alpha$, where α is pre-established as the required threshold for considering that frequency increase enough relevant.

6. LEARNING CUSTOMER PROFILES

The customer approaches the broker with a requirement: he wishes to buy an insurance policy to cover certain risks. This requirement will usually be incomplete and uncertain, and the customer will not be aware

of all the options available. As such, if the broker's evaluation of the received proposals were only based on the attributes that the customer is able to specify the result might be very poor. We propose the construction of a user profile, induced from the set of selected proposals for the next negotiation rounds. This profile reflects the customer's preferences on all the attributes of an insurance product. The training set consists of the proposals that the user found interesting.

The task of constructing the customer profile involves judging whether an attribute of an insurance product is relevant or irrelevant for the user. It would be very frustrating and time consuming for a user to interact with an agent that starts with no knowledge but must obtain a set of positive and negative examples from user feedback. To reduce user evaluation burden, BIAS considers only examples that are interesting for the user (only positive examples).

Formally, a proposal is described as a vector $P = (atr_1, atr_2, \dots, atr_n)$ of n attributes. The attributes can have binary, nominal or numerical values and are derived from the system ontology. The task of the learning method is to select the desired insurance configuration, based on a training set of m input vectors, that is, the selected proposals for the next negotiation rounds.

The construction of the customer profile is based on the correlation between the content of the selected proposals and the user's preferences as opposed to methods based on the correlation between customers with similar preferences. These preferences can be determined by using either explicit or implicit feedback. Explicit feedback requires the user to evaluate received proposals on a scale. In implicit feedback the user's preferences are inferred by observing user's actions, which is more convenient for the user. That's why we have adopted it in BIAS, despite the greater complexity in implementation.

In BIAS, insurer's proposals are represented as an n -dimensional vector, where each dimension corresponds to a distinct attribute and n is the total number of possible attributes. It's possible to extract a vector V_i from each proposal, $V_i = [x_1:Fp_1, x_2:Fp_2, \dots, x_n:Fp_n]$, where Fp_i indicates how frequently an attribute-value pair x_i appears in a particular proposal. If the proposal does not contain x_i then Fp_i is set to zero.

Customer profiles can be represented just like documents by one or more vectors. The profile is represented as an n -dimensional vector, where n is the total number of possible attributes for an insurance product. M vectors represent each dimension, where m is the total number of possible values for that attribute. In this approach a weight w_i is assigned to each value, based on how often the attribute-value pair appears in a particular proposal, Fp_i , and how frequently it occurs in the selected set of proposals, Fs_i .

$$Fs_i = \sum_{j=0}^n Fp_{ij}$$

$$w_i = Fp_i * \frac{Fs_i}{n}$$

We propose the following algorithm for the construction of the customer profile. The assumption behind this algorithm is that the more times a value appears in the selected set of proposals, the more relevant it is for the user.

```

for each selected proposal
    extract the vector  $V_i$  for this proposal
    combine  $V_i$  and the constructed profile  $V_{prof}$  in  $V_k$ , updating  $w_i$ 
    sort the weights in the new vector  $V_k$  in decreasing order and keep the  $n$  highest elements
endfor

```

This algorithm runs whenever a user selects a proposal for the next negotiation rounds. Thus, the customer profile is incrementally and continuously updated.

7. RESULTS

In [Nogueira, 2002] we have showed the importance of the generated stereotypes for each specific customer. The Broker Agent, through the construction of customer's communities and the identification of the

representative preferences of its users, is able to provide needed help and advise in defining customer's needs, selecting a policy and dealing with insurers.

The quality of the generated descriptions for each community increases as we go down in the hierarchy constructed by COBWEB. Communities in lower levels are more concise and the extracted model has greater significance. The tests have showed us that the insurance attributes that are chosen by either too few or too many users do not appear in the constructed community stereotype. In the former case the algorithm ignores them during learning and in the latter case, they correspond to such general interests, that they cannot be attributed to particular communities. Filtering out these two types of preferences is a positive feature of the used metric [Paliouras et al, 1998], greatly improving the quality of the generated stereotypes.

Changes in electronic insurance commerce, introduced in BIAS, are of benefit of both customers and insurers. By increasing the degree and the sophistication of the automation process, commerce becomes much more dynamic, personalised and context sensitive. From the customers' perspective, it is desirable to have software that could search all the available offers to find the most suitable one and then go forward through the process of actually purchasing the product. From the insurer's perspective it is desirable to have software that could vary its own offering depending on the customer it is dealing with, on what its competitors are doing and on the current state of its own business.

8. CONCLUSION

In most current e-commerce applications, the buyers are generally humans who typically browse through a catalogue of well-defined products (books, computer components, CDs) and make fixed price purchases. However, there are important differences between selling this type of goods and selling insurance and other financial products over the Internet. This paper explores some of those differences from both the insurers' and customers' perspectives and describes the development of a multi-agent system through which products (and services) offered by insurance companies could be better evaluated and selected. From the customers side point of view, more interesting information can be found, even things that the customer did not think of before. On the other hand, the BIAS system, with its intimate knowledge of who the user is and what he wants, can shorten the time needed for finding an appropriate insurance product. Insurers can then use information automatically collected during negotiation to develop a more customer-directed kind of marketing strategy. Information about the customer can be used to find out what he is interested in and, therefore, a more personalised product could be offered.

Different communities of users can be identified and used to improve the exploitation of an insurance brokering service. The construction of those communities is achieved using an unsupervised learning technique. We also use a specific metric to decide which are the representative preferences of a user's community.

We propose the construction of a user profile, induced from the set of selected proposals for the next negotiation rounds. This profile reflects the customer's preferences on all the attributes of an insurance product.

We have also adapted an advanced negotiation protocol, suitable for multi-issue negotiation in electronic commerce activity. A learning capability was also included enabling agents to become more effective in a dynamic market by learning with past experience through the qualitative feedback received from their opponents.

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FLEXIBLE POSITIONING FOR LOCATION-BASED SERVICES

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ABSTRACT

Location-based applications and services will get increasingly important for mobile users of the future. They take into account a mobile user's current location and provide a location-dependent output. Often, location-based applications have to deal with raw location data of specific positioning systems (e.g. GPS) and perform further processing to get an appropriate representation. In this paper, we present a platform, which hides specific details of positioning systems and provides a uniform output containing both physical as well as semantic information. With the help of our platform, an application developer can concentrate on the application-specific details and has not to deal with position capturing and mapping. The corresponding infrastructure reflects a location domain model especially designed to cover the needs of mobile users. The domain model contains logical links and allows the expression of semantic relations between locations. As our infrastructure is self-organizing, it is flexible and easy to extend.

KEYWORDS

Ubiquitous computing, location-based services, positioning systems, wireless communication

1. INTRODUCTION

Determining a mobile user's current location will be one of the most important functions of future mobile computing environments. Location-awareness is a key issue for mobile, ubiquitous and handheld computing and many people expect a high potential of location-based services such as city guides or navigation systems for m-commerce scenarios.

Many applications use the satellite navigation system GPS (global positioning system) to determine the current location. GPS receivers are inexpensive and the corresponding location output is accurate, thus GPS is widely accepted. GPS however only works outdoors since the receiver must have a direct "view" to at least four GPS satellites. If a location-based service is designed for a high coverage, it has to use other (e.g. indoor) positioning systems. Accessing more positioning systems however, increases the complexity of a location-based service. As a solution, we suggest a flexible positioning platform, which relieves the service developer from position capturing and converting coordinates into different coordinate systems. Using such a platform, a developer can concentrate on the actual service function and has not to deal with sensors and low-level protocols to determine the location. In addition, such a platform can provide additional location information such as the semantic locations. Semantic locations transfer, in contrast to physical coordinates, a *meaning* of the location. E.g., instead of the GPS coordinates $N51^{\circ}22.579/E007^{\circ}29.616/169m$, it is often more meaningful to use the term "University of Hagen, building IZ, back door".

In this paper, we present the self-organizing, decentralized *Location Server Infrastructure (LSI)*, which strongly separates the location-based service from positioning issues. We strongly considered scalability and accessibility issues. In our approach, we use a network of location servers, which automatically connect among each other. As the location data is distributed among a network of servers, our infrastructure is highly accessible for mobile users.

2. RELATED WORK

Many location-based applications have been developed in the last years. Tourist information systems are ideal examples for such applications. The systems CYBERGUIDE [1], GUIDE [4] and the PinPoint Tourist Guide [19] offer information to tourists, taking into account their current location. Usually such systems come along with a general development framework, which allows a developer to create other location-aware applications. A second example for location-based applications is context-aware messaging. Such systems trigger actions according to a specific location [20]. ComMotion [12] is a system which links personal information to locations and generates events (e.g. sound or message boxes), when a user moves to a certain location. CybreMinder [5] allows the user to define complex conditions under which a reminder will be generated (e.g. time is "9:00" and location is "office"). Conditions are stored in a database and linked to users. Whenever a condition is fulfilled, the system generates a message box.

Several frameworks deal with location data and provide a platform for location-based application. In [11] Leonardt describes a conceptual approach to handle multi-sensor input from different positioning systems. Cooltown [10] is a collection of location-aware applications, tools and development environments. As a sample application, the Cooltown museum offers a web page about a certain exhibit when a visitor is in front of it. The corresponding URLs are transported via infrared beacons. Nexus [8] introduces so-called augmented areas to formalize location information. Augmented areas represent spatially limited areas, which may contain real as well as virtual objects, where the latter could only be modified through the Nexus system. OpenLS [17] is an upcoming project and provides a high-level framework to build location-based services.

Geographic information systems (GIS) and spatial databases provide powerful mechanisms to store and retrieve location data [21]. Such systems primarily concentrate on accessing large amounts of spatial data. In our intended scenarios, however, we have to address issues such as connectivity across a network and mobility of clients, thus we have to use data distribution concepts, which are only rarely incorporated into existing GIS approaches.

Many existing frameworks either rely on a specific positioning system such as GPS or only provide a very high-level concept to integrate other positioning systems. Especially the relation of physical to semantic locations and the mapping of local sensor-data to global location information have a high influence on how location-based applications perform their service.

3. LOCATIONS AND POSITIONING SYSTEMS

Pradhan [18] distinguishes three types of locations: *physical* locations such as GPS coordinates, *geographical* locations such as "City of Hagen" and *semantic* locations such as "Jörg's office at the university". The notion of semantic locations is not new (e.g., [11]), but descriptions often tend to be very abstract. Semantic locations play a major role for applications, which do not focus on physical coordinates, but on the *meaning* of a location. A semantic location can be a railway station or airport, a city centre or a room inside a building, a river or mountain or a private apartment. Note that a user can reside at different semantic locations at the same time, e.g., being in a railway station, a user may be in a city centre as well. Some applications can process semantic locations much easier than physical ones, as they represent an entire area of physical locations. Semantic locations can easily be used as a search key for traditional databases. In this paper, we do not distinguish geographic and semantic locations any more, but view any location other than physical as a semantic location.

Different location-based applications or services need different location types: a navigation system for sailors needs physical locations, whereas a tourist guide may need semantic locations. The positioning systems, on the other hand, provide different types of location data, regardless which type of location currently is needed by the application.

In addition to the location *type* (semantic or physical), we can classify positioning systems according to the *scope* (local or global). GPS provides *globally unique* physical locations. Indoor radio systems (such as [2], [7], [16]) in contrast provide physical locations which are valid only *locally*. They use a location such as a special corner of the building as a reference point.

A positioning system that provides global physical locations is based on the GSM cellular phone network [6]: each GSM base station transmits a globally unique cell ID to the mobile phones. This mechanism is

called cell of origin (COO). In addition, a mobile phone knows the distance to the base station in steps of 555 m with the help of timing measurements between base station and mobile phone (timing advance [14]). With this information, a mobile phone can look up its area, described as a circle segment with a certain thickness.

Some positioning systems already provide a kind of semantic location. Indoor infrared systems ([22], [23]) use the property of infrared light not to penetrate walls. An infrared beacon usually covers an entire room or hallway, which can be viewed as a fine-grained semantic location.

4. THE LOCATION SERVER INFRASTRUCTURE

The primary goal of our approach is to provide uniform location information, which is independent from the actual positioning system. Even if a user moves from one positioning system to another, a location-based application should not notice this. For each position, we want to provide a physical location as well as *all* semantic locations, which cover this position. We want to provide both location types since we do not want to impose any limitations to location-aware applications. Having both types, the application can choose the appropriate type (or even both) for the specific operating condition.

4.1 The Location Model

We use a location model primarily based on semantic locations to structure the physical space. Moreover, semantic locations are an ideal means to organize the logical network of servers.

We structure the entire space with so-called *hierarchies*. Hierarchies are built up of *domains*, each of it representing a semantic location which its corresponding physical extension (e.g. the physical bounding of a city centre). Each hierarchy has a root domain and a number of subdomains; each of it can in turn be divided into subdomains. We call a domain a *master* of the corresponding subdomains. Fig. 1 shows two hierarchies, a *de* hierarchy (the area of Germany, white boxes) and a *geo* hierarchy (geographic entities such as rivers and mountains, grey boxes). We call a link between a subdomain and a master domain a *relation*. Relations carry information about containment of one domain according to another, i.e. a subdomain is fully embedded into a master's domain.

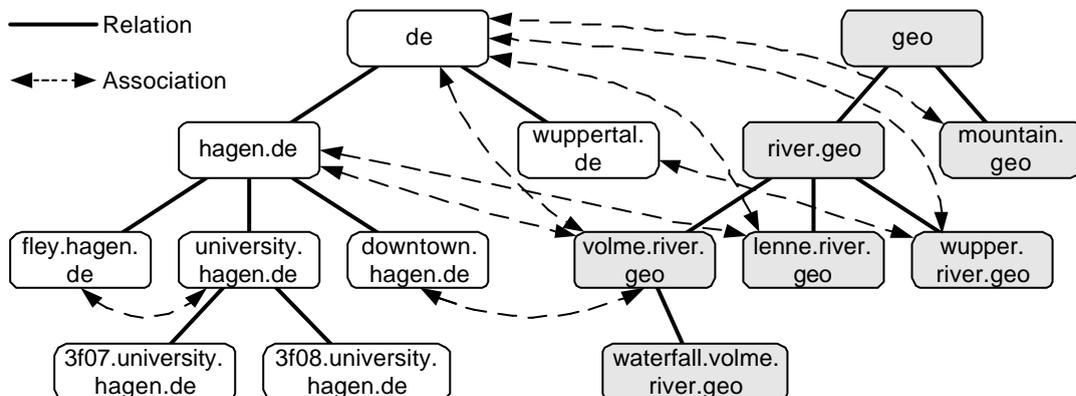


Figure 1. The domain model

Domain names follow the Domain Name System (DNS) of the Internet [13]: the name of a subdomain extends the master's domain name according to the pattern $\langle \text{subdomain} \rangle := \langle \text{extension} \rangle . \langle \text{master} \rangle$.

In addition to relations, a domain can be *associated* to other domains. Domains are associated, if their corresponding physical areas overlap. Associated domains can be in different hierarchies or in the same hierarchy. The domain *downtown.hagen.de* is associated to *volme.river.geo*, because Volme is a river that flows through the downtown of Hagen. Associated domains can also be inside the same hierarchy (e.g. *fley.hagen.de* and *university.hagen.de*), i.e. we allow two subdomains of a domain to overlap.

Using such a model, we have to address organizational issues: we have to find useful domain names and divide hierarchies into useful subhierarchies. We have to decide how high a specific domain will be inside a

hierarchy and which physical area it exactly covers. We want to put back such problems. We believe that we only can solve these problems, if we have a meaningful model and a powerful underlying technical infrastructure. Therefore, we concentrate in this paper on the technical and formal issues to build reasonable structures.

4.2 The Location Server Infrastructure

Storing maps and retrieving location information is traditionally a domain of spatial databases and geographic information systems. As an ad-hoc solution for our problem, we could use one huge database and store hierarchies with the corresponding domains on one server. A single database for a big number of potential clients, however, would be a bottleneck. In addition, information about local domains is usually available only locally and difficult to administrate in a central database.

Representing each domain by a separate server on the other hand would lead to an unacceptable high number of servers. In ideal solution lies between the two extremes. Our approach was strongly influenced by the Domain Name System of the Internet. The DNS has a similar function as our infrastructure: it maps symbolic host names to network addresses. DNS has a decentralized architecture: local administrators are allowed to define new local names and mappings and store them in local servers. We follow a similar approach and store location information in so-called *location servers*. Fig. 2 shows how location servers can be mapped to the location model.

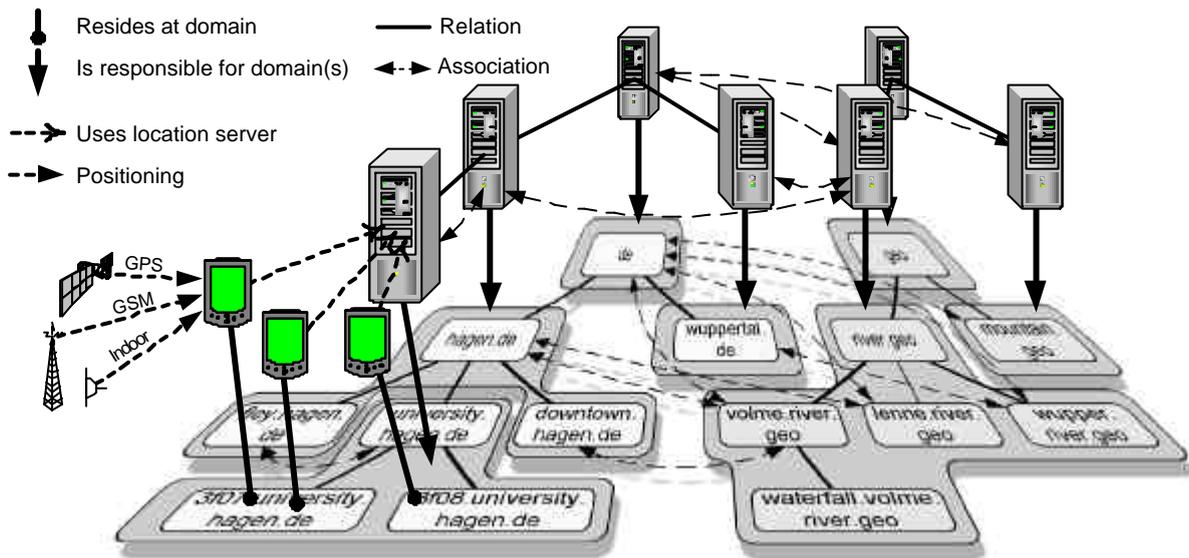


Figure 2. The logical location server network

Each location server is responsible for a specific domain and all subdomains, for which *no* other location server is set up. In our example, the location server for *hagen.de* covers *fley.hagen.de* and *downtown.hagen.de*, but not *university.hagen.de*, as this domain has its own location server. Since mobile users are distributed among different location servers, this infrastructure is highly scalable. Especially, our system does not overload top-level servers.

4.3 Resolving Positions

A mobile computer is connected to one or more positioning systems, which may provide raw position data with only local meaning. The primary task of our platform is to produce globally valid physical and semantic location data. For this, the mobile computer connects the responsible location server (called the *local location server, LLS*). In our example (fig. 2), the mobile nodes residing at the university of Hagen connect to the

server *university.hagen.de*. Only this server knows the corresponding subdomains and the used positioning systems inside the university. The knowledge of positioning systems is important to perform the mapping of raw position data to globally valid positions. In detail, a location server performs the following mapping for mobile computers:

- global physical → global semantic, e.g., $N51^{\circ}22.578/E007^{\circ}29.610/169m \rightarrow 3f08.university.hagen.de$
- global semantic → global physical area, e.g., $3f08.university.hagen.de \rightarrow \text{polygon}(N51^{\circ}22.577/E007^{\circ}29.614/169m, \dots)$
- local physical → global physical, e.g., $5.5m/6.3m \rightarrow N51^{\circ}22.581/E007^{\circ}29.622/169m$
- local semantic → global semantic, e.g., $beacon_3F08 \rightarrow 3f08.university.hagen.de$

Note that a semantic location cannot be mapped to single physical point, but to a physical *area* described by, e.g., a polygon.

With these mappings, our platform can provide physical positions (or areas) and semantic locations from any positioning system. If more than one positioning system is available, the client can choose the "best" one with the help of parameters such as *precision* or the *age* of location data. In addition, the platform can merge location data of different systems to increase precision.

A crucial point for a mobile node is to find its LLS when it enters a new region. One design goal was to run the system with a minimum configuration; particularly the user should not enter raw network addresses manually. Especially when moving between locations, the user should not be aware, if the system performs a handover to a new LLS. A mobile client has to permanently supervise its location and possibly discover a new LLS. Our infrastructure supports the following discovery mechanisms:

- The mobile client can send lookup requests to the network, via, e.g. broadcast messages.
- The mobile client can use service discovery protocols such as SLP.
- The positioning system can distribute information about the LLS via, e.g., infrared beacons.
- After a movement, the mobile node can ask the old location server for the new LLS. For this, the location server uses relations and associations.

In addition, a location server notices, if a mobile client wants to resolve a position outside the covered area. In this case, it uses the relations to find a more suitable server. The server first redirects the request to its master, which in turn may redirect it to its master or a more suitable subdomain server.

We use the association links to resolve *all* semantic locations. If in the example above, a mobile user sails on the river Volme through the downtown of Hagen, the resolution process should return *volme.river.geo* and *downtown.hagen.de*. The LLS possibly only computes a subset of semantic locations. Only if all relevant location servers contribute their results, we get a complete list of semantic locations. For this, we first query the LLS for a list of associated location servers, then query all associated for additional semantic locations.

4.4 Maintaining the Logical Network

The resolution mechanism requires the location servers to know their master, subdomains and associated location servers. Building and maintaining the corresponding entries is performed in three phases: *discovery*, *registration* and *re-registration*. The first two phases only run once when a server starts its service.

When a server starts up the first time, it has to look for other location servers. A location server can use for this discovery mechanisms as described in the previous section. Using network broadcast, a server transmits a discovery message with its own domain name and the specification of the physical area it covers. A server, which receives a discovery message, can easily decide, whether this message is relevant or not.

When all replies arrived, the new location server registers itself to other servers. We strongly separated the discovery from the registration procedure, as both steps use different communication paradigms. Discovery uses, e.g., multicast protocols which are only uni-directional, thus unsuitable for registration. The registration step in contrast uses a reliable bi-directional transport protocol, thus a registration can be acknowledged by the receiver. Once a registration was accepted, both servers store the relation or association in their local databases.

If a location server breaks down or disconnects from the network, it cannot explicitly inform other servers. Thus, we need a mechanism to ensure that inactive location servers are automatically removed from

databases after a certain time. Active servers have to periodically re-register to all related and associated servers. If a re-registration is overdue, a server deletes this server from its list.

4.5 The Software Architecture and Implementation Details

Fig. 3 left shows the software architecture. The main parts of the architecture are the client and server processes. An XML file configures the server process during startup. A spatial engine does the processing concerning spatial information. The spatial engine decides, e.g., if a physical location resides in a certain area. The current implementation of the spatial engine uses analytical representations of areas, i.e. irregular surfaces have to be split up into areas, which can be described with means of equations. This allows the quick computation for small sets of spatial data, but complex areas could not be described in sufficient precision. In the future, we want to replace this engine by a spatial database based on vector representation to allow the description of more complex areas.

The mobile node hosts a client process, which fully runs in the background. Developers of location-based applications can use the LSI framework with the help of the LSI API.

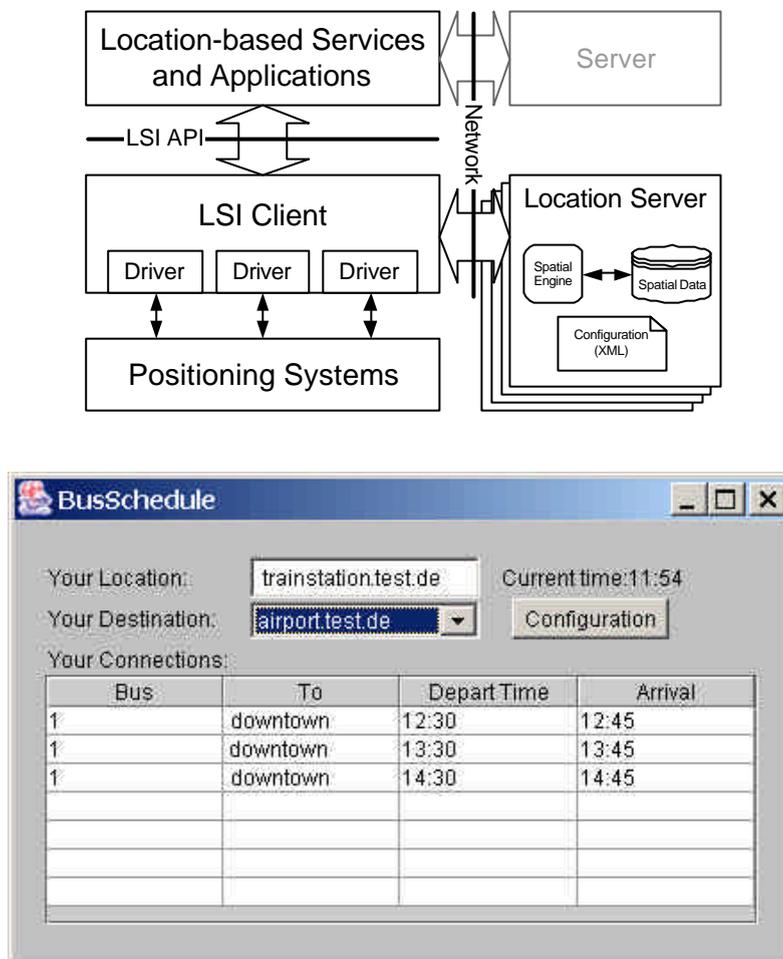


Figure 3. The software architecture and a sample application

Note that the communication between a mobile client and the server for the actual location-based service is not addressed by our platform. It depends on the location-based service or application to find an appropriate server and establish a service connection.

The platform communicates with positioning systems via *drivers*. Drivers run the capturing protocol, e.g., with the GPS receiver. Drivers have a strongly defined driver interface. We can easily attach positioning systems to the client during runtime. In addition to location data, drivers provide information about the scope and type of location, thus the LSI client can perform the required mappings without manual configuration.

We implemented the client and server processes in Java, with some time-critical parts in C. The software system currently consists of 150 Java classes.

A sample code to demonstrate the strength of LSI can be outlined as follows.

```
ResolvedPosition p=LSI.resolve();
for (int i=0;i<p.sempos.length;i++)
    if (p.sempos[i].endsWith("hagen.de"))
        ShowMessage("Now I'm in Hagen!" +
                    "My physical position is "+p.physpos.toString());
```

This program resolves the current position with the help of the API and checks, if the user resides at a certain semantic position. To avoid polling, an application can register itself as a *listener* for position-related events. As a result, the API calls a certain method of the application, whenever a specific location is entered or left.

A more complex application that makes use of our infrastructure is the bus schedule (fig. 3 right). When a user starts the application, it determines the current semantic location. The user selects a destination and the application looks up appropriate bus connections. The application automatically informs the user when to change the bus or when he arrived at the final destination. The planning process fully operates on semantic locations, which are easy to look up in the timetables. Since the application has not to deal with the positioning process, it is very small (approx. 700 lines of code). The development needed less than one week.

To even more simplify the development, we created a platform on top of LSI called *PinPoint* [19], which allows using the powerful WWW infrastructure for location-based services. With PinPoint we developed, e.g., a tourist guide which runs in a Web browser of-the-shelf.

Some further details of our platforms are the following:

Caching: The client uses results of old resolutions for further queries. This can dramatically speed up the resolution process, since the client only has to connect to location servers if it moves outside recent visited areas.

Filtering: A specific location based-application may only be interested in a subset of all available domains. E.g., the bus schedule may need semantic locations representing bus stations and not *geo* domains. If a mobile node only has to load specific domain information, we can drastically reduce the amount of network traffic. We configure the access to specific domain information with so-called *domain filters*, which contain a description of subhierarchies included or excluded from a resolution process.

Compression: The number of associations can be very high and overload servers, especially top-level servers. We solve this problem with a *compression* mechanism. For this, associations are replaced by the highest server of the corresponding subhierarchy. In fig. 1, the *de* domain first is associated to *volme.river.geo*, *lenne.river.geo*, and *wupper.river.geo*. The compression replaces these associations by a single association between *de* and *river.geo*. This however, slows down the resolution process. Looking for overlapping domains, we now sometimes have to go down a hierarchy, thus a server has to carefully decide when to compress.

Security: In distributed systems, security is an important issue. To protect a server or a mobile node against malicious servers, a node can currently request an authentication certificate of the correspondence node. Our intended security solutions are very complex, thus we cannot present these mechanisms at this place.

5. OPEN ISSUES

Although our system has reached a certain state of completeness, some issues are still open and subject of intensive future research.

Organizational Aspects: The technical platform of LSI is entirely decentralized. Nevertheless, for a specific hierarchy, we need a central organization to supervise the registration of subhierarchies. This problem is

similar to the registration of Internet domain names. In addition to formal parameters such as domain name, covered physical area etc. a domain has to satisfy informal conditions. E.g., if a city wants to register as a subdomain of *de*, one could require that the city has a certain number of inhabitants. Our system currently does not support such issues and concentrates on the technical infrastructure. We could consider a second infrastructure to help organizations to control hierarchies and store, e.g., additional information about domains.

Private Domains: In the current implementation, our system maintains domains with a public character. Every user can access our domains. Domains such as rivers or cities have a certain meaning for the public. For some applications however, there may be the need for domain definitions with a private character such as "my office" or "my favourite place at the beach". Introducing such domains, our system must provide access control mechanisms.

Proximity: Currently, our infrastructure only resolves locations which are *inside* a certain area, i.e. an application can ask the system in which physical area or semantic location the mobile user currently resides. Often these data is not sufficient and an application wants to request location data in the nearer area. Proximity is currently only supported in an indirect manner: in our location model, we can express proximity based on physical areas. As a solution, we want to relax the notion of sharply defined physical areas with the help of fuzzy sets.

6. CONCLUSION

Currently, no positioning system is available which is accessible everywhere and which provides both physical as well as semantic locations. Our infrastructure makes location data available for arbitrary location-based applications and allows the integration of a wide range of positioning systems. Developers can use this infrastructure as a platform and do not have to deal with positioning capturing and resolution. The infrastructure is self-structuring and decentralized, thus highly accessible and scalable. In the corresponding location model, we define hierarchies and express logical links between domains, thus the system provides a semantic structure of the entire location space.

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AN EXPANDABLE LOCATION-BASED PORTAL FOR MOBILE USERS

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ABSTRACT

The provision of information and electronic services to citizens through wireless networks has already started a few years ago. In particular, most GSM network operators in Europe offer a considerable number of services to their customers through their mobile portals based on the WAP technology. However, those portals are designed around centralized contents and offer from third party entities, although crucial for the success of those services, is still very limited.

In this paper we describe the development of a system that provides location-based information to the citizens of a municipality through their mobile phones. The information is maintained mostly by several third party entities, but we also discuss a model where information is managed by a central entity in order to support the progressive enrolment of local providers, as they get involved into the use of information technology.

With this experiment many difficulties and limitations have been identified that impair the implementation of many interesting features. The prototype has provided a better understanding of some of the key issues involved in implementing a real system of this nature. Among them is the difficult access to information about the location of mobile users, which is mainly controlled by mobile network operators. Such access would greatly enhance the usability and usefulness of mobile portals.

KEYWORDS

Location-based services, context-aware, location management

1. INTRODUCTION

Since the creation of the World Wide Web, the Internet has been seen and effectively used as the preferred channel for information exchange among users worldwide. This enormous success created many new business opportunities and triggered many new technological developments. The concept of Web Site has evolved into the concept of Web Portal, through which information and a variety of services can be accessed, and we are now assisting to the introduction of the Web Services technology [Kreger2001].

A similar approach was attempted within mobile cellular networks. The idea that the Web could be made available to mobile users through their mobile phones has been described as the Mobile Internet. The approach used by the Japanese NTT DoCoMo i-Mode [i-Mode] technology has proved to fulfil many of the users needs and its deployment and operation is seen as a case of success. Different results were achieved by the Wireless Application Protocol (WAP) based solutions [WAP], and many reasons were presented for the initial difficulties. However, the potential of the Mobile Internet is enormous as long as innovative and attractive services and applications are provided to the users.

In this paper we describe the design and implementation of a portal through which mobile users can access a variety of location-based information services. This project was a joint venture between the University of Minho and the Municipality of Paredes (a nearby municipality). The idea for this joint development was driven by a problem earlier identified by the municipality council: the main industrial activity in the region is furniture production, but its commercialisation is mainly done at a neighbour region. The development of a mobile portal for mobile users is part of a programme to enhance the image of the region as a furniture shopping area and not only as a production centre. For this, a development team was created with members from the University of Minho and from the Municipality Council. The main objectives

were to explore the mobile channel to provide information that could help citizens to find furniture shops and to provide other relevant information services both for local residents and visitors, and to involve the information providers themselves. One of the key aspects that led to this approach was that the penetration of mobile phones in Portugal is very high, with much more mobile subscribers than PC users.

Also, due to the localised area of use, an approach based on location-based services was adopted [Mandato2002]. This way, users can access the information that is relevant for their current location, thus enhancing the interaction with the portal through the limited capabilities of mobile phones.

This project was also faced as an experiment to evaluate the practical applicability of current wireless technologies in real environments as well as to evaluate more recent advances on pervasive computing. Some of the solutions adopted in this system architecture and implementation derive from previous work done at the University of Minho in the areas of mobile computing and location-based services [José2003]. In a recently concluded project [Hypergeo], a prototype of a mobile portal for the tourism area was implemented based on an open and scalable architecture that supports the integration of information services provided by third party entities like restaurants, hotels, tourism operators, etc. A different architecture is currently being used by most of the portals maintained by mobile network operators. These are closed systems where the information is mostly centralized and where the information services, although updated frequently, do not dynamically adapt their behaviour to the user location or context.

The remaining of this paper is organized as follows. In section 2 we describe the approach used in this project, including the characterization of the technological environment and the proposed usage scenario. Then we present the system architecture and describe its implementation. The achieved results are presented and discussed in section 4, along with some guidelines for future developments. Finally some concluding remarks are presented in section 5.

2. THE APPROACH

The approach used in this project was to create a usage scenario and design the system in order to fulfil it. This scenario considers three major aspects: the types of users, the services to deploy and the technological constrains.

We have considered four types of users:

- Resident users: are local users in the sense that they live in the region. These are characterized by a good knowledge of the geographic area: they can easily recognize places, in particular around their home neighbourhood and working area. The information needs of these users include: local weather forecast; social events; drugstores (pharmacy) opening hours and addresses; emergency phone numbers; etc.;
- Visiting users: are people living outside the municipality area. They are not familiar with the region, and they do not know the names of places or small villages nor how to go from one place to another. The information needs of these users include those of resident users and the following: tourism points of interest; local restaurants and hotels; public services opening hours, phone and address (post office, police, banks, etc.); furniture production plants and shops (type of furniture, address, phone number, URL of a Web Site, etc.). Visitors and Residents are assumed to access the system using their mobile phones equipped with a WAP browser;
- Professional users: are members of the staff of the municipality council or related entities. These users have special information and services needs that depend on their professional activity, like access to restricted information, reporting problems or asking for additional support, etc. No specific services were identified for this type of users in the first phase of the project. Professional users can use a mobile phone or another specific terminal device (like devices installed inside a car or truck) to access the system;
- Providers: these are the users that interact with the system to provide services or information. This type of users includes the municipality council, drugstores staff, restaurant and hotel owners, tourism operators, furniture producers and salesmen, etc. To cover the largest possible number of information providers, they access the system through a web application, for which the availability of a single computer connected to the Internet is the only requirement.

As an initial requirement, users should be able to access the information system while on the move. As the penetration of mobile phones is very high, the mobile network was chosen as the preferred infrastructure to support the connection between users and the system. The adoption of the WAP technology [WAP] over GSM networks addresses the need to reach a potential large number of users. Although not all mobile phones are WAP enabled, it is expected that within 1 to 2 years all terminals will have these capabilities.

On the other hand, the limited capabilities of the mobile terminals put some constraints on the applications and services that can be deployed, in particular in what concerns the user interface. These constraints lead to applications with very simple interfaces, that can present small amounts of information mainly based on text and very simple images, and that should avoid that the user has to type data into the terminal.

Based on the above, a usage scenario for the first system prototype was developed. This scenario considers Resident, Visiting and Provider users, and the deployment of the following location-based services:

- Drugstore service: this service provides information about drugstores such as opening hours, name and address, phone and fax numbers. During normal working hours, all nearby drugstores are returned to the user, otherwise the nearest open drugstore is returned;
- General information about Public Services service: this service provides information about public services, such as address and opening hours. Three initial public services were considered (churches, parish councils and health centres) but this general service supports the addition of other public services without the need to develop or modify any code;
- Furniture service: this service provides information about furniture shops and production plants, such as name, address, type of furniture being sold and the shop opening hours.

In this first system prototype, all the information is provided by the municipality council and stored in a central database. The next step should be to involve other entities as information providers. For this, a Web application was developed to enable the remote management of the information. The system also supports information services that are independent from the central database and provided by third party entities.

3. SYSTEM DESIGN AND IMPLEMENTATION

Figure 1 depicts the system architecture. The core of the system is a portal implemented over a HTTP server.

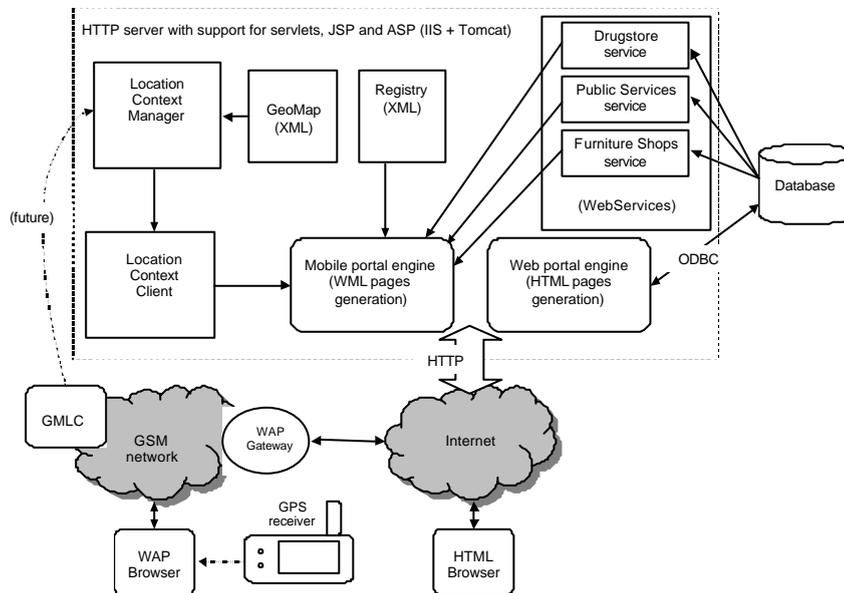


Figure 1. The system architecture.

Mobile users access the portal using their mobile phones. Users, especially Professional users, can also make use of an external GPS receiver to determine their geographic location and to, manually, enter that information to the system. This feature is important when a precise knowledge of the user location is

required. Alternatively, users can use special devices with integrated GPS receiver to automate this feature. When available, the user position will also be accessible from a GMLC (Gateway for a Mobile Location Centre) [LIF].

The mobile network operator itself supports the connection between the Internet and the mobile GSM network through a WAP Gateway. Since all network operators support this functionality, all mobile users can access the portal.

In this first prototype, all the information is stored in a local database. This information can be inserted or updated through a Web application using any computer connected to the Internet.

The portal system integrates the following main components:

- A set of Web Services that provide all the information to the mobile portal. In this prototype all Web Services are running on the same computational platform and they all share a common database where information is stored. However, external Web Services are also allowed. This can happen in the future, as soon as Providers get more involved into the system operation;
- The Registry that maintains a list of all Web Services, local or remote, available for each location;
- The mobile portal engine: this is the module that implements the WAP application and generates the WML decks and cards [WAP]. This engine is composed by a set of Java Beans that interact with the Web Services and the contextualization modules and by a set of JSP pages used to generate the dynamic WML decks;
- The Location Context Management modules that are used to perform the contextualization of the mobile users. The implementation of these modules is based on a set of Java servlets and location information is stored in XML format;
- The Web application through which providers can insert and update information stored in the database. This application was developed using ASP technology with direct access to the database through an ODBC driver.

3.1 Location management

When a mobile user accesses the mobile portal, he/she has access to information relevant for his/hers current location. To support this feature, the portal needs to know the user location in real time. The initial objective was to obtain that information from the mobile network, as there is already technologies for providing this service. One of the possibilities is to query a GMLC maintained by the mobile network operator. In this case the portal must know the user identity and privacy has to be considered. An alternative is to obtain location data directly from the mobile terminal. However, none of these options could be used. Although the mobile network operators have their GMLC operational, they don't provide access to the location of their subscribers to third party information providers. The obvious reason is that many privacy issues are yet to be solved, including legal ones [Smailagic2002]. The second solution – obtaining the location data from the terminal device – could be implemented through the use of one WTAI function (WATGSM.netinfo()) and WMLScript [WTAIGSM]. The Wap Forum has already specified this function since July 2000, but at the time most, if not all, existing devices don't implement this function. Our solution to overcome this limitation was to rely on the user to tell the portal his/her location. The implementation of this functionality was made independent from the WAP application so that it will be easy to replace by an automated function as soon as access to the GMLC is available.

Wherever a user enters the portal, he/she is asked to give his/her location, by selecting one place from a list. The list of locations from where the user can chose is derived from a geographic space model that is the base for the location-awareness of the portal. This space model – a GeoMap - is represented by a XML document as shown in Figure 2. In this model the space is represented as a set of geographic areas, each one designated as a *location context*. Each location context is described by a set of items, namely its name, type, author and geographic definition, i.e. a list of geographic points, described as pairs of coordinates in the WGS84 datum, that define a non self-intercepting polygon. A few other geographic elements are included to improve the processing of GeoMaps by the Location Context Manager. In this prototype the entire area of the municipality was modelled as a set of non-overlapping areas, each one corresponding to one of the municipality parishes.

Users with access to a GPS receiver, such as Professional users, may enter a pair of geographic coordinates and the system maps that point to one of the location contexts defined in the GeoMap. All other users are invited to choose one location from the list of available location contexts.

```
<?xml version="1.0" encoding="ISO-8859-1" standalone="no"?>
<!DOCTYPE CONTEXTDB SYSTEM "http://localhost:8080/lcm/context.dtd">
<CONTEXTDB>
  <CONTEXT>
    <CONTEXTID>2</CONTEXTID>
    <NAME>urn:x-around:cm-paredes:Aguiar de Sousa</NAME>
    <TYPE>Freguesia</TYPE>
    <DATE>2001.10.8</DATE>
    <AUTHOR>C.M.Paredes/Univ.do Minho</AUTHOR>
    <POLYGON>
      <LATITUDE>41.1491</LATITUDE>
      <LONGITUDE>-8.47257</LONGITUDE>
      ...
    </POLYGON>
    <AREA>0.0023832</AREA>
    <CENTROID>
      <LATITUDE>41.1255</LATITUDE>
      <LONGITUDE>-8.44496</LONGITUDE>
    </CENTROID>
    <RADIUS2>0.00137282</RADIUS2>
  </CONTEXT>
  ...
</CONTEXTDB>
```

Figure 2. The geographic space model representation.

In summary, the contextualization process always associates the user to a location context. Since no identification of the user is required, the portal can be used anonymously and no privacy issues exist (even the user identity is hidden by the WAP Gateway and cannot be logged by the HTTP server).

3.2 The Web Services

The Web Services provide location-dependent information to the mobile portal. Each Web Service acts as the source for a certain geographic area, in this case a parish. Three different types of Web Services were developed corresponding to the three types of services described in Section 2: a Drugstore service, a PublicService service and a FurnitureShop service. These WebServices were developed using the Java WebServices Developer Pack version EA2 and 1.0 Final from Sun Corporation, using the JAX-RPC technology. An interface and its implementation were developed for each service using Java. The interface specification for the FurnitureShop service is shown in Figure 3. A WSDL – Web Service Description Language - specification was also created for each service [Kreger2001].

```
package pt.uminho.paredes.webservices.furnitureshop;

import java.rmi.Remote;
import java.rmi.RemoteException;
import pt.uminho.paredes.webservices.furnitureshop.*;

public interface FurnitureShopIF extends Remote
{
  public String getName() throws RemoteException ;
  public Address getAddress() throws RemoteException ;
  public String getPhone() throws RemoteException ;
  public String getEmail() throws RemoteException ;
  public TimeTable getTimeTable() throws RemoteException ;
  public String getStyle() throws RemoteException ;
  public int getArea() throws RemoteException ;
  public String getURL() throws RemoteException ;
  public FurnitureShopData getFurnitureShop() throws RemoteException ;
}
```

Figure 3. Interface specification of the FurnitureShop Web Service.

In this initial prototype, a total of 120 Web services were implemented, one of each type for each one of the 40 parishes. They all run on a Tomcat 4.0.1 HTTP server. The information they provide is stored in the central database. This solution was adopted to provide a smooth path for the enrolment of third party information providers. With this platform, information providers are allowed to insert and update information remotely without the need to maintain a computational platform and a permanent Internet connection.

The Registry module maintains the association between a Web Service and its geographic area of relevance. This is a simple XML document with a list of locations – parishes – and a reference to the corresponding Web Services. New Web Services, local or remote, can be added to the system by adding its reference to the registry. The use of UDDI – Universal Description, Discovery and Integration – for the implementation of the Registry was also considered [Kreger2001]. However, we found that current implementations are not flexible enough to appropriately support spatial queries. This issue is currently being studied, namely through the creation of a taxonomy better tailored for location-based services.

3.3 The mobile portal model

The model used to generate the user interface of the mobile portal is shown in Figure 4 and integrates two main parts: i) the contextualization process, from which the user location is obtained, and ii) the interaction with the Web services and the information presentation.

Since no automatic location of the users has been yet implemented, when a user access the portal, he is asked to provide his location, by selecting it from a list or by entering a pair of coordinates. This choice is presented in deck d2 (deck d1 implements the portal home page). If the user decides to provide a geographic point, the coordinates are validated and, if correct, his position is mapped into one of the location contexts defined in the GeoMap. In any case the Location Context is updated with the user current location through the Location bean and through the Location Context Client. In the future, this initial deck (d2) can be removed and the Location Context Manager be enhanced to obtain the user location automatically. That is what makes this system ready to evolve as soon as location services become available: this improvement will have no impact on the main part of the portal.

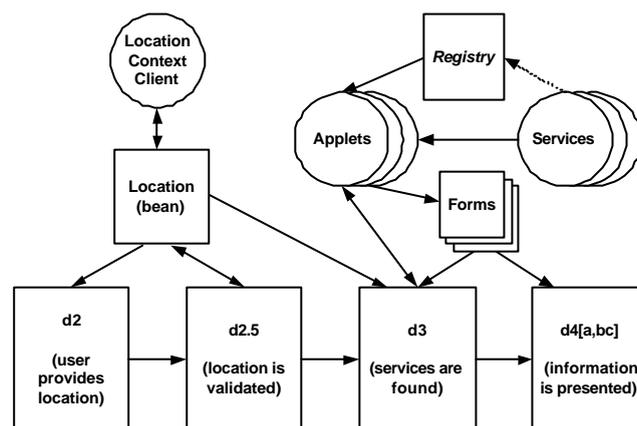


Figure 4. Model used to generate dynamic WML decks and cards.

Access to information services starts within deck d3. Here, the Location Context Manager is queried to obtain the user location (also through the Location bean), the Registry is queried for the available Web Services for that location, the Web Services are contacted and the information is retrieved. This process is implemented by the Applets and Forms shown in Figure 4. The Applets, which are Java beans, implement the application logic and interact with the Registry and the Services. There are as many Applets as types of Web Services as they must know how to interact with the Web Services. The Forms are used by the Applets to store information obtained from the Services. Forms are bound to the user HTTP session and store the information relevant for the user location. As the user selects one of the services, the WML decks and cards d4[a,b,c] presenting the information are dynamically generated using JSP technology.

3.4 The Web Application

The Web Application is used by Providers to insert or maintain the information stored in the database. This is a simple application developed using the ASP technology and that interacts directly to the database through an ODBC driver. Access to this application requires the users to authenticate using login/password.

A note on the synchronisation between this application and the Web Services is required: Providers are free to update the information on the database without any interference on the behaviour of the Web Services that use the database; this is because Web Services only access the database when they start up. To update the Web Services, they must be restarted.

4. RESULTS

The major result of this project is a prototype of a mobile portal, accessible by any WAP enabled mobile phone, and that provides information relevant for the user location.

The user interface of the mobile portal was designed to facilitate the interaction between the users and the application. Except for the case where the user chooses to enter a pair of geographic coordinates, he/she is never asked to type data into the application; only selection is required to navigate through the several decks and cards. In the development of the cards special care was taken to make them small, to minimize the download time, and to use simple WML tags to maximize the support by many different mobile phones.

A few examples of the user interface are shown in Figure 5 (in Portuguese).

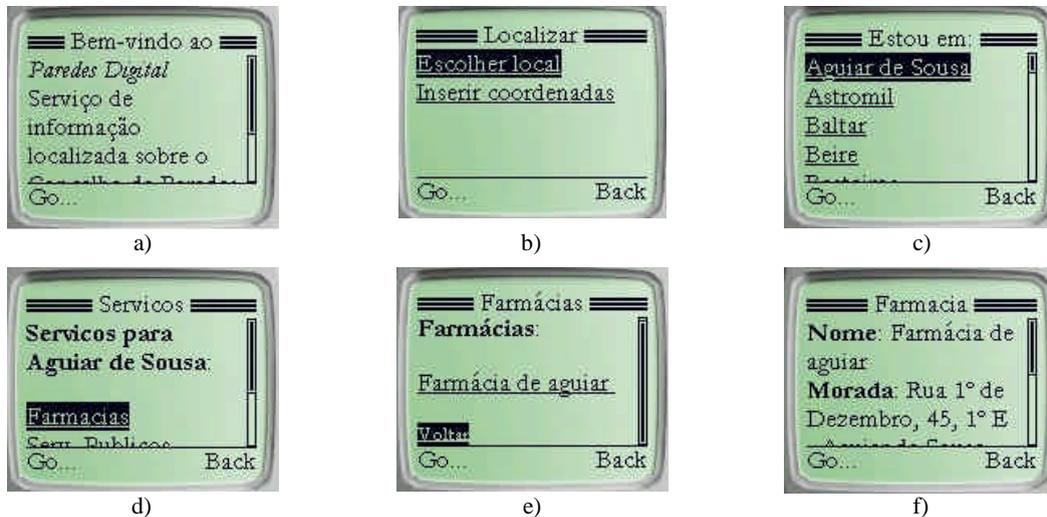


Figure 5. The WAP application user interface: (a) main page; (b) selecting a list of locations or the insertion of a pair of coordinates; (c) selecting a location from a list; (d) services available for “Aguiar de Sousa”; (e) list of drugstores in “Aguiar de Sousa”; (f) detailed information about the selected drugstore.

The portal was tested with a few different mobile phones, using both CSD (Circuit Switched Data) and GPRS (General Packet Radio Service) connections, and the portal response time was found to be very good (the observed delay is mainly the delay introduced by the network connection).

A question however arises at this point: what makes this mobile portal different from a simple application with direct access to a database, as was done for the Web application? Wouldn't that approach result in a simpler system? The differences are that:

- This approach leads to an open system, where Web Services maintained by third party entities can be easily integrated. The only required operation is its registration in the Registry. This way, the path for the involvement of other Providers running their own web Services is implemented. With this feature, many dynamic and real time services, like reservation services, can be accessed through the portal.
- An intermediate solution between centralized contents and complete distributed Web Services is also supported to permit information Providers to integrate their services without the need to maintain a computation platform and a permanent Internet connection;
- The contextualization process is separated from the selection of services. Although this prototype only supports manual positioning, it can evolve to integrate automatic positioning as soon as the mobile network operators provide access to their location services (GMLC). Other positioning technologies

can also be easily integrated, for instance by reading the geographic position of a user directly from a GPS receiver.

On the other hand, some limitations still exist:

- Users are required to manually enter their location. For Resident users this is not major problem. However, for Visiting users, this limitation has a great impact on the system usability, as they are not familiar with the local geography and names of places. Even so, it might be interesting to keep this manual feature into future versions of the system with automatic positioning, to allow the users to simulate their presence at a certain location without actually being there;
- For Web Services of the same type that share the same database, it would be more interesting to have only one Web Service that could provide information for different locations. This approach was attempted but with the current state of the Web Services technology the required implementation is not yet supported.

As this paper is being written, the system prototype is being prepared to become publicly available. The database is being loaded with the required data by the municipality council staff and then some final testing will be performed.

The evolution of this system is also being planned. Future developments of this prototype should include the development of other new services, like access to local maps, routing directions or specialized services for professional users. The integration of automatic positioning and automatic authentication of users will continue to be evaluated as technology matures.

5. CONCLUSIONS

In this paper we described the development of a location-based portal for mobile users based on the WAP technology. The architecture for an open system, integrating the mobile channel for mobile users and a Web based application for information providers, was proposed.

With this experiment, we found that Web Services provide a promising approach to support the openness of the system to third party information providers. For more limited information providers a centralized information database, with remote access capabilities through a Web browser was also demonstrated. We also concluded that, although supported by the current state of the technology, access to position/location services maintained by mobile network operators is still unavailable. Such access would greatly enhance the system usability and has great potential for the implementation of more sophisticated services and applications. To overcome this problem, an approach based on the user input was demonstrated.

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TOWARDS A PORTAL FOR MINORITY RIGHTS IN EUROPE*

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ABSTRACT

We here present the ongoing research project MIRIS which for a very first time will offer an intelligent Web portal to all relevant information on minorities of all member states of the Council of Europe. MIRIS contains both legal documents as well as factual knowledge and provides a coherent presentation with powerful query capabilities including content-based search. We adopt a knowledge-based approach, heavily relying on the use of ontologies and metadata. An ontology will be used to annotate the documents with contents, to expand queries, and to provide different views on the information. Various possibilities to access the information system will be provided, from a focused search for specific information and documents up to the generation of reports to a certain topic. Current Web standards including XML and RDF will be applied.

KEYWORDS

Ontology, semantic web, information system

1. INTRODUCTION

The rapid growth of the Web and the lack of powerful representation languages make it increasingly difficult to locate, organize, and integrate the available information. One of the problems is that the available data and knowledge is mostly represented for human readers, and computers don't have any idea about the content. The Semantic Web tackles this problem by explicitly introducing semantics (Berners-Lee, T. 1999). The vision is to annotate the information sources with content such that machines can process documents on a semantic basis — hence to move from a human-browsable Web to a machine-processable Web. Several languages, standards, representation formalisms, and tools including XML, RDF, OIL, DAML have been developed which foster the development of a Semantic Web.

On the content side, ontologies as an explicit representation of knowledge have been proven to play an absolute crucial role for the Semantic Web. An ontology as a “an explicit specification of a conceptualization” (Gruber, T. R., 1993) provides a particular view of some part of the world by specifying classes of objects and relationships that are assumed to exist. The main purpose of any ontology is to provide a shared understanding and facilitate an effective communication between various agents by providing a means for a concise and unambiguous representation of the knowledge to be transferred. The communication partners include humans as well as computational systems (Gruninger, M. and Lee, J., 2002). If two agents agree about a common ontology, they have a shared understanding of (a part of) the world and know what it means if an agent refers to a particular class, object or relationship.

In this paper we present an ongoing research project which aims to develop a comprehensive information system for minority rights in Europe. Our main focus will be on the use of Semantic Web technologies which allow intelligent information access. Section 2 presents the background and a general overview of the system. Section 3 provides an overview of the relevant documents. Section 4 is devoted to the knowledge base which stores meta-information for the documents as well as a domain ontology. Section 5 describes various modes to access the information. In section 6 we discuss related work.

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2. THE MIRIS SYSTEM

Due to a new sensibility towards minority questions, the documentation and easy availability of data on ethnic, national, and linguistic minorities is increasingly significant. While international treaties and documents of international organizations are mostly available on the Web, the gathering of extensive information on the legal standards in different countries, such as national legislation or case-law, is still a difficult task. The existing databases about ethnic/linguistic minorities are either limited to a few countries (e.g. MINELRES and CEDIME-SE, which are focusing on south-eastern European Countries only) or they only cover a few topics (e.g. Mercator, which focuses on linguistic rights only). Furthermore, those databases are mostly unstructured. Often, documents are simply listed without being organized by keywords or topics. From a content and technical point of view, the user's search is not supported. Thus, a quick search or a comparison between different countries is often a difficult task.

Taking into account these problems, the ongoing research project MIRIS (Minority Rights Information System) aims to develop a comprehensive information system about ethnic minorities and autonomies in Europe. MIRIS will offer for the very first time an intelligent Web portal to all relevant information on minorities of all countries which are member states of the Council of Europe. It will become a major consultation center for minority questions in Eastern and Western Europe. MIRIS is a project led by the European Academy of Bozen/Bolzano in cooperation with the Faculty of Computer Science of the Free University of Bozen/Bolzano (Italy).

The principle architecture of MIRIS is shown in figure 1. We want to adopt a knowledge-based approach similar to (Staab, S. et al., 2000), heavily relying on the use of ontologies and metadata. Semantic Web concepts will be applied such as content annotation of documents. The query engine provides a coherent presentation and powerful query capabilities including content-based search. The knowledge base contains factual knowledge about minorities, metadata about the documents, and a domain ontology. The inference engine derives additional knowledge which is not explicitly stored in the knowledge base. The document database stores only the most important documents. The other documents are retrieved on demand from the original URL.

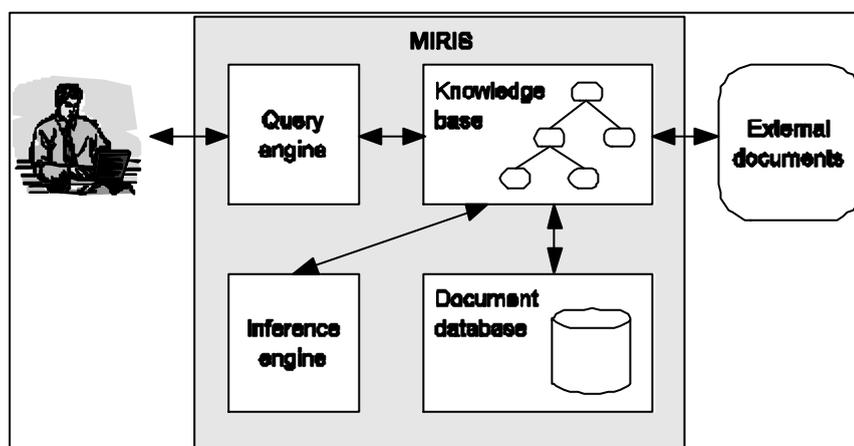


Figure 1. MIRIS system architecture.

The query engine is implemented using Java Servlet and JSP technology running on the Tomcat Web server. For the document database we use Oracle. For the representation of data and knowledge we intend to apply current Semantic Web standards and formalisms such as RDF(S), DAML, or OIL (Gómez-Péres, A. and Corcho, O., 2002). The first version of MIRIS with limited functionality can be accessed at <http://miris.eurac.edu>.

3. TEXT DOCUMENTS

Nearly all of the relevant information is stored in human-readable documents, such as the state reports to which the member states are committed, minority reports, international law contracts, national laws, etc. Ta-

Table 1 represents a snapshot of the documents we collected to date (January 2003). We distinguish between internal documents, which are physically stored in our database, and external documents, for which we only store the URL.

The most important documents stored in our system are encoded for structural information using XML, which not only allows a coherent visualization of the documents but also a more specific and fine-grained search. In combination with content annotation at the level of law articles, MIRIS offers direct access to relevant parts of documents on a semantic basis.

Table 1. Overview of MIRIS documents

Document types	Internal	External	Total
Case Laws	145	25	170
Country Information	57	62	119
International Organization Documents	38	52	90
Info about International Organization Documents	10	24	34
Minority Information	41	76	117
National Laws	1128	529	1657
Reports	186	274	460
Treaties	74	48	122
Total	1679	1090	2769

For structural encoding we use the DocBook XML document type definition (DTD) because of its general nature. DocBook has been adopted by a large and growing community of authors writing documents of all kinds, it is easy to understand and there is a rapidly expanding support for it in a number of free software environments.

As structural encoding is a very time-consuming task, only the most important documents and documents which rarely change can be stored locally. For all other documents we store the URL, and they will be retrieved on demand. Similar as for local documents, MIRIS offers content-based search at a fine-grained level for external documents, but the user cannot directly jump to the relevant parts, merely he/she gets the indication and has to scroll to the relevant section/law article.

The MIRIS team is composed of twelve lawyers. Each one is responsible for the retrieval and annotation of documents pertaining to one or more countries. The texts they look for are primarily official versions along with official/unofficial translations in other languages. Another group in the team is in charge to convert most of the documents into the DocBook XML format. Figure 2 shows a small chunk of the “Framework Convention for the Protection of National Minorities” encoded using DocBook XML.

The “Framework Convention” represents the first ever legally binding multilateral instrument devoted to the protection of national minorities in Europe. Only 34 of the 43 European Countries signed and ratified the “Framework Convention”. Our lawyers have collected to date (January 2003) all the data about national laws and the most important reports pertaining to minority questions of 15 different European countries out of the 34 we aim to cover.

4. KNOWLEDGE BASE

The knowledge base and inference engine serve two essential goals: content-based access to the text documents or parts of them as well as the possibility to ask complex queries retrieving factual knowledge in combination with documents.

4.1 Metadata and Ontology

In order to support intelligent access capabilities, we store for all documents, internal and external documents, a set of metadata which includes administrative information as well as content information.

```

<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE article PUBLIC "-//OASIS//DTD DocBook XML V4.1.2//EN"
"http://www.oasis-open.org/docbook/xml/4.1.2/docbookx.dtd">
<article id="s1006337597034">
  <title id="s1006337597034.0">Framework Convention for the Protec-
tion
  of National Minorities</title>
  <para id="s1006337597034.1">Strasbourg, 1.II.1995</para>
  <section role="preamble" id="s1006337597034.2">
    <para id="s1006337597034.2.0">The member States of the
    Council of Europe and the other States, signatories to the
    present framework Convention,</para>
    <para id="s1006337597034.2.1">Considering that the aim
    of the Council of Europe is to achieve greater unity between
its
    members for the purpose of safeguarding and realising the
ideals
    and principles which are their common heritage;</para>
    <para id="s1006337597034.2.2">Wishing to follow-up the
    Declaration of the Heads of State and Government of the mem-
ber
    States of the Council of Europe adopted in Vienna on 9 Octo-
ber
    1993;</para>
    ...
  </section>
  <section role="section" id="s1006337597034.3">
    <title id="s1006337597034.3.0">Section I</title>
    ...
    <section role="article" id="s1006337597034.3.3">
      <title id="s1006337597034.3.3.0">Article 3</title>
      <para id="s1006337597034.3.3.1">Every person belonging
choose
      to a national minority shall have the right freely to
taste
      to be treated or not to be treated as such and no disadvan-
      tage
      shall result from this choice or from the exercise of the
      rights which are connected to that choice.</para>
      <para id="s1006337597034.3.3.2">Persons belonging to
      national minorities may exercise the rights and enjoy the
      freedoms flowing from the principles enshrined in the pre-
sent
      framework Convention individually as well as in community
with
      others.</para>
    </section>
  </section>
  ...
</article>

```

Figure 2. Example of a document encoded in DocBook XML.

These pieces of information are important for organizing, accessing, and presenting the documents. When properly implemented, metadata can crisply and unambiguously describe information resources, enhancing information retrieval and enabling accurate matches to be done, while being totally transparent and invisible to the user. Search specificity is increased (noise reduction — only good matches) and search sensitivity is boosted (i.e. silence or missed matches are decreased and signal-to-noise ratio increased — all good matches) (Boulos, M. et al., 2002).

In our metadata set, administrative information include among others the author, the document type, the pertaining country, and the language of the text. Table 2 shows a snapshot of the metadata associated with the above-mentioned “Framework Convention”.

More important for content-based search is the annotation with topics, which explicitly describes the content of the documents. We allow content annotation not only at the document level, but down to the level of law articles. The topics are organized in a domain ontology which represents common knowledge about ethnic minorities and provides the vocabulary which is required for describing the content of the documents. An

excerpt of our relatively simple topics ontology is shown in figure 3. The ontology consists of a taxonomy built on the *isa*-relation and a *relatedTo*-relation, which connects related topics.

The ontology is currently being created by our lawyers using Protégé-2000, a powerful knowledge-base-editing environment developed at the Stanford University (Noy, N. F. et al., 2000, Noy, N. F. et al., 2001). It allows us by means of its flexible metaclass architecture to use configurable templates for the classes we include in our knowledge base.

We generate content annotation at different levels for internal and external documents. This allows fine-grained, content-based search in a uniform way independent of the location of the actual document. Additionally, for local documents MIRIS guides the user directly to relevant parts of the document. For external document only the entire document can be accessed and the user has to scroll to the indicated part.

Table 2. Metadata associated to the “Framework Convention”

Metadata Slot	Value
documentType	<i>International Organization Document</i>
title	<i>Framework Convention for the Protection of National Minorities</i>
author	<i>Council of Europe</i>
language	<i>English</i>
source	<i>Council of Europe</i>
sourceURL	<i>http://www.coe.int</i>
dateOfSignature	<i>1995-02-01</i>
dateOfEntryIntoForce	<i>1998-02-01</i>
documentNumber	<i>157</i>
officialVersion	<i>yes</i>
legallyBinding	<i>yes</i>
treatyParty	<i>Albania</i>
treatyParty	<i>Armenia</i>
treatyParty	<i>Austria</i>
treatyParty	<i>¼</i>

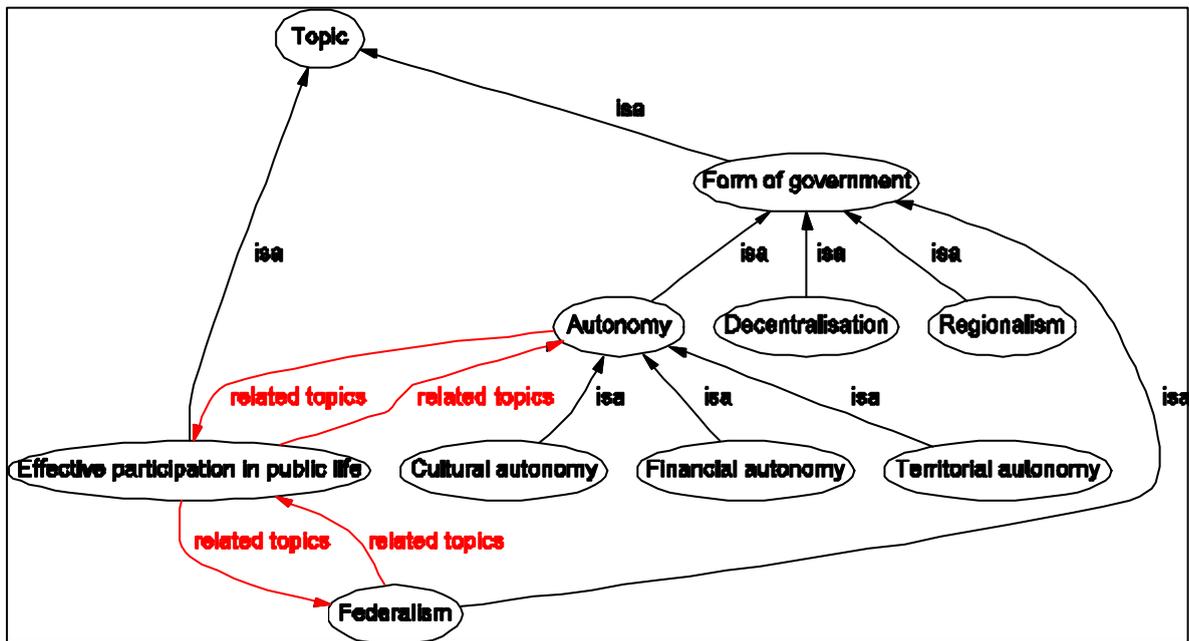


Figure 3. Part of the topics ontology.

Our metadata set will soon be restructured and re-mapped into a new one, as extension of a well-known metadata standard: the Dublin Core (DC), a 15-element metadata set intended to aid discovery of electronic resources. DC is not a complete metadata solution though. For example, DC cannot be used to describe the *guiding principle* of a case law, the *list of minorities* covered by a specific legal text or the fact that a docu-

ment is *legally binding*. Since there are no DC elements covering these peculiar aspects of our resources, MIRIS is attempting to fill this gap using its own additional elements.

4.2 Factual and Legal Knowledge

In addition to the metadata, we plan to store factual knowledge about ethnic minorities, e.g. the minorities in a specific country, population numbers, and languages used. This allows to ask specific queries such as “What is the largest minority in Italy?” or “How many ethnic groups exist in Germany?”. The inference engine can deduce new knowledge which is not explicitly stored. For example, let’s suppose that a Regional Law article states that every citizen has the right to use his/her mother tongue in public offices. Since municipality offices are public offices, the system can deduce that every citizen can use his/her mother tongue in municipality offices.

5. ACCESSING MIRIS

5.1 Searching and Browsing the Database

An important aspect of the MIRIS system is to provide a coherent presentation and powerful query capabilities to information about minority rights. Various functionalities and interaction modes will be offered including

- simple search mode,
- ontology-driven search mode, and
- natural language interface.

Figure 4 shows a screenshot of the MIRIS interface for the *simple search mode*. On the left-hand side, the user can specify up to six query parameters by selecting values from check boxes. In our example, we are interested in English versions of national laws which regulate non-discrimination. The right-hand side shows the result of the query. The documents in the result list are ordered first by country and then by date. The result list contains for each hit some important metadata including the date of the document, the topics which are regulated in the document (related subject), and the minorities for which this document applies.

Since the current interface seems to be rather complex, we are investigating a context-dependent, *ontology-driven*, iterative search strategy, where the user starts with one or only a few search criteria. If the result set is too large, the system offers the “best” next selection criteria in order to reduce the number of matched documents. In this way, the system can avoid that the user specifies a search criteria which is irrelevant for the result set.

Concerning the presentation of the search results, we still have to investigate the dynamic annotation of the result set with additional information, such as topics and links to related documents. Again, the ontology might provide valuable information to enrich the query result.

The third kind of database-access that we want to offer is a *natural-language interface*. This will allow users to formulate questions in English which will be translated by a natural-language-processing (NLP) engine into SQL queries. Obviously, English (or indeed any natural language) is more expressive than SQL. The problem with English is that it is too expressive. Therefore, restricting the domain of an NLP system is the only practical way to get a manageable subset of English to work with. Databases as MIRIS usually cover a small enough domain so that an English question about the information contained in it can be analyzed by an NLP system. The standard approach that we will try to follow creates a ‘semantic grammar’ for our database. This grammar generates a representation of the semantics, or meaning, of the sentence and will be used to parse the English questions.

Another kind of query mode which still has to be investigated in detail is to ask complex queries which involve both the knowledge base and the text corpus, e.g. which topics are regulated in a specific country? This query shall result in a list of topics together with the documents which regulate these topics. Obviously, such a query requires some inference. A topic is regulated if it is explicitly stated in the state report of a country or if it is regulated by a national law.

5.2 Country Comparisons and Report Generation

Two rather important functionalities which we aim to include into MIRIS are the comparison of two different countries and the generation of reports about a specific country.

The *comparison of two countries* analyzes on the basis of the knowledge and the documents stored in MIRIS, how a possibly limited set of topics is regulated in the two countries. The result might be presented in a two-column table which lists in parallel all documents ordered by topic and document type for both countries. Such a table provides a first overview about which topics are regulated and, what is also very important, by what type of document.

The *generation of reports* is meant to collect information and data from several documents and composes a single report, which provides a summary about a specific topic, e.g. “Ladins in South-Tyrol”. Such a report might be generated automatically or can be individually composed by the user. This can be supported by preparing a list of terms out of which the user can choose.

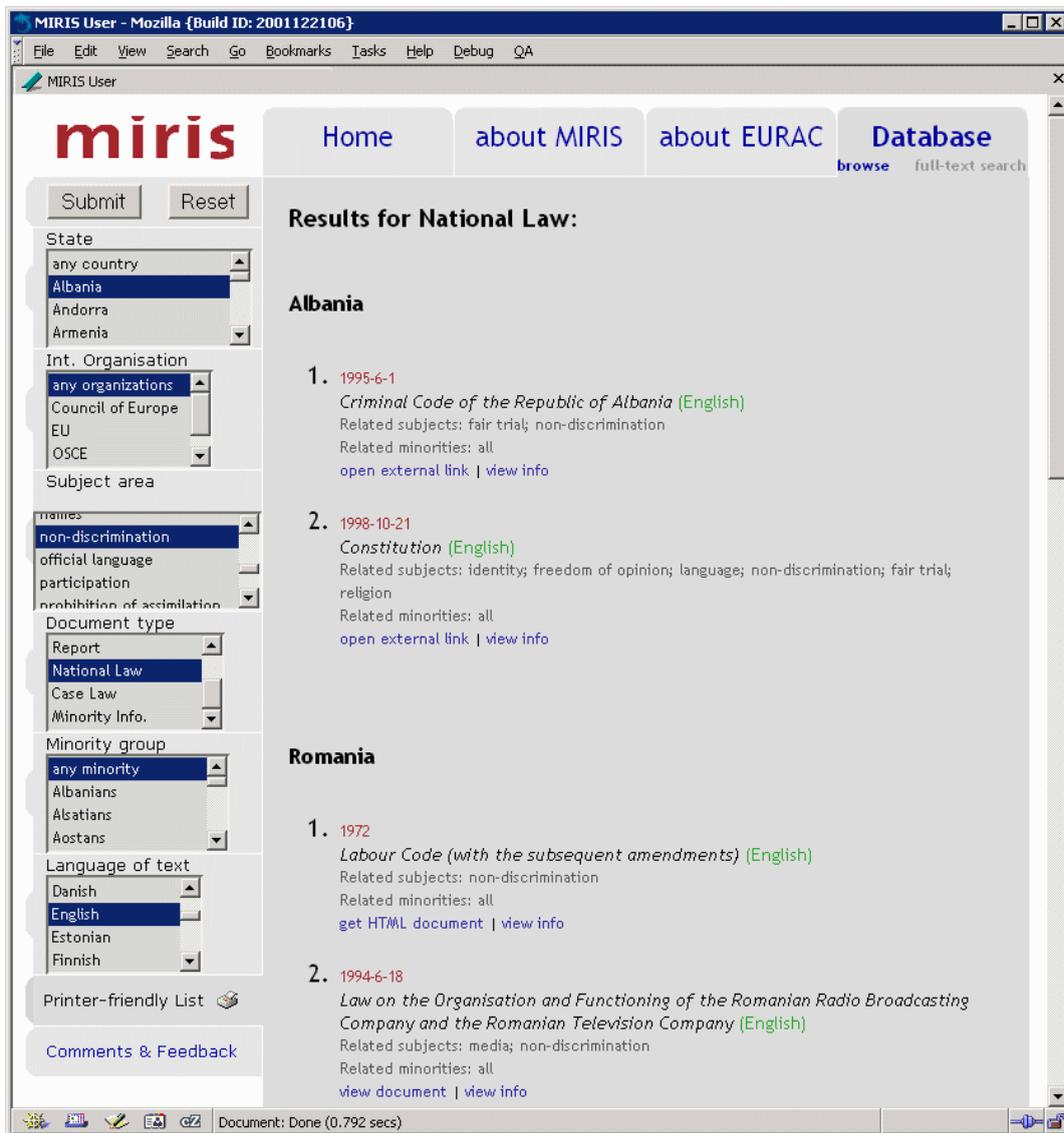


Figure 4. Screenshot of the MIRIS search interface.

6. DISCUSSION AND CONCLUSION

While the Web offers exciting possibilities as a knowledge and data repository, its rapid growth in terms of available information requires new methods and techniques for the organization, storage, and retrieval of information. One of the main limitations of today's Web is that most documents are not prepared to be processed by machines but only by humans. In other words, the semantics of the documents is not made explicit.

As the Web is rapidly growing, the needs for a Semantic Web have been recognized by several researchers. Recent efforts and projects have been presented and discussed in several workshops, conferences, and journals, which were devoted to the invention of the Semantic Web, e.g. (Fensel, D. and Musen, M. A., 2001, Horrocks, I. and Hendler, J., 2002, Preece, A. and Decker, S., 2002).

Aside from the work on new standards, expressive languages, and powerful tools, there are several projects which focus on the implementation of Semantic Web applications. Thereby, ontologies play an absolute crucial role. Several systems have been developed which focus on the use of ontologies for information integration and content-based search, e.g. (Bergamschi, S. et al, 1998, Guarino, N. et al., 1999, Cost, R. S. et al., 2002, Staab, S. et al., 2000) to cite a few examples. All of these systems follow the same idea, namely the use of ontologies to explicitly describe contents, which is the basis for content-based search. The systems mainly differ in the application domain and in the used technology.

The ongoing research project MIRIS presented in this paper follows the same line. We adopt a topics ontology which provides the vocabulary to annotate the documents with contents, which finally allows for content-based search. MIRIS contains both legal documents as well as factual knowledge. Various access possibilities will be provided, from a focused search for specific information and documents up to the generation of reports to a certain topic. It will for a very first time offer an intelligent Web portal to all relevant information on minorities of all member states of the Council of Europe.

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A PRACTICAL FRAMEWORK FOR MOBILE SET PAYMENT

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ABSTRACT

Making SET payments through mobile devices is difficult because of the limitations on both mobile devices and wireless networks. To overcome these limitations, agent-based SET payment systems have been proposed. However, they are still not quite suitable for wireless environment. In this paper, we propose a new framework for agent-based SET payment which provides more suitable and practical solution for wireless networks. With our modified SET wallet, the computational load at the client side is reduced. We also show that the system satisfies transaction security properties including accountability and client privacy which are the most important properties of electronic commerce protocols. In addition, the credit-card information is not required to be sent over the air. This results in the security enhancement of the system. The system is practical because it is fully compatible with the existing SET payment infrastructures, hence there is no modification required on merchants and payment gateways.

KEYWORDS

Mobile commerce, SET protocol, payment system, electronic commerce, mobile agent

1. INTRODUCTION

SET protocol [8] is a well-known credit-card payment protocol introduced by Mastercard and VISA. Even though SET is successfully implemented on fixed networks, it is not easy to implement it on wireless ones because of the nature of the SET itself and the wireless networks. Firstly, SET is a complex protocol which is implemented using public-key infrastructure (PKI). All involved parties are required to possess their own certificates. For wireless environments, the implementation of PKI requires more powerful wireless devices than current ones. In the case of wireless networks, in addition to the higher connection costs compared with the fixed ones, wireless networks also have limitations on low bandwidth and poor reliability.

To overcome such limitations, Romao and da Silva [9] proposed an agent-based SET payment system (SET/A). With SET/A, client is not required to stay connected to the Internet during the whole period of the transaction. An agent containing SET wallet plays as the client's role in SET payment session. Thus, the client needs to connect to the Internet for short periods during the entire transaction. However, SET/A is vulnerable to attacks because the agent is required to bring SET wallet with it to perform cryptographic operations at the merchant environment which is considered to be hostile. To solve this problem, [9] suggested that SET/A should be implemented on temper-proof environment or a secure co-processor.

Wang *et al* [10] proposed SET/A+ which is a modified version of SET/A in order to solve the problems and limitations of SET/A. SET/A+ is operated in the larger scenario than that of SET/A, in that, it includes the brokering and negotiation phase which naturally requires the capability of agent in SET protocol. Client's *Purchase Request* is completely generated on the client's mobile device before it is brought with an agent to merchant. However, performing all cryptographic operations including public-key encryptions at client results in the problem of high computational load.

In this paper, we propose a new framework for agent-based SET payment which is able to solve the problems that are presented in both SET/A and SET/A+. We employ the combination of proxy-based solution described in [12] and the agent technology to secure transactions and solve the problems of implementing SET payment in wireless environments. The SET wallet operations are divided into two parts; one resides in the client's mobile device performing low-computational tasks and the other is brought with agent performing high-computational cryptographic operations.

With our system, it does not only satisfy all fundamental transaction security properties including *Accountability* which is one of the most important properties for electronic payment protocols, but also the *Client Privacy* which is a major goal of SET protocol. Moreover, the computational load on the client side is reduced. Furthermore, we show that our system is practical in that no modification on both merchants and payment gateways is required. Thus, it results in full compatibility with the existing SET infrastructures.

This paper is organized as follows: section 2 describes an overview of SET protocol, problems and limitations of mobile payments, and the existing approaches. Section 3 illustrates our framework. In section 4, the analysis and discussions of our system are presented. Section 5 concludes our work.

2. BACKGROUND

2.1 Overview of SET Protocol

Three main parties are engaged in SET protocol [8]: client, merchant, and payment gateway (PG). Client uses a credit card to purchase goods or services from merchant. Merchant is an authorized party who has goods or services. PG is a party who acts as a medium between client and merchant sides and issuer (client's financial institution) and acquirer (merchant's financial institution) side. The money is deducted from the client's account by issuer and deposited to the merchant's account by acquirer. The transfer of real money is done over the banking private network. In SET, all parties are required to possess their own public-key certificates. The basic SET protocol can be shown as in Figure 1:

PinitReq:	$C \rightarrow M:$	<i>Initial Request</i>
PinitRes:	$M \rightarrow C:$	$\{TID\}_{Pri-M}, Cert-M, Cert-PG$
PReq:	$C \rightarrow M:$	$OI, h(PI), \{h(OI), h(PI)\}_{Pri-C}, \{h(OI), PI\}_k, \{k\}_{Pub-PG}, Cert-C$
AuthReq:	$M \rightarrow PG:$	$\{\{TID, Price, Date, h(OI), (OI), \{h(OI), h(PI)\}_{Pri-C}, \{h(OI), PI\}_k, \{k\}_{Pub-PG}\}_{Pri-M}\}_{Pub-PG}$
AuthRes:	$PG \rightarrow M:$	$\{\{TID, Price, Date, Yes/No\}_{Pri-PG}\}_{Pub-M}$
PRes:	$M \rightarrow C:$	$\{TID, Date, Yes/No\}_{Pri-M}$

Figure 1. SET Protocol

Where

- $\{C, M, PG\}$ stands for a set of client, merchant, and payment gateway, respectively.
- $\{Pub-A, Pri-A\}$ stands for the set of public key-private key pair of a party A , respectively.
- $Cert-A$ stands for the certificate of a party A which contains the identity and the public key of A .
- OI stands for order information. $OI = \{TID, h(OD, Price)\}$. Where OD and $Price$ stands for the description of the goods and its price, respectively.
- PI stands for payment information. $PI = \{TID, h(OD, Price), ID_M, Price, CCI\}$. Where CCI stands for credit-card information and ID_M stands for merchant identifier.
- TID stands for transaction identifier which contains the date of transaction (*Date*).
- $\{X\}_{Pri-A}$ and $\{X\}_{Pub-A}$ stands for the message X signed with the private key and encrypted with the public key of party A , respectively.
- $\{X\}_K$ stands for the message X encrypted with a symmetric key K .
- $h(X)$ stands for applying hash function to the message X .

From Figure 1, client and merchant exchange the information (**PinitReq** and **PinitRes**) to start a SET session. The important step starts at **PReq** where client sends *Purchase Request* to the merchant. The content in **PReq** has two parts for two purposes; one signed with the client's private key is used for requesting to purchase goods or services from merchant, and the other encrypted with PG's public key is used as a request

to PG to deduct the money from the client's account. However, the latter part is not directly encrypted with PG's public key, but it is symmetrically encrypted with a session key k generated by client, and then the key k is encrypted with PG's public key.

After receiving **PREq**, merchant retrieves *OI* and then sends *Authorization Request (AuthReq)* which is the request to PG for transferring money to the merchant's account to PG. **AuthReq** is signed and encrypted with the merchant's private key and PG's public key, respectively. PG then decrypts **AuthReq**, verifies the merchant's signature, and retrieves *PI* which contains the client's credit-card information. PG consults the issuer and the acquirer about the validity of the client's account. After the payment is approved, PG sends the *Authorization Response (AuthRes)* which is the commitment to deduct the money from the client's account and to transfer the money to the merchant's account, respectively, to merchant. **AuthRes** contains *TID*, price, the date of transaction, and status of transaction "*approved/rejected*".

Merchant decrypts the message and retrieves the result of the transaction. The merchant then sends the *Purchase Response (PRes)* which is the receipt of the payment and the commitment to deliver goods or services to the client. Client then verifies the merchant's signature and retrieves the result of the transaction.

2.2 Mobile Payment – Problems and Limitations

The evolution of mobile Internet offers broader ranges of applications than that of traditional Internet. Ideally, the mobile Internet and traditional one could serve all applications, including making payments, with the same level of security. Moreover, the mobile Internet applications could be compatible with the existing infrastructures for traditional Internet applications.

In fact, practically, two main limitations cause payments on mobile Internet unaccomplished: the resource limitations of mobile devices and mobile networks themselves [9]. Firstly, mobile devices are considered to be low-powered devices and have low-computational capabilities. They are operated using batteries compared with electric power in personal computers (PCs). Moreover, the computational capability of mobile processors is comparatively lower than that of PCs. Because of these limitations, high computational cryptographic algorithms are not applicable to mobile devices. Secondly, wireless networks have lower bandwidth compared to fixed networks. The network connections are less reliable, thus it takes longer than fixed networks to complete each transaction. Furthermore, the cost of connection of mobile communications is considered to be more expensive. Thus, making payment on wireless networks is a time-consuming process which is unacceptable by customers.

2.3 Existing Approaches

2.3.1 SET/A

SET/A was proposed by Romao and da Silva [9] in order to solve the problems of implementing the SET protocol [8] in wireless environment. The concept of SET/A is to let agent perform transactions on the behalf of client outside client. In SET/A, the SET protocol is operated in asynchronous mode. Client starts the SET initialization request by sending an agent containing SET wallet traveling into merchant's server and staying there in order to perform transactions on behalf of the client. At the merchant's server, the client's **PREq** is generated and sent to the merchant. The merchant then performs the transaction as per the original SET protocol. The agent waits for **PRes** from merchant, and then returns to client.

With the use of agent, client connects to the Internet only two short periods; one for sending the agent out at the beginning of the transaction and the other for receiving the agent back at the completion of the transaction. Thus, the cost of connection is reduced. Moreover, the computational load on mobile devices is reduced by sending agent to perform operations at merchant.

However, performing cryptographic operations at merchant is vulnerable to attacks because the merchant's server is considered to be a hostile environment. In particular, in order to construct **PREq**, the agent is required to randomly generate a session key k for encrypting *PI*. This process is vulnerable to attacks. [9] suggested that SET/A should be operated in a tamper-proof environment or secure coprocessor, but they are complicated and can incur high cost [10].

2.3.2 SET/A+

Wang *et al* [10] proposed a modified agent-based SET payment system (SET/A+) to solve the problems of SET/A. They proposed the SET payment from the user's point of view which considers payment procedure as a stage of Internet trading. This makes the system operate in larger scenario than that of SET/A.

SET/A+ employs two agents performing two different tasks: (i) Information gathering and Negotiation Agent (INA) for brokering and negotiating, and (ii) Payment Agent (PA) for making payments. INA is sent to collect the information about goods and the corresponding merchant information and return to client. PA performs payment operations. In order to make the payment, client sends PA containing **PReq** to merchant. PA waits for **Pres** within merchant's server, and then returns to client.

[10] argued that SET/A+ has practical advantage over SET/A by considering the payment together with the brokering and negotiation of goods. This allows the system to operate in a larger framework. Moreover, **PReq** is completely generated within the client's mobile device. Thus, the problem of session key compromise occurred in SET/A is eliminated.

However, generating **PReq** at the client side results in the problem of the high-computational load which is what Romao *et al.* [9] tried to avoid when designing SET/A itself.

3. PROPOSED APPROACH

In our approach, we try to solve the problems that are presented in both SET/A and SET/A+ protocols. We divide the SET wallet operations into two parts; one is operated at client's mobile device, and the other is brought with agent traveling outside the client. At the client side, we try to minimize the computational load. With agents traveling to merchant's server, we let them perform high computational tasks.

We employ the concept of using two agents from SET/A+: Information gathering and Negotiation Agent (INA) travels to merchant's sites to collect information and makes decision on the suitable merchant, and Payment Agent (PA) performs payment operations by carrying a part of SET wallet with it.

In our protocol, all involved parties except client are assumed to have powerful computers. Thus, we do not concern about the computation on these parties. Client is assumed to have mobile device which is able to access the internet. The issuer has clients' credit-card information and has powerful computational capability. Thus, we can have the issuer as a party whom the agent performs high computational operations for generating **PReq** within her machine.

PReq mainly comprises *OI* and *PI*. *OI* is signed by the client's private key. *PI* is symmetrically-encrypted by the session key k , and k is then encrypted by PG's public key. Other computational loaded tasks are operated outside the client. Thus, we divide the SET wallet operations into two parts: one in mobile device signing *OI* and the others in PA encrypting *PI*. The details of the protocol are shown as follows.

Descriptions of the Protocol

0. Two agents are operated in our system: INA and PA, which are generated and owned by the client. Client establishes the requirements about the goods and affordable price to INA. INA then travels to merchants' sites to search for such information. After INA returns to client with relevant information, client then runs the Authenticated Key Exchange (AKE) protocol (described later in section 4.1.4) to establish a secure channel to the issuer. After the completion of the AKE protocol, both client and issuer possess the session key K_{ex} . Then, the payment phase is proceeded as follows:
 1. As described above, SET wallet is divided into 2 parts. After getting the key K_{ex} , the SET wallet at client constructs a message containing necessary information for establishing **PReq** and the message is encrypted using the key K_{ex} . This information is then passed to the agent PA which is then sent to the issuer.

$$C \rightarrow PA(C): \quad PReqGen, \{ID_I, h(PReqGen)\}_{Pri-C}$$

$$PA(C) \rightarrow I: \quad \{PA(C)\}_{K_{ex}}$$

Where $PReqGen = \{OI, \{h(OI), h(PI)\}_{Pri-C}, ID_M, Price, h(CCI), Cert-PG, Cert-C\}$, I stands for issuer, ID_I stands for the identity of the issuer, and $PA(C)$ stands for the agent PA owned by C.

2. The issuer decrypts the message, verifies the client’s signature, and compares the hash value of *CCI* contained in *PA* and that she has in the database. If they are matched, the issuer issues the pre-image of *CCI* to *PA*. *PA* then performs the following tasks:
 - (i) Generate the session key *k* (for encrypting *PI*).
 - (ii) Reconstruct *PI* from collecting $\{TID, h(OD, Price), ID_M, CCI\}$.
 - (iii) Decrypt $\{h(OI), h(PI)\}_{Pri-C}$ to retrieve $h(OI)$, and then compare with the received *OI*. If matched, it is a valid *OI*.
 - (iv) Encrypt $\{h(OI), PI\}$ with the key *k*.
 - (v) Encrypt *k* with *Pub-PG*.
 - (vi) Collect all relevant information to construct the **PREq**.

After constructing the **PREq**, *PA* containing **PREq** travels to merchant.
 3. Merchant verifies client’s signature, retrieves *OI*, and then sends **AuthReq** to PG.
 4. PG verifies merchant’s and client’s signatures and then retrieves *PI* and consults issuer and acquirer. After completing the authorizations from both parties, PG sends **AuthRes** back to the merchant.
 5. Merchant verifies PG’s signature and then sends **Pres** back to *PA*.
 6. *PA* verifies the merchant’s signature and then travels back to the client.
- Each step of the payment phase of the protocol is diagrammatically shown in Figure 2.

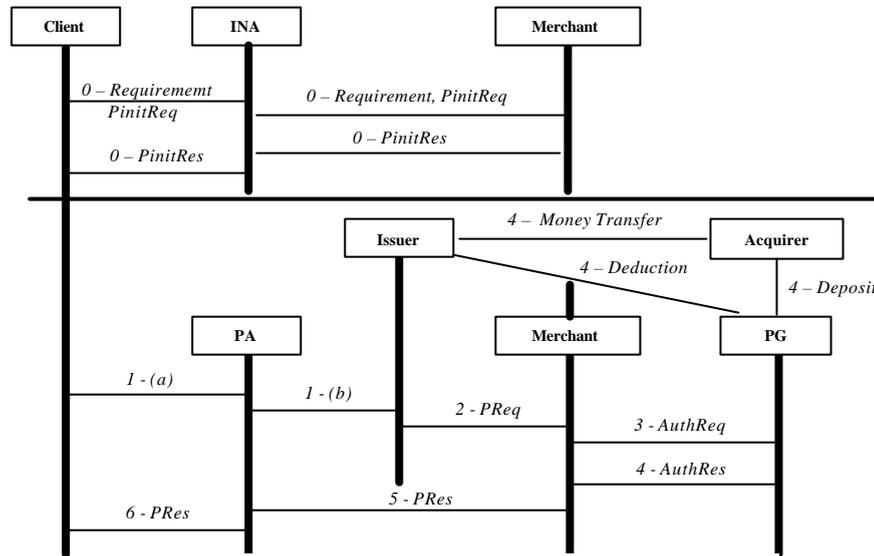


Figure 2. Proposed Agent-Based SET Payment Protocol

4. ANALYSES AND DISCUSSIONS

4.1 Security Issues

4.1.1 Transaction Security

In general, any payment system must satisfy the following security requirements [1]: (i) party authentication, (ii) privacy of transactions, (iii) transaction integrity, and (iv) non-repudiation of transactions.

In this paper, we focus on the extension of the original SET which is the message sent from the client to the issuer. We can see that the messages in our system satisfies all basic security properties stated above: the client’s signature satisfies the authentication of client to issuer and the non-repudiation of the messages which ensure that it is originated by client, the message encrypted with session key K_{ex} satisfies transaction privacy since only client and issuer can decrypt the message, and transaction integrity is ensured by $h(PReqGen)$. Moreover, client is not required to send the credit-card information over the air. Thus, it is not susceptible to attacks. Although K_{ex} may be compromised, the most sensitive information that attackers can

retrieve is only the price of the goods. They cannot extract the goods description since it is hashed. Thus they are not able to provide any linkage between the goods descriptions and its price.

4.1.2 Accountability

In addition to the basic properties described in the previous section, designing a payment protocol requires *Accountability*. The accountability property is the ability to show that particular parties who engage in the protocol are responsible for the transaction [7]. We consider the accountability as the *high-level* security property which covers all above basic transaction security properties (stated in section 4.1.1). From [7], the accountability is not only used to resolve disputes among the involved parties, but also specify protocol goals. Thus, it is worth to consider the accountability as the main security property of our protocol.

We analyze the accountability of our protocol using the Kungpisdan and Pempooantanalarp (KP)'s logic [7] which is a modal logic for analyzing the accountability of e-commerce protocols based on the belief of a party that a prover is able to convince a verifier (or judge) that she is responsible for the transaction. This can be done if the prover is able to provide the accountable evidence to the verifier and the verifier then believes that the prover is indeed responsible for the transaction.

In this paper, we focus only on the interaction between client and issuer since other parts have been analyzed in [7]. The message sent between them means that the client gives the authorization to the issuer to be the party whom PA performs operations within the issuer's machine. In some cases, the dispute arises if the client claims that she has never asked issuer to perform transaction. To resolve the dispute, the issuer should be able to prove to a verifier that client has indeed requested her to perform the transaction. When we are concerned about the goal of the message, the client must be able to prove to issuer that she has requested the issuer to do such task. Thus, the message sent from client to issuer could be seen as a valid proof. To analyze the protocol, we name the transaction between client and issuer as *Transaction request*. Based on [4], to resolve the dispute between the client and the issuer, we can construct the goal of the proof as follows:

I believes I CanProve (C authorized transaction-request(C, I, Date)) to V

Where *I* stands for issuer, *C* stands for client, and *V* stands for any external verifier. The statement above states that *I* believes that she can prove to *V* that *C* has requested to perform transaction on her machine. In order to specify the goal of the transaction between client and issuer, the goal of the proof can be shown as follows:

C believes C CanProve (C authorized transaction-request(C, I, Date)) to I

The goal states that *C* believes that she can prove to *I* that she has requested to perform the transaction at *I*'s machine. We do not show the details of the proofs because of the limited space. The results of our proofs show that the client can prove her request to a verifier and the issuer can infer the client's request with all necessary information. As a result, our system can provide accountability on the extension of original SET protocol. In more general, the accountability of the whole protocol is still preserved.

4.1.3 Client Privacy

One of the most important goals of SET is *Client Privacy*. The client privacy is concerned with the secrecy of goods descriptions (*OD*) and payment information (*PI*). SET achieves the client privacy if merchant cannot infer client's *PI*, and PG (including issuer and acquirer) cannot infer *OD* at the completion of the protocol.

Our system still satisfies the client privacy since there is no modification at both merchant and PG. **PREq** brought with PA sent from issuer has the same structure as that of the original SET. Furthermore, *OD* is not revealed to issuer during the communication between client and issuer because it is hashed within *OI*.

4.1.4 Authenticated Key Exchange Protocols

As mentioned in section 3, the purpose of AKE protocols is to authenticate and secure the communications between involved parties. In our system, the AKE protocol is used to preserve the confidentiality of the content in **PREq** because it contains both client's certificate and the price of the goods. If they are sent in clear text, an attacker can make the relationship between the client and the price. In this paper, we leave the AKE protocol between client and issuer as a block of operation since it is out of the scope of the paper.

Many AKE protocols for wireless networks [7, 3, 12, 14] have been proposed including their analyses [4, 6]. [6] and [2] employ the elliptic-curve cryptosystem to reduce the computation and resource consumption

on the involved parties, especially the client. The difference between these protocols is that [6] is PKI-based whereas [2] is password-based. [11]'s protocol is based on the challenge-response. Recently, [13] proposed a password-based AKE protocol using RSA algorithm. Horn *et al* [5] proposed the analysis of the existing AKE protocols for wireless networks including [3] and [6]. They argued that both protocols are suitable for wireless communications even though [3] requires more communication passes.

4.1.5 Issuer

In the proposed scheme, the role of issuer has been increased from that of original SET protocol in that the issuer acts as an assistant of client in performing the transactions. This is because we consider that the issuer (such as client's bank) is the party who has the database of the corresponding client's credit-card information. Thus, the client's credit-card information is not required to be sent over the air as in SET/A. The client is required to send only $h(CCI)$ to compare with its pre-image kept in the database. If match occurs, the issuer will issue the valid credit-card information to the agent in order to establish **PREq**.

It could be noted that the issuer does not play as a major role in our system. Normally, its tasks are the same as that of the original SET protocol. The additional tasks are only being the assistant of client on issuing credit-card number and of PA in performing high computational operations. The message brought with PA sent from issuer has the same structure as the original SET's **PREq**. Thus, adding some tasks to the issuer does not affect the whole SET protocol. It could also be noted that the issuer would cooperate in this framework because, in the business viewpoint, this would be a service which results in the benefit to the issuer in that it is able to increase a number of clients as well as a number of money transactions.

4.1.6 Security of Agents

In this paper, we focus on PA whose tasks are relevant to SET payment. The PA is defined as a dumb agent. It acts as a messenger who knows its tasks and responsibility. It travels to specific destinations (specific issuer and specific merchant) carrying the information regarding the client's **PREq** and returns with the corresponding **PRes**. The agent could be defined to be having a minimum security level. The security of the information contained by the agent does not depend on the security of agent, but on the cryptographic algorithms applied to such information. The client is not necessary to be trusted by the issuer. The issuer can verify the client from her signature. Thus, the security of the agents is not a major issue in our system.

4.1.7 Security of the Session Key

Wang *et al* [10] pointed out that in SET/A, the session key is risky to be compromised since it is generated by the agent in the merchant's server which is considered to be a hostile environment. Because this session key is used to encrypt payment information, the merchant should not be able to know this key due to the client privacy property which is a goal of SET protocol described in section 4.1.3.

In our framework, the session key k could be generated within the issuer's server because the issuer is trusted by client, and it is assumed to be secure against attacks since if an attacker can access the credit-card database, the whole system would fail.

4.2 Computational Load

Computational capability of the involved parties is one of the most important factors when applying SET protocol in the wireless environment. Especially the client, its computational load must be minimized. This problem has not yet been solved in [10]. In our system, we minimize the client's computation and move high computational tasks to other parties by the payment agent. Thus, the operations at client are only signing, hashing, and symmetrically encrypting messages. The agent PA roaming on the issuer performs the rest of high computational tasks such as public-key encryptions and certificate verifications in order to construct **PREq**. As a result, our system provides the load optimization for the payment on wireless communications.

4.3 Practicability

In extending the applications of existing payment protocols such as SET to wireless environment, the important issue needed to be concerned is *Practicability*. Mobile SET protocol should be compatible with the existing SET payment systems. In order to achieve this, merchants' and payment gateway's payment

infrastructures should not have any modification. Both SET wallets for wireless devices and wallets for wired devices could be operated on the same payment infrastructures.

In our system, even though there are some modifications to the existing SET wallet, the client's **PReq** sent to merchant's server has the same format as that of original SET. Thus, it can be implemented on the existing SET infrastructures. Moreover, our system is operated in the same scenario as that of SET/A+.

5. CONCLUSION

In this paper, we show that the existing SET payment systems for wired networks are not suitable for making SET payment in wireless environment. We then propose a practical and efficient framework of SET payment for wireless networks by solving the problems occurred in the existing approaches. With the agent technology, client is not required to stay connected to the Internet during the entire transaction.

To deal with the problem of computational load at the client side in SET/A+, the SET wallet operations are divided into two parts: one resides at the client's mobile device and the other brought with payment agent perform high computational-loaded tasks at issuer who acts as a client's assistant. We solve the problem of SET/A regarding the session key generation mentioned in [10] with the assistance of the issuer. Moreover, the credit card information is not required to be sent over the air which results in security enhancement.

We also show that our system satisfies all the necessary transaction security properties including accountability and client privacy which are the most important properties of the SET protocol. Furthermore, the proposed system is practical in that it is compatible with the existing SET payment infrastructures without any modification on both merchant and payment gateway.

Our future work will analyze the performance of possible implementations based on the proposed framework. This will allow us to tune an implementation to achieve a predefined performance criterion.

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THE DISTANCE SELLING DIRECTIVE: CONSUMER CHAMPION OR COMPLETE IRRELEVANCE?

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ABSTRACT

This paper investigates the origins, significant content, UK and EU implementation and outcomes of Directive 97/7/EC on distance selling, hereafter referred to as the Distance Selling Directive (DSD). The DSD has been implemented in national legislation by all EU Member States. In the UK this legislation was the Consumer Protection (Distance Selling) Regulations 2000 (SI 2000 No. 2334), hereafter referred to as the CPDSR.

KEYWORDS

Distance Selling Directive, consumer protection.

1. INTRODUCTION

This paper discusses the implementation of the Distance Selling Directive (DSD) and questions whether the legislation affords consumers any protection when buying goods or services on-line. The paper discusses the origins of the DSD, illustrates some of the problems of implementation by presenting some recent "cases" involving the DSD. Conclusions question the validity of the DSD in actually protecting consumers on-line.

2. THE ORIGIN OF THE DSD; MAIL ORDER SHOPPING.

Although the DSD was adopted in May 1997, the initial European Commission proposal for it dates back to 1992 and this in turn stemmed from the Commission's response to a 1989 Council Resolution on consumer protection policy. The consumer protection issues of the time related to mail-shops and telephone shopping performed at a distance. During its genesis, the substance of the DSD was not altered in relation to concurrent technical developments on the Internet that gave birth to e-commerce.

2.1 Coverage & Exemptions

The DSD does not define distance communications by their technical forms, but in terms of their general principles:

"any means which, without the simultaneous physical presence of the supplier and the consumer, may be used for the conclusion of a contract between those parties" (Article 2.4).

The DSD gives only what it calls an “indicative list” of distance communications technologies in Annex 1. This list is unchanged from that originally proposed by the Commission in 1992. It includes electronic mail, but this is probably because private e-mail providers (like AOL, Compuserve and Genie) pre-date Internet-based email by many years. There is no mention of Internet-based technologies like World Wide Web etc. The rest are predominantly traditional technologies, paper and telephony-based. As Recital 9 wisely states, “the constant development of those means of communication does not allow an exhaustive list to be compiled”.

This technological blind spot is causing problems for some new areas. For example:

“The Distance Selling Directive and other regulations must be tailored for m-commerce, as the notices needed by such directives will eat into the storage facilities of mobiles and make 'frictionless' m-commerce almost impossible.” (Naylor 2002)

while the mobile network operator Orange described the DSD as:

“failing to be adaptable and suitable for a range of different means of conducting sales” (McRobb 2000)

It may well be that the first generation of Internet-enabled WAP mobile phones falls foul of DSD because of their small screens, inability to display graphics, slow data transfer speed and miniscule data storage capacity. However this is at worst a temporary problem as the ever-developing capacity of mobile phones (faster GPRS/EDGE/UMTS connections, bigger colour screens, more memory etc.) will eventually allow them to fulfil the requirements of the DSD. Ironically, not defining technologies seems like a lucky windfall when technologies are changing so fast.

There is certainly a problem in the definition of transactions the DSD covers. It does not cover business to business distance transactions. Article 2.2 defines a consumer as a person “acting...outside his trade, business or profession” while Article 2.3 defines a supplier as a person “acting in his commercial or professional capacity”. As Chissick and Kelman 2002 state:

“the implications from early documentation and debate behind the legislation is that a consumer is a non-specialist dealing with an undertaking in a superior bargaining position”

Commentators on the DSD agree that owners of B2B sites should be careful to not allow their customers (other companies) to be ‘consumers’ under the definition in the DSD, since this will allow them rights that they should not warrant. However the definitions of ‘consumer’ and ‘supplier’ can affect the fundamental supply/demand chain operation of e-commerce:

“A big point relates to the co-ordination of the contracts between the site, customers and suppliers. The sale on site is B2C and subject to the customer’s increased rights to cancel [under the DSD] but the sale from supplier to the site is B2B, in which you have no such cancellation rights. So its vital to ensure traders do not have to return monies and yet not get reimbursement from their suppliers.” (Richardson 2002)

2.2 Important exemptions

While most exemptions in the DSD are unremarkable, two need comment. The first is that contracts for the “supply of foodstuffs, beverages or other goods intended for everyday consumption supplied to the home of the consumer, to his residence or to his workplace by regular roundsmen” are excluded. The use of the phrase “regular roundsmen” was clearly intended to limit application to a local grocer in his van, but in an era of Tesco Direct and other online supermarket services, an exemption from the provisions of DSD seems unnecessary and inappropriate. The DTI in their guide for business (Department of Trade and Industry 2000a), however, say that in relation to supermarket deliveries:

“This exemption [from the DSD] will not generally apply to the growing market for home deliveries by supermarkets. Such deliveries are normally ordered specifically on each occasion by telephone, on the Internet or by fax.” However there appears to be nothing in the CPDSR which enforces this suggestion.

The second, and perhaps the most glaring omission is for auctions. While the unique nature of their traditional small-scale specialist role might have warranted exclusion, one of the great e-commerce success stories has been in the area of online auctions, evidenced by companies such as eBay and QXL, who have created vibrant, easy to use auction sites which bring millions of buyers and sellers together. These sites have completely redefined the role of the auction in commerce and massively increased its market share of transactions: in 2000 eBay Inc’s net income rose to \$6.3 million from \$3.8 million a year earlier while sales rose to \$85.8 million from \$42.8 million, exceeding the \$80.2 million forecast (USA Today 2000). Such a large slice of online transactions (for those parts of Ebay based in Europe) ought to come under the DSD:

“in terms of consumer disputes, the credit card company Visa reported in 1999 that one of the major grounds for disputed payments in Europe concerned goods bought through Internet-based auction services.” (Hornle, Sutter and Walden 2002)

3. THE MISSION OF THE DSD: CONSUMER EMPOWERMENT

3.1 Prior Information

At a distance consumers do not have the same opportunity to assess a good/service as they would in a shop. Therefore the DSD requires that certain elements of “prior information” be provided for a would-be purchaser before a contract is entered into. Most of the prior information requirements are uncontroversial and are in essence no more than a sensible trader would wish to provide anyway. The burden of proof concerning delivery of this information (and other DSD supplier information requirements covered later) is on the supplier rather than the consumer. The reason for this provision can be found in Recital 22: “the use of the means of communication is not under the consumer's control, therefore the supplier should prove that the communication has 'reached' the consumer.” The point that has to be made is that the range of distance communication technologies deliver different types of information (text, numbers, still images, audio and video) in different quantities, qualities and speeds to consumers who may be using a variety of different ‘receiving devices’ which may themselves have dampening ‘features’ such as time-charges, unfamiliarity, poor ease of use. Thus while it is possible to legislate what information is provided there cannot be any guarantee that different consumers using the same supplier via the same medium for the same good/service will receive the ‘same’ information.

3.1.1 Prior Information: taxation issues

There is one major problem for suppliers with the prior information requirement and that is for the inclusion of “the price of goods or services including all taxes”: “Does this mean an e-trader, who may take in orders from anywhere in the world, must calculate taxes local to the buyer?” (Walton 2000) Unfortunately the answer according to the DSD must be ‘yes’ if a good comes from an EU Member State, as extra charges from local taxes can make an appealing price offered by an online supplier much less appealing. This problem first came to light in the run up to Christmas 1999, which has the reputation of being the first “e-Christmas” online shopping experience for many consumers: “Alan Stevens, editor of Which? Online, the Internet wing of the Consumers Association, said: "People are shocked when they discover they are going to have to pay up to 33 per cent more than the advertised web site price." Mr Stevens said he did not believe customs recognised all the taxable goods. "At the moment it is a lottery whether Customs and Excise picks up on your parcel. If a package looks as if it is coming from a book retailer, but actually contains videos, customs may not realise this. As part of an EU directive on distance selling, the Department of Trade & Industry proposes making inclusive prices compulsory. Consumers will have the legal right to refuse payment if extra charges are not disclosed. The problem has arisen because most online retailers ship to markets worldwide from a centralised warehouse" (Grande 1999)As the quote notes, the DSD then had only just been passed by the Commission, and was not yet implemented in the UK in the CPDSR.

3.1.2 Providing Prior Information

Article 4.2 requires that prior information must be “provided in a clear and comprehensible manner.” This would obviously exclude information in a very small font hidden linked deep inside a web site. Furthermore, its “commercial purpose...must be made clear” and must be provided in a “way appropriate to the means of distance communication used”. This provision means that the information should be given in the same manner as the distance communication method used, i.e. in the case of a phone call, orally and in the case of a web site, by text and images. However, comprehensibility does not affect the language used, since “the languages used for distance contracts are a matter for the Member States” (Recital 8): “The original draft [of the DSD] did at least require contract information supplied to the consumer to be in the same language as the contract solicitation. This may be a minor point, however, since it is to be hoped that it would be regarded as a breach of good faith for a supplier to supply contract information in a language which he knows

the consumer will not understand. This would not necessarily mean that the supplier should translate the terms, but might well mean that, say, an English company receiving an order in French from a French consumer should supply information in French, whereas it might quite fairly supply the information in English if the order were in English". (Bradgate 1997)

3.2 The Right of Withdrawal: "Cooling off Period"

The most controversial consumer empowerment issue raised by the DSD stems from its longest Article, Article 6, on the consumer's right to withdraw without giving a reason from a distance contract within a seven working day "cooling off" period starting after the receipt of ordered goods/services. Article 6.4 places an obligation upon all Member States to ensure that their legislation provides that any "credit agreement shall be cancelled, without penalty, if the consumer exercises his right to withdraw" which is significant for Internet e-commerce which depends on credit cards, there being no digital cash alternative. Recital 10 limits right of withdrawal to the first contract only. This is unfortunate as this right could usefully apply to successive individual transactions entered into by the parties, as for example in the case of a book club. Note that the right of withdrawal should be seen in addition to existing statutory rights to a full refund of goods are sold faulty or a service is not carried out to a reasonable standard or within a reasonable time frame.

3.2.1 Who Benefits?

The right of withdrawal enables the consumer to make a fully informed choice before the contract is regarded as completely finalised and binding upon the consumer. It provides the consumer who purchases goods or services at a distance the same opportunity to inspect what is on offer that a consumer making such a purchase in a traditional shopping environment will have. Although consumers will receive prior information, it may not adequately 'describe' a product (does a picture show how well a pair of shoes will fit?). This right is also intended to entice new consumers into the advantages of shopping at a distance (lower prices, wider choice, home delivery etc.). Suppliers stand to benefit as well as the right of withdrawal should reduce consumer reluctance to buy unfamiliar products or services and/or use suppliers that might be previously unknown to them. Of course there are possible drawbacks: "What effect will this [right of withdrawal] have on (e.g.) niche-market products shipped halfway round the world? A potential supplier considering selling via e-commerce will realise that the returned goods may not be re-sellable. They will certainly raise the selling price to compensate. They might even decidethat e-commerce is altogether too risky - why not let retailers and distributors carry the risks of fickle customers instead?" (Brooks 2000) "Cooling off" periods are calculated differently for goods and services. The "cooling off" period for the former begins when goods are received but for the from the day of the conclusion of the contract. This is not a problem except where it is unclear whether a specific contract is a contract for goods or a contract for services. For example, it is unclear whether software which is purchased online and downloaded is to be treated as goods or services. Clearly the same software purchased on a physical medium is classified as goods. The OECD has argued that for purposes of VAT and customs duties, software delivered via download should be treated as services (Hornle, Sutter and Walden 2002). However software designed on a bespoke basis to fulfil the needs of a specific consumer would qualify as a service, but it seems odd that a standard software application should be classified differently purely on the basis of the means of delivery employed. The same uncertainty will affect the streamed delivery of pay per use music and video.

3.2.2 Exemptions from the Right of Withdrawal

Certain goods and services are exempted from the right of withdrawal (Article 6.3). A minor anomaly is that "newspapers, periodicals and magazines" are exempt but not books. A similar exemption applies to "audio/video recordings or computer software which were unsealed by the consumer". It has become the norm for film, music and computer software sold on storage media to be sold shrink-wrapped, a simple but nonetheless effective means of ensuring that a consumer cannot take a copy of the content and return the original, thereby acquiring the content without paying for it. However content like music, software etc can be sold directly over the Internet by download and in this situation it appears as though the DSD does not protect suppliers against consumers copying said content, and then exercising their right of withdrawal. This is a weakness with the DSD that needs addressing.

Another worrying anomaly relates to the exemption for goods “made to the consumer's specification or clearly personalised”. It seems sensible that, where there is no question that quality is in any way substandard, a consumer should not be able to reject goods made to their own specification. However, where does “clearly personalised” stop and customised through choice of standard options begin:

“For example, if a consumer purchases a car online, requesting a specific colour, this will clearly be a standard product. But what if a custom colour, to be mixed to the individual consumer's specification, is offered, along with other significant cosmetic and/or other alterations to the standard model, many of which will not be reversible without considerable expenditure? Is this enough to qualify for the exception? In most cases it is likely that the line between stock options and personalised will be obvious, but there are potential grey areas that will fall to be decided by the courts.” (Hornle, Sutter and Walden 2002)

Finally it should be noted that there is no right of withdrawal from contracted services “if performance has begun, with the consumer’s agreement, before the end of the seven working day [“cooling off”] period”. There is intended to be a balance between the consumer’s interests and those of the supplier who may have provided the consumer with benefits from service before withdrawal, but a better approach would surely be to allow the consumer to withdraw but require the consumer to pay for any benefit received. This is a useful exemption for those esteemed professions that make their meagre honest living through vital services: “Many solicitors with consumer clients served by e-mail, fax and telephone only, have already altered their terms and conditions. The Regulations apply and, in many cases, unless conditions are not altered, the consumer could instruct the lawyer, who does the work and then finds the consumer cancels the contract and does not have to pay for the work done. This is reason enough for conditions to be altered now.” (Singleton 2001)

3.2.3 Refunds and Reclaiming of Goods

While the right of withdrawal is clear, the actual mechanisms to be used are not. If prior information not fully provided the right to withdraw becomes a period of three months. However the biggest implementation problems revolve around two vital components of withdrawal: the consumer’s right to a refund and the supplier’s right to reclaim goods.

From a commercial perspective, an e-business will want to limit the amount to a refund as far as is legally possible in its returns policy. It is worth considering a typical situation whereby an e-business states in its terms and conditions that it will refund the “price of the goods” following cancellation. Is this allowed? The DSD states that the supplier should “reimburse the sums paid by the consumer free of charge”. Regulation 14 of the CPDSR provides that, “on the cancellation of a contract under regulation 10, the supplier shall reimburse any sum paid by or on behalf of the consumer under or in relation to the contract to the person by whom it was made free of any charge” In both there is no guidance on what is meant by “sums paid” or “any sum”. However, since the whole rationale for the DSD and the CDPSR is to provide maximum protection to consumers where they enter into a distance contract it would be contrary to their spirit to penalise consumers by not allowing them a full refund.

This is confirmed by Section 12 of the DTI Guide for Business which states:

“When a consumer cancels the order all money paid must be returned within 30 days of the date the notice of cancellation is given... If goods have been delivered and the consumer has paid a separate charge for delivery, the supplier must also return the delivery charge unless it was provided under a separate contract.” (Department of Trade and Industry 2000a)

There does not appear to be any scope for arguing that the supplier is only obliged to refund the price of the goods themselves. Nevertheless, it appears that many e-businesses are not refunding delivery or shipping charges in breach of the Regulations. For example, Amazon.co.uk and BOL.com were forced by the Office of Fair Trading to refund delivery charges when people return goods:

“Amazon.co.uk is a tad peeved at the decision claiming it's based on the OFT's "interpretation" of Distance Selling Regulations. It seems Amazon.co.uk doesn't share the OFT's view. "It is not settled law," said Amazon.co.uk in a statement. It went on: "The OFT's [press] release implies we've been brought into line - we haven't - we will always act in the best interests of consumers (as we always do) and we will always work with government to drive clarity for customers and industry.” (Richardson 2002)

The DSD requires that reimbursement takes place as soon as possible, at the latest within 30 days. Here there is an argument for a stronger form of enforcement since the supplier has the consumer’s money. The main objective of any enforcement mechanism or sanction should be the return of the consumer’s money rather than punishing the supplier. However there is evidence that consumers are generally reluctant to use

the Small Claims Court, especially for items of modest value and even less likely to pursue options including criminal sanctions enforced by Trading Standards Officers.

Finally with regard to recovering returned goods, the DSD is clear that "the only charge that may be made to the consumer because of the exercise of his right of withdrawal is the direct cost of returning the goods". Under the CDPSR, the recovery charge must not exceed "the direct costs of recovering any goods supplied under the contract". The DTI Guidance for Business interprets this requirement as follows:

"The business must not charge more than the direct costs of recovery of the goods, such as the cost of postage or, for larger items, the cost of a van making a routine trip to the consumer consumer's home, nor can the business charge for any consequential loss." (Department of Trade and Industry 2000a)

Suppliers will therefore have to accept that it is not possible to build any profit element into the recovery charge in order to make up for having to refund the delivery charge to the consumer.

4. A SIDE EFFECT OF THE DSD: CONTRACT LAW REDEFINED?

Article 7 has been seen as raising problems with contract law. Article 7.1 states that "unless the parties agree otherwise, the supplier must execute the order within a maximum of 30 days from the day following that on which the consumer forwarded his order to the supplier":

"Does the word 'must' impose a mandatory duty on the supplier to accept all offers?...What if the consumer responds to an advertisement offering to supply goods but stating that offers may take 60 days to fulfil? In order to accommodate the wording of the Directive the advertisement must be read as an offer, accepted by the order, but the common law has been reluctant to interpret advertisements of goods for sale as offers to supply...The Directive may thus require some reconsideration of traditional common law rules of contract formation" (Bradgate 1997)

E-commerce definitely wants to make payment authorisation and the sales transaction one and the same thing, as this makes it as easy as possible for the consumer to purchase – Amazon.com recently acquired a patent on its 'one-click technique' whereby customer data and bought goods are combined and validated in one transaction (Oakes 2000). It ran into a furore of abuse because all the other Internet retailers wanted to use this technique as well and did not want to licence it from Amazon. But the real danger here is in conflating the advertising of an item and the sales transaction so that they seem to be part of the same activity. Amazon, and other Internet retailers have run into problems when pricing glitches meant their 'one-click' purchasing plan enabled consumers to get 'mispriced' goods. For example, Kodak's web site recently advertised digital cameras at the price of £100 instead of £329. Not surprisingly they got lots of orders and their system duly sent customers an automatic email response to say that their order had been accepted. Realising the error, Kodak refused to supply and a lawsuit was filed:

"One argument [Kodak used] is that no contract was formed because the website constituted an "invitation to treat". As such, a would-be purchaser's order was an "offer". However, Kodak's confirmation of that order was not...an acceptance of the offer because it included terms and conditions which the customer may not have seen at the time of making the offer. Instead, it was a counter-offer which in turn would need to be accepted by the consumer. If it was not accepted there was no binding contract." (Foxwilliams 2001b)

This argument fails under the DSD as it stands. Kodak could have tried the argument that a visitor to its web site could be expected to know that the price of £100 for the camera was a mistake but it was advertised as a special offer and it is common knowledge that Internet retailers need to undercut 'bricks and mortar' retailers to get custom. This problem has been addressed by the German legislature when they implanted the DSD as they added a prior information requirement on the supplier to clarify to the customer which act will constitute the (legal) acceptance of an offer, that is at what point a contract would be executed (Steins 2000). This might be a pointer to follow in a general revision of the DSD.

5. IMPLEMENTATION OF THE DSD IN THE UK: ONLY ONE PROSECUTION

The Consumer Protection (Distance Selling) Regulations 2000 were made on 31 August 2000 and come into force on 31 October 2000. However the DSD should have been implemented by 4 June 2000 so the UK government was in breach of its obligations. (Department of Trade and Industry 2000b)

As a result of the two consultation papers issued by the DTI, the CPDSR gives more detail on restoration of goods by consumer after cancellation (Article 17) and injunctions to secure compliance with these Regulations (Article 2):

“The original draft of the Regulations issued by the DTI provided for the criminalisation of certain failures to comply with the Regulations. However, the Regulations have removed criminal sanctions for non-compliance other than in relation to unsolicited goods and services. The DTI considers that the sanction of an extended period during which the consumer can cancel the contract where the supplier fails to comply with the Regulations...will be sufficient to ensure adequate compliance with the Regulations” (Youngerwood and Mann 2000)

5.1 Compliance and Enforcement

Regulations on spam email were left for future legislation. Otherwise CDPSR implements the DSD. Six months after the CDPSR came into force, the Office of Fair Trading carried out a survey of 637 UK websites, checking for their compliance with the CDPSR most fell short in providing any easily accessible information on both refund and exchange policies and how they would handle customer’s personal details” (Office of Fair Trading 2001).

Since data protection is not a requirement of the CDPSR it is odd that it was checked.

Although not included in the OFT survey, contemporaneously it was reported that the Labour Party web site was in breach of the CDPSR (Kelly 2001). A similar picture was reported in ‘Shopping Online 2001’, a survey funded by the European Commission and produced by Consumers International (Irish Times 2001). It involved 15 consumer organisations in 14 countries using an international team of researchers, acting as internet shoppers, to place more than 400 orders for goods and services with websites globally. Many web sites failed to give a clear total cost or give consumers information about key terms and conditions of the contract. In 9 per cent of cases, retailers failed to send a refund for goods that had been returned to them. Where refunds were sent, many took well over a month to arrive. Fewer than two-thirds of web sites provided a confirmation that an order had been accepted. Less than half of the European-based sites complied with the DSD by providing consumers with information about their seven day “cooling-off” period to withdraw from the contract. Foxwilliams 2001a reports the case of Fiche and Chips, a mail order computer business, about whose poor operation Middlesborough Trading Standards Authority received more than 500 complaints. An injunction forced Fiche and Hobbs to comply with the CDPSR. This so far is the only prosecution to be brought under the CDPSR.

It seems as though general ignorance of the CPDSR/DSD provisions allied with little regard for the consequences of breaking them are the main causes of their lack of effect as reported by surveys. Although there have been worries of the cost to business of implementing the CPDSR/DSD, it seems as though these have not been onerous: in the second DTI consultation paper for example, only three businesses responded with highly speculative estimates of the cost. If it had been an issue, more would have responded with firmer costings (Department of Trade and Industry 1999):

“In reality the new regulations don’t ask retailers to do much more than best practice would urge them to do anyway” (Clearlybusiness.com 2001)

5.2 Consumer Awareness

Not only suppliers ignore the CPDSR/DSD: there is no evidence that consumers have been (over)exploiting their rights, for example using incomplete prior information to get a three month withdrawal period for free use of goods in that time. As Walton 2000 notes: “Traders who fail to follow the Regulations to the letter will give customers the opportunity to shop around within the three months after delivery to find the same goods

at lower price, cancel the first contract, claim reimbursement from their credit card and then buy at lower price elsewhere. They do not have any obligation to return the goods, just to permit them to be collected”.

One wonders if Article 16 on consumer information has been addressed effectively. Another factor perhaps is the origin of the CDPSR/DSD: it seems like yet more Brussels ‘interference and red tape’, to be treated with typical offshore disdain.

6. IMPLEMENTATION OF THE DSD IN EUROPE: FLOOR AND CEILING

The original EEC Treaty did not contain any specific provision on consumer protection as it was assumed that the consumer would be one of the main beneficiaries of the Community's trade liberalisation and competition policy provisions as a result of both greater choice and the economic efficiency benefits of an open competitive market. In fact, the risks to the consumer of competitive de-regulation leading to inadequate levels of protection led to the recognition that rules for consumer protection were needed.

6.1 EU Rules of Consumer Protection

To begin with, rules were adopted under the general harmonisation provisions, Article 100 and then Article 100a of the Single European Act. In 1989 the EC formed the Independent Consumer Policy Service, which was followed by Commission action plans. Article 129a, a new Title on Consumer Protection, was added in the Treaty on European Union (Maastricht Treaty) and later amended by the Amsterdam Treaty.

Article 129a makes it clear that Article 100a and Article 129a(l)(b) itself are alternative legal bases for consumer protection legislation. Community action is seen as additional to, rather than replacing, that of the Member States. The legal basis of the DSD was Article 100a, making it aimed squarely at the consolidation of the internal market and seeing cross-border distance selling as "one of the main tangible results of the completion of the internal market" for consumers (Recital 3). The DSD has its own version of Article 129a(3) in Article 14 allowing member states to “introduce or maintain, in the area covered by this Directive, more stringent provisions compatible with the Treaty, to ensure a higher level of consumer protection”. As Cremona 1998 notes:

“The case thus illustrates that whereas a harmonising Directive may set minimum standards, leaving to Member States the choice of imposing higher standards in their implementation of the Directive, those higher standards must themselves comply with the fundamental Treaty rules on the freedom of movement of goods and services: they must satisfy the "mandatory requirements" tests of non-discrimination, public interest objective, necessity and proportionality. As is sometimes said, the Directive provides the "floor" and the Treaty rules provide the "ceiling".”

6.2 Implementation on the Member States; Is there Consistency?

While the DSD provide a level floor, the height of the ceiling unfortunately varies by country. Unlike in the DSD (Article 3.1), online auctions are not per se exempted from the German Distance Selling Act, but are exempted only from the customers' right of withdrawal from a distance selling contract. Also in Germany the customer is obliged to pay for the return of goods worth up to 40 Euros, the supplier paying for more expensive items. The customer is furthermore obliged to pay the supplier for the use of the goods or for the received services in the period up to the exercise of his or her right of withdrawal. In France refunds must be paid to the consumer within 15 days rather than 30.

If Article 5 obligations are not met, Article 6 extends the period of withdrawal. In the UK, under the CDPSR the period is three months. Should the information be provided during these three months, then the withdrawal period will end on the expiry of the seven working day period, beginning on the day after the day on which the consumer receives the information (not the same day as in the DSD). Should the information be given on the last day of the three months, the cancellation period will run for a further seven working days. In Germany, the Distance Selling Act provides that the withdrawal period ends unconditionally with the expiry of the four months which is sets as the upper period, irrespective of whether the information has

arrived on the last day of that period. The Italian Distance Contracts Decree adopts the same approach as the German Act, the three month upper limit being an absolute cut off point. In Sweden the extension period is one year!

Regarding the right of withdrawal, some member states have implemented the minimum periods given in the DSD whilst others have chosen to extend these periods further. The German Distance Selling Act sets the basic withdrawal period at two weeks, also raising the maximum from the three months in the Directive to four months, while the Italian Distance Contracts Decree 1999 retains the upper limit of three months where the information requirements are not complied with, but sets the standard period at ten working days.

Article 6 does not set out any procedural rules for the valid exercise of the right of withdrawal. The UK CPDSR provides that the contract is cancelled when the consumer provides a notice of cancellation to the supplier (Regulation 10.1). Regulation 17 states this must precede the return of the goods. This notice of cancellation must be "in writing or in another durable medium available and accessible to the supplier" (Regulation 10.3), with letter, fax and email all being sufficient (Regulation 10.4). The Italian Distance Contracts Decree, however, requires a "written notice to the geographical address of the place of business of the supplier by registered post and acknowledged receipt." Thus, while a consumer in the UK can exercise the right of withdrawal in relation to an Internet contract merely by sending an email to "the business electronic mail address last known to the consumer" (Regulation 5.4), a consumer bound by the Italian rules must comply with much stricter regulations.

The uneven ceiling thus presents a potential problem for suppliers of goods and services over the Internet, as they will require to be aware of the requirements of each member state, and ensure that they are in compliance with their corresponding obligations. The harmonisation aims expressed in the preamble to the DSD are certainly not assisted by this state of affairs. And there are some bumps on the floor: the DSD means "working days" to mean all days other than Saturdays, Sundays and public holidays. A supplier will need to take account of the different public holidays in the United Kingdom and in other EU Member States. The question therefore arises about how much harmonisation is possible over consumer protection in the Member States. (Swan 2001)

6.3 Modifications

The EU issued proposals to modify the 1968 Brussels (and Lugano) Conventions dealing with the Jurisdiction and Enforcement issues between those domiciled in EU (and some other European) States. The Conventions were to be amended to allow a consumer to bring proceedings before a court in the country/jurisdiction of the consumer if the transaction resulted from an advertisement and the consumer took steps in that country/jurisdiction necessary for the conclusion of the contract. In response to business concerns that web sites are not directed advertisements, the existing proposals were modified and passed as the Jurisdiction Regulation 44/2001 (in March 2002) making contracts made through websites only be subject to the jurisdiction of an EU country where the website was "directed at" consumers in that country: "It remains unclear as to what exactly constitutes "directing" a website at a particular country, and in particular how a site can definitively not be "directed at" countries in which it may be visible. It might be necessary simply not to ship goods to certain countries, which would clearly not promote an open electronic market in the EU." (Grave 2001) The UK CPDSR states: "These Regulations shall apply notwithstanding any contract term which applies or purports to apply the law of a non-Member State if the contract has a close connection with the territory of a Member State." What precisely is a "close connection"? Presumably overseas suppliers could include wording in their contracts to distance the contract from EU states, stating that it is performed abroad, executed abroad or that the customer pays any import duties. Even so it is very likely that UK courts would consider that the CPDSR applies (Singleton 2001).

This raises a further question, as even if a UK court can rule against a foreign-based web site, is a consumer going to make the effort? Consumers very rarely resort to the courts to address claims, mainly due to the costs involved and a lack of familiarity with the legislative procedure. Article 11.2 of the DSD makes provision for consumer bodies to act of behalf of individuals. Unfortunately not all Member States currently have an independent consumer organisation while a few have too many. (Hornle, Sutter and Walden 2002). The DSD requires the establishment of out-of-court dispute settlement systems (Article 17). In May 2000, the Commission jointly with the Portuguese Presidency launched a network of national out-of-court settlement schemes called EEJ-Net (European Extra-Judicial Network). Each country has to establish a

'clearing house' for consumer complaints. So far little has come of this initiative. Perhaps the issue needs to be tackled at a higher level than the EU. OECD Member States are considering the possibilities of ADR, i.e. Alternative Dispute Resolution, for Internet related disputes. (Van Den Brande 2001)

6.4 Leading the Way: The European Union

Prior to the DSD, few aspects of distance selling were subject to statutory regulation in the UK (beyond that which applies generally to the sale of goods and services). There was however self-regulation with most significant business types being members of one of the relevant trade associations and abiding by their codes of practice. With the arrival of e-commerce dot.coms were too new to be in trade associations, although TrustE and the Consumers Association run schemes whereby online e-tailers can pay to undertake accreditation tests. The DSD covers resort to trade associations (Article 11.4) as many minor issues (sales promotion techniques such as rebates, gifts, lotteries and competitions for example) are still covered by these self-regulatory arrangements: "This combination of legislative and voluntary (soft-law) techniques is typical of consumer policy within the Community." (Cremona 1998) Whilst it is easy to criticise the application of the DSD within the floor and ceiling paradigm, European consumers should perhaps be grateful that the Commission has at least attempted to legislate for contracts concluded at a distance as no such attempt has been made in the US. (Sidkin and Elliot 2001)

7. CONCLUSION

Many specific points have been raised above to suggest areas of revision for the DSD and also for national legislation that implements the DSD. It is proposed here that the whole question of distance selling and its regulation needs to be considered afresh, for the following reasons.

It is estimated that online sales will increase to 5 per cent of the overall retail market by 2005." (Sidkin and Elliot 2001)

To a certain extent this growth will not just come from the 'pull' of distance selling but the 'push' of other retailing options such as the corner or specialist shop disappearing. There is an argument that regulation is unnecessary. Consumers will become more 'empowered' and have greater choice as businesses convey huge amounts of good, service and information to them.

"Overall...regulatory bodies seem to approach e-commerce very carefully as far as the introduction of a framework of new laws and rules is concerned. Such a 'hands-off approach' appears to be reasonable in view of rapidly changing technologies and business schemes because in many instances, technological "developments can protect consumers in more ways than traditional regulation." (Ulrich 2000)

Certainly 'customer power' can be seen at its most ferocious on the Internet where, for example, 'sucks' sites viciously attack companies and brands that consumers have had bad dealings with (Cisneros 2000) but does everyone have the motivation and skill to mount a personal guerrilla campaign?

The overall level of awareness of consumer protection online, especially as expressed through DSD and its national statutes, is too low. To raise its profile a suggestion would be to follow the example of P3P (Platform for Privacy Preferences), a W3C standard for privacy preferences as expressed on supplier web sites. A similar system could be used for consumer protection, i.e. a set of supplier information requirements that had to be encoded in a structured manner (using XML) and be retrievable (using metadata) so that consumers and enforcement agencies could (automatically if needed using special agent software) check that supplier web sites followed a particular set of rules, as expressed by a descendent of DSD. Trends in networked services are heading this way for example, Microsoft .Net (Microsoft 2002) is a proposal to create 'web services' from data and software objects distributed across web sites. Web services, which include transactions, will need a global registry to allow them to be published, and then requested and bound to (activated) by clients. Automated service discovery should allow services to be found and switched very quickly so that, for example, if one service fails, another could be used instead.

The real concerns for law in e-commerce relate to the jurisdiction issue. Most commentators on DSD wrongly focus on its technological naivety. This should be seen as a strength in that technology in itself does not raise new legal issues, but the evolving set of problems that novel or 'mutated from old' business models produce certainly do. The DSD and its offspring have real bite for consumers, but their almost total lack of

use must give a lot of doubt as to their effectiveness: a consumer champion in intent but a complete irrelevance in practice.

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THE EFFECT OF GROUP PRESSURE ON SOFTLIFTING INTENTION - A LABORATORY EXPERIMENT

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ABSTRACT

The purpose of this study is to investigate the effect of group pressure on softlifting, moderated by financial gains. A laboratory experimentation with fifty-four subjects was conducted, in which each subject was told to participate in a software quality evaluation exercise. However, a ploy was carried out to measure the subjects' intention in software piracy under different levels of group pressure and financial gains. The results are interesting. On intention of software piracy, both group pressure and financial gains are significant determinants. The interaction of group pressure and financial gains is also significant: when group pressure is toward pirating software, financial gains is not a relevant factor; whereas when group pressure is toward purchasing, financial gains becomes a dominant factor in softlifting intention.

KEYWORDS

Softlifting, group pressure, software piracy, conformity, financial gains, ethics.

1. INTRODUCTION

Illegal copying of software, commonly referred to as software piracy, has become a major concern over the past two decades. Due to the prevalence of personal computers and the ease of software copying, the issue has become a major concern. Financial loss arising from software piracy has been astonishing. According to the "Global Software Piracy Study" released by the Software Publishers Associations (SPA), the financial loss caused by software piracy totaled up to \$11.8 billion globally in 2000 [Mearian, 2001]. Hence, software piracy is one of the most important issues for the development of the software industry. While large scale pirating and illegal sales of pirated software do much of the damage, illegal copying of software for personal use, also known as *softlifting*, is also a major concern [Simpson et al., 1994; Thong et al., 1998].

1.1 Ethical and Moral Issue

Software piracy is traditionally considered as an ethical issue. Mason [1986] pointed out that intellectual property rights is one of the four major ethical issues in the information age. Conger et al. [1995] found that ownership of information is one of the five crucial ethical issues in the information society. However, there has not been a consensus among researchers on the topic.

Many approaches have been proposed to study software piracy issues, and various variables have been investigated as its motivating factors. One approach focuses on the building of a behavioral model [Eining & Christensen, 1991; Simpson et al., 1994]. The issue has been studied from a variety of perspectives including reasoned action theory [Leurkittikul, 1994], planned behavior theory and expected utility theory [Peace, 1997] and equity theory perspectives [Glass and Wood, 1996]. Research has also been conducted to see whether certain types of software piracy acts are ethical or unethical [Im and Van Epps, 1992; Oz, 1990; Taylor and Shim, 1993].

In addition, attitudes towards computers, material consequences, normative expectations, socio-legal attitude and emotional factors are also believed to contribute to illegal copying intention [Eining & Christensen, 1990]. Another model, proposed by Simpson et al. [1994], attributes softlifting behavior to the ethical decision process of an individual, and the process is determined by five factors, namely stimulus to act, social and cultural factor, legal factors, personal factors and situational factors. Several demographic variables, gender, college major, religion or personal values have also been investigated [Fritzsche, 1995; Simpson et al., 1994; Solomon and O'Brien, 1990; Eining & Christensen, 1990]. However, even with subjects of similar background (business college students in the US), study results are quite inconclusive. For example, in Eining and Chirtensen's research, only attitudes towards computers, material consequences and normative expectations turn out to be significant factors. Likewise, in Simpson et al.'s study, even though four factors (stimulus, social or legal, personal gains and situation) are found to be significant, they only account for 7.24% of total variance in factor analysis.

Other researches treat software piracy as a moral dilemma and take the traditional Kohlbergian paradigm [Kohlberg, 1969] to study the relationship between one's attitude toward software piracy and cognitive moral reasoning level [Lodsdon, Thompson & Reid, 1994]. In another study, a person's cognitive moral reasoning, measured by Rest Defining Issues Test [Rest, Bebeau and Volker, 1986] shows weak relationship with his attitude toward software piracy [Logsdon et al., 1994].

1.2 Cultural Issue

Culture can also play an important role. Attempts have been made to discover the cultural differences on the ethical dimension. Reasonable explanations in terms of different cultural dimensions have been proposed [Nyaw & Ng, 1994; Vitell et al., 1993; Eining et al., 1991; Swinyard et al., 1990]. With tradeoff analysis, Swinyard et al. [1990] concludes out that when it comes to making unethical decisions of software piracy under different rewards or consequences, Americans tend to be rule-based, yet Singaporeans tend to be goal-oriented. Similar findings are reported in Nyaw and Ng [1994] where the national origin of students does have an impact on their reactions particular ethical dilemmas. Wagner [2001] further explores the issue from a religious perspective.

1.3 Normative Expectations and Financial Gains

Despite the differences in previous researches, at least two consistent factors have been identified. Normative expectations, defined as "the internalized norms of the individual as well as the impact of friends' and associates' opinions regarding the correctness of the specified behavior" in Eining et al.'s model, is similar to the socio-cultural factors in Simpson et al.'s model, not only in the importance of reference groups but also in the positive results of empirical studies. A meta-analysis done by Ford and Richardson [1994] indicates that reference groups influence a person's ethical decision making in most studies. Al-Jabri, I M; Abdul-Gader [1997] also confirms the influence of peer belief on software piracy behavior.

Another factor, whatever it is called material consequences, stimulus to act, or reward, is "financial gains" in nature. Swinyard et al. [1989] proposes a tradeoff analysis, aiming at investigating the ethical decision making a person might take under different financial gains. Most subsequent studies confirm the importance of financial gains as one of the crucial reasons to trigger the ethical dilemma of whether or not to pirate software [Simpson et al., 1994; Eining and Christensen, 1991; Swinyard et al., 1990]. If the influence of reference group and financial gains are important factors of software piracy, then the next question will be: how to conceptualize and operationalize these factors.

2. RESEARCH MODEL AND METHOD

2.1 Research Model

The influence of peer pressure on an individual's perception, attitudes and behavior has been the central topic of social psychology for decades. Conformity, usually defined as "the voluntary performance of an act because others also do it [Sears et al., 1986]," is the characteristic of a person to follow or modify his or her behavior in the direction of a norm under group pressure. Asch's classic studies and several other researches have demonstrated the impact of group pressure on a person's behavior [Allen and Levine, 1971; Wiener, 1958; Wiener et al., 1957; Asch, 1955]. Therefore, it makes sense to consider group pressure an excellent candidate for a research variable in our study. Based on the above, we propose the following hypothesis.

H1: *Softlifting intention is positively affected by group pressure.*

The perceived level of reward or loss has been regarded as one of the fundamental factors related to unethical decision-making. For example, Bommer et al. [1987] proposes a behavioral model of ethical/unethical decision-making and in which perceived level of reward or loss is one of the characteristics of decision process that influence decision. While it is hard to measure the perceived level of reward, software price can act as a surrogate for financial gains. Hence, we propose the following hypothesis.

H2: *Softlifting intention is positively affected by financial gains of the action.*

In addition, we believe that under the conditions of different financial gains, the influence of group pressure on intention will be different. Hence, we propose the following hypothesis.

The research model for this study is depicted in Figure 1 below, where group pressure and financial gains are believed to affect softlifting intention.

H3: *The effect of group pressure on softlifting intention is moderated by financial gains.*

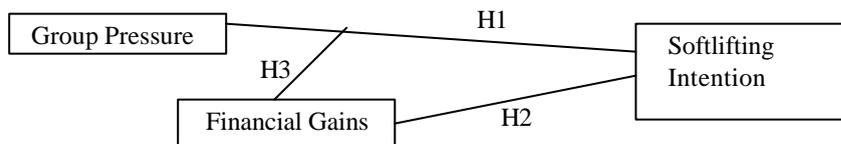


Figure 1. The Behavioral Model of Softlifting

2.2 Experimentation

So far, most studies on software piracy employ survey as the research tool, and the dependent variables of these studies are "attitude" or "intention" of software piracy. However, using a cross-sectional survey study, it is not possible to draw strong enough conclusions as to the direction of causality.

As a result, the laboratory experiment method is employed in this study. Two major advantages can be achieved with this approach. First, high internal validity is one of the major advantages of laboratory experiments [Benbasat, 1989]. Second, with appropriate research design and manipulation, it is possible to infer causality.

2.2.1. The Experimental Design

A 4 X 2 mixed analysis of variance design was used, containing four levels of group pressure and two levels of financial gains. A series of role-playing scenarios were designed to manipulate the group pressure construct.

2.2.2 Subjects

The subjects were students of an introductory database course of the Management Information System department at the National Central University. There are 43 males and 11 females subjects, with average age 20. Subjects were volunteers recruited to participate in a disguised software quality evaluation exercise,

earning NT\$100 in cash within 15 minutes (approximately US\$4). Each subject was randomly assigned to one of four experimental situations.¹

2.2.3 Process

Each subject in the experiment was individually invited to a session disguised as a “software quality evaluation exercise” in a room equipped with a computer loaded with the target software. An experimenter and four cohorts were there in the room. At the beginning of each session, the experimenter declared the objective of the exercise: to understand the differences of perception on software quality, between college students and graduate students (experimenter and cohorts are graduate students). And then, the experimenter demonstrated the software, which was useful for the database course that the subjects were taking. After that, a software quality survey was distributed and filled out by the participants. Towards the end of filling out the questionnaire, one cohort asked the experimenter about the price of the software. The experimenter announced the price at NT\$ 3,000 (New Taiwan Dollars, about US\$100) and asked each cohort about his or her intention to purchase. This was to avoid the risk of directly asking for illegal copying. The experimenter then went on to ask the subject’s intention to purchase.

As soon as the subject gave his or her answer (or no answer in one minute), one of the cohorts asked the experimenter about the availability of student’s edition for this software. The experimenter responded “Yes,” announces the price at NT\$ 500 (about \$15) and proceeded to ask the subject about intention to purchase.

Four levels of group pressure conditions were designed: (a) 4 cohorts unanimously chose to copy; (b) 3 cohorts chose to copy and one chose to purchase; (c) one intended to copy and 3 chose to purchase; and (d) 4 cohorts unanimously chose to purchase. As stated earlier, two levels of financial gains were employed: (a) price of software at NT\$3,000 and NT\$500. The price levels were chosen to reflect “expensive” and “affordable” software prices in Taiwan, through a pretest.

Group pressure is a between-subject variable and price of software is a within-subject variable. That is, when a subject was assigned into one of the four Group Pressure conditions, he or she had to make a decision of copying or buying under both price levels.

In the “4 unanimously copy” and “4 unanimously purchase” conditions, the four cohorts who role-played in an experiment session, had to give unanimous decisions in copying or purchasing before the subject; in the other two conditions, the sequence by which the decisions (to copy or to buy) are announced were randomly assigned during the session.

2.2.4 Apparatus

The software was a window-based database development tool, consisting of two diskettes. To save time and to avoid breaking the intellectual property law of the Republic of China, only one of the diskettes was used in the experiment and the serial number essential for the setup of this software, was not given to the subjects.

One questionnaire with ten items was designed and alleged to measure the quality of the software, but its true purpose was to convince the subjects and to acquire necessary demographic data along the way.

2.2.5 Threats to validity

To avoid the threats of discussions and information exchange among the subjects, the entire experiment was completed within a six hours period. The recruited subjects were asked to report to a waiting area at a prescheduled time. Each subject was taken individually from the waiting room to one of the three experiment rooms in random. At almost the same time, the other 3 cohorts for each experiment room (one experimenter in each room) entered the experiment room to take part in the study. To make the scenario looked real, the experimenters and cohorts were trained to role-play a script before the sessions.

To avert experiment risks and to make all four experimental group size similar, each group changed its experimental situation after completing a session. For example, if the first subject is assigned the condition – “4 unanimously copy,” the second will be assigned the condition – “3 copy and one purchase” and so on.

¹ The experiment was conducted within one day from 18:00 to 23:40. Since most students lived in dormitories, there was not much trouble recruiting these students.

At the end of each session, cash was handed to the subject and cohorts (cohorts returned the money after the subject left) immediately after the experiment. They were asked to promise not to discuss with their classmates about the experiment that evening.

2.3 Measurement

A scale with four levels is used to measure softlifting intention: (1) purchasing, (2) hesitancy or no response for a minute, (3) "I will copy when I need it," and (4) copy. One of the cohorts of each group was responsible to privately record the results of the subject's intention. Scores were assigned to the four levels of intentions, from 0 to 3 respectively. The higher the score, the more the subject intended to copy.

Face validity and content validity are probably acceptable for the scales of intention. However, no construct validity and reliability measures are suitable for this study. Data from post experimental students' discussions on campus electronic Bulletin Board System (BBS) and some informal interviews indicated that the experimental manipulations were effective.

3. ANALYSIS OF RESULTS

Descriptive results of the experiment are tabulated as Table 1, and results for the analysis of variance are presented in Table 2.² Figure 2 presented the interaction effects graphically.

Table 1. Descriptive Statistics on the Intention of Software Piracy

Group Pressure \ Software Price	4 Unanimously Purchase (4P)	3 Purchase 1 Copy (3P1C)	1 Purchase 3 Copy (1P3C)	4 Unanimously Copy (4C)
NT\$3,000 (high)	1.42	2.38	2.79	2.50
NT\$500 (low)	0.42	1.38	2.54	2.69

Table 2. Analysis of Variance on the Intention of Software Piracy

Source of Variance	SS	DF	MS	p value	F
Within Subject					
Group Pressure (A)	48.62	3	16.21	.000	9.82 **
Within Group Ss (S X A)	79.62	48	1.65		
Between Subject					
Price (B)	7.06	1	7.06	.001	13.55 **
Price X Group Pressure (B X A)	6.49	3	2.16	.011	4.15 **
Residual	25.01	48	0.52		

The ANOVA result in Table 2 reveals that the main effects of both group pressure and price on softlifting intentions are statistically significant at the level of 0.05. In addition, the interaction effect is also significant at 0.05. Thus, the Null Hypotheses of the research hypotheses are rejected, supporting all three hypotheses of this research, as depicted in Figure 1.

² One male data was missing during data collection, leaving 53 valid records.

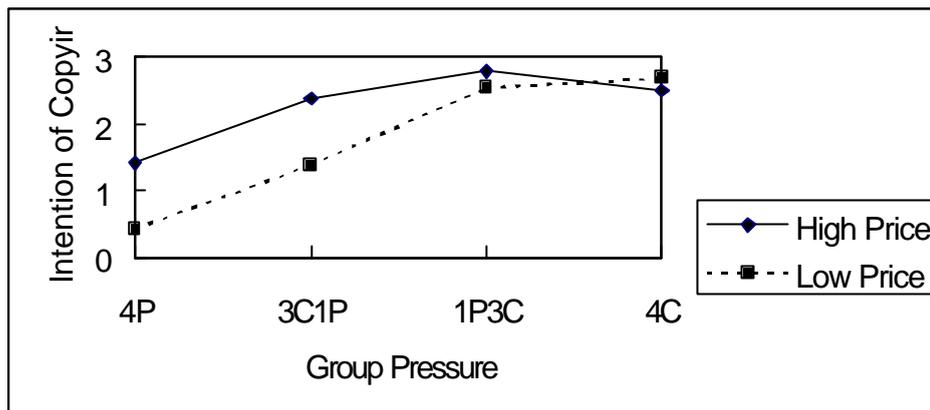


Figure 2. Relationship Between Group Pressure and Intention of Copying

As Table 1 and Figure 2 show, group pressure has more influence on softlifting intention when financial gains from the softlifting action is low. In the cases of 4P and 3P1C groups, intention to copy are significantly different at different levels of financial gains. However, in the cases of 1P3C and 4C groups, the differences in intention to copy at different levels of financial gains is not statistically significant.

The interaction of group pressure and price is another important finding. The effect of group pressure on softlifting intention is moderated by the level of financial gains: the price of software is a less dominant factor for software piracy compared with group pressure when the price is lower; the importance of price is higher when the software is more expensive. But group pressure and price of software consistently influence people's intention of copying respectively.

4. CONCLUSIONS

4.1 Implications

It is evident that the softlifting intention is significantly affected by group pressure, which is consistent with Jones and Kavanagh [1996] – peer influences have dominant effects on an individuals' intentions to act unethically in the workplace.

Is there any other psychological factor affecting an individual's intention to softlift? Harrington [1996] demonstrates that an individual characteristic, namely personal denial of responsibility, is a crucial factor on computer abuse judgments and intentions (software piracy is included). However, if we interpret our results in terms of Harrington's study, it is the situation (under group pressure) that makes individuals deny of responsibility – thus rationalizing their copying intentions.

The implication of this study is that situational factor – group pressure and financial gains seems to be dominant factors in software piracy. Therefore, cultivating a social norm with group pressure toward purchasing software should be something to think about. We believe this can be achieved only through education.

In addition, software pricing policy is another important agenda for inhibiting software piracy. If software prices are set at a level that is not perceived to be expensive, the effects of a positive social norm will be more effective. The result shows that “student edition” price can be effective to prevent massive softlifting in campuses. However, the perception of financial gains can be further looked into. First, in different country, the right price to be categorized as “low” can be dramatically different. It probably has to do with the per capita income of that economy. Thus, pricing structure can be designed for different situations. In addition, the penalty or risk involved may be rationally included as part of the formula for financial gains. However, most penalty to date focus on large scale piracy, or sales of pirated software. What are the effective measures to curtail the perception of financial gains in softlifting is probably an issue to think about.

4.2 Limitations

The above findings must also be viewed with the limitations of the study in mind. First, the sample subjects are Taiwanese college students taking the information systems major, thus external validity of this study may be challenged. However, since software piracy is a widespread phenomenon among business students taking M.I.S./C.I.S. courses in the United States [Solomon and O'Brien, 1990], the prevalence of software piracy is not in campuses in Taiwan alone. We may apply this result to the business students in colleges.

Second, this research takes on a microscopic view, excluding other factors like cultural differences. More replication of this research may be required to assess the difference in different areas of the world. In addition, other factors may be investigated in future studies.

Third, prices of software are "thought" to be "expensive" at the price of NT\$ 3,000 and "cheap" at the price of \$500. However, different subjects may have different perception on price, i.e., one may think of NT\$ 3,000 being "cheap," while others may perceive NT\$ 500 as being "expensive". The individual subjects' perceived values of software in the experiment were not assessed, thus making generalization of results in software price vulnerable.

Last, this research employed a mechanism whereby subjects were deceived when they entered the laboratory. This was intended to avoid the threats to internal validity, whereby subjects performed as expected of them, if it was apparent that the sessions were about a research on softlifting. A public announcement was made to the class on the electronic bulletin board right after the experiment, with an apology.

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PROXY-BASED LINKING IN AN ADAPTIVE WEB-BASED INTEGRATED LEARNING ENVIRONMENT

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ABSTRACT

Web-based delivery of educational materials is a growing area in education, offering substantial support for teachers in the face of growing class sizes and declining resources. Additionally, such materials permit additional teaching aides, such as online discussion groups and bulletin boards, 24-hour availability, and in particular, a personalised lesson plan tailored to maximise a student's benefit from the materials. This paper concentrates on the technical aspects of this latter feature, describing the implementation of adaptive hypermedia technologies in the WHURLE system and discussing the automatic generation of hypertext links in a body of educational materials.

KEYWORDS

Integrated Learning Environment, Adaptive Hypertext, Linkbase, Linking

1. INTRODUCTION

It is well-documented that the online delivery of educational materials has many benefits (Laurillard, 1993). Primarily these are reducing the load of the teacher and being able to adapt the content of the materials, not just to the requirements of the lesson but to the individual strengths and weaknesses of the student. For example, some students learn more easily with pictures to supplement the text, while others are comfortable with symbolic representations. Online delivery also allows the materials to reach a far wider audience than a single classroom, resulting in a broader range of abilities and learning style, and potentially a diverse set of cultural backgrounds influencing the students' comprehension, absorption and retention of materials.

Experimental evidence shows that the use of hypertext materials can polarise the benefit gained from online education (Quentin-Baxter, 1999) so that some students are systematically disadvantaged by the use of these materials while others perform much better than with non-digital materials. The aim is to overcome this disparity with an experimental Integrated Learning Environment - WHURLE (Web-based Hierarchical Universal Reactive Learning Environment) (Moore et al., 2001; Brailsford et al., 2002). It combines a number of technologies such as adaptive hypertext, computed linking, open hypertext and XML recommendations in order to create a learning system that tailors the organisation and presentation of learning materials to best suit the needs of individual students, using experimental user modelling (Zakaria et al., 2003).

The next section of this paper overviews the core relevant technologies that are a key part of a tailorable and interactive learning environment. The following section describes the implementation of such an environment, based on these core technologies, with the emphasis of this paper being on the linking technologies.

2. RELATED AND RELEVANT WORK

There are many areas of work which have contributed to the design and development of the integrated learning environment discussed in this paper and some of these are discussed in (Moore et al., 2001; Brailsford et al., 2002). This paper is focused on the hypertext linking as implemented in this learning environment, and this section will consider only those areas directly relevant to the linking work.

There are four major areas of work that have motivated and directed the work on hypertext linking reported in this paper. These are adaptive hypertext, which allows for the presentation of personalised materials to students, and computed linking, which automatically computes links for an arbitrarily-sized corpus. Other important technologies are the XML recommendations for interchange of arbitrary document formats, and open hypertext services.

2.1 Adaptive Hypertext

Fixed, or "static", hypertext provides the same experience for every person, regardless of their abilities, interests or browsing targets. The adaptive hypertext community aims to overcome the limitations of the "one size fits all" approach to delivery of reading materials by tailoring, or adapting, the content and the organisation of those materials to best fit the varying abilities, requirements and methods of the reader. It can also assist in ensuring that culturally appropriate materials are delivered to students from around the world (Stewart et al., 2003).

Adaptive hypertext is an especially useful technology for learning materials (Brusilovsky, 1998). Students begin learning from a diverse range of backgrounds, with inherently different learning styles and with different abilities. Adaptive hypertext allows different paths through the learning materials, tailored to the student's needs. The student's needs can be assessed as the student progresses, either by tests or analysis of navigation, or can be specified by the student themselves. This requires modelling the student and their abilities, to allow for tailoring of the materials and presentation according to need.

Adaptive hypertext systems generally use either the overlay model, which measures the learner's knowledge within a given domain (Carr & Goldstein, 1977; Eklund et al., 1997), or else the stereotype model which classifies students according to their background and abilities (Eklund et al., 1997). Zakaria et al 2003 have been developing a new, "hybrid" user model that combines these previous user modelling techniques, and is the one implemented in the interactive learning environment described later.

The reader is referred to (de Bra, et al., 1999) for a survey of adaptive hypertext technologies.

2.2 Automatic Generation of Hypertext Links – Computed linking

Automatic computation of hypertext links is accepted as a key tool for the generation and maintenance of hypertext materials, especially in a changing document corpus (Ashman, 2000) (Davis 1998). When the core materials change, the links connecting them become dislocated or irrelevant, or sometimes point to materials that no longer exist (Davis 1998). It is already a very time-consuming process to manually create a set of

links for a body of materials, and to detect and correct any errors can add to this burden. A mechanism that automatically creates links and corrects any that may have been rendered wrong can save a hard-worked author or teacher a great deal of time (Ashman et al., 1997). This is especially so when there are a large number of links which could easily be specified with a simple computation but which are laborious to create manually (for example, links from names of historical characters to a biography, such as in (Fountain et al., 1992)).

However, in the educational context, another major benefit of automatic link creation is the tailorability that becomes possible by use of link computations that include some element of context. Adaptive hypermedia requires context to be taken into account when presenting materials and links to the student, and automatic computation of links using context variables as parameters to the computation is a highly efficient way to do this.

One side benefit of computed linking is that it can incorporate an arbitrarily large corpus of information from arbitrary sources. Links that are dynamically computed (as opposed to precomputed) can be created over any data from any source, merely by applying the computation to that data. This can be done in a “late binding” fashion (Brailsford, 1999) so that sets of appropriate links can be applied to the data immediately before it is made visible on the viewing tool. Dynamic computation can save on storage of individual links, which can be important when searching through large sets of links (Ashman et al., 1997).

The reader is referred to (Agosti et al., 1996), (Ashman et al., 1997) (Green, 1999) and (Wilkinson et al., 1999) for surveys and detailed explanations of computed linking technologies.

2.3 Open hypertext services

The hypertext community are increasingly favouring the provision of hypertext services by a hypertext engine that is external to the application that displays data. This is not to suggest that applications displaying data ought not have a hypertext capability but rather that any application can use supplementary hypertext features without the need for incorporating them into the application, or the need for storing hypertext links.

A core characteristic of open hypertext systems is that the links (or computation specifications for computed links) are not stored within the data being linked. This has a range of benefits, such as making it possible to link into and out of materials of arbitrary type and from arbitrary sources (Cawley et al., 1995), using computation capabilities from arbitrary applications (Verbyla et al., 1994), and the ability to use different links for different situations. These are key elements of a tailorable learning environment, making it possible to modify the ordering and presentation of materials.

The reader is referred to (Carr et al., 1999) for a brief survey on open hypertext systems and to (Brailsford, 1999) for a survey on links not stored in the data being linked.

2.4 XML and its recommendations

The eXtensible Markup Language (XML) is a collection of recommendations for the creation of markup languages for document interchange over the Internet. A key feature is that an author can create their own markup language to contain tags and actions specific to the requirements of the application under development. It can also allow developers to specify data structures to be used. XML is favoured for the development of Internet-based applications as it enables the exchange of data and actions specific to the application in a simple, HTML-like format. Most importantly, it is possible to create pointers into positions within Web pages without needing pre-existing NAME tags, and hence avoiding the need to overwrite a document in order to provide a link into a specific position within it. XML also allows the specification of “out of line” links which allow an author to create a set of links both into and out of documents that are not necessarily owned by the author.

XML contains three recommendations specific to linking, these being XLink, XPointer and XPath. The reader is referred to (De Rose, 1999) for a survey on the XML linking recommendations, and to www.w3.org/XML for up to date information about XML.

3. THE WHURLE FRAMEWORK

The previous section highlighted key technologies important to implementing the hypertext functions for an interactive learning environment that is tailorable to the needs of individual students. In this section, an implementation based on these technologies is described.

WHURLE is an experimental adaptive learning environment for the web. It uses XML to store and deliver educational content in atomic constructs called chunks. Chunks are the fundamental unit of information in the environment, and are the smallest possible fragment of conceptually self-contained information (i.e. where the component parts don't make sense in isolation). A chunk is usually small, such as a paragraph of text or an image, but it could be large - as in the case of an entire legal document. A captioned image would generally be a single chunk, because the caption is unlikely to make sense without the image.

A lesson is very simply a collection of chunks with hypertext links to provide pathways through the information. Teachers generate lessons by creating a default pathway through the available chunks, but this pathway can be modified by taking into account observations derived from the student's user profile.

WHURLE automatically generates navigation to enable movement around the hierarchical structure of a lesson. Previously this was entirely done by the WHURLE software, but a recent development is to outsource some of this activity to a specialist, robust linking proxy system, GOATE (Martin et al., 2002).

3.1 Chunks and Lessons

The base unit of information is the chunk. Data is stored in chunks, although link computations can address words, phrases or other items within a chunk. A purpose-designed markup language, the WHURLE Chunk Markup Language (WCML) is used to structure chunks.

However, the end user does not ever see chunks as such, rather they will see the combination of chunks and links into a single seamless document or document series, such as a lesson. Teachers create lessons as default pathways through chunks by specifying a lesson plan, which is another XML file, this time specified in another purpose-built language, WLPML (WHURLE Lesson Plan Markup Language).

The lesson plan contains a hypermedia pathway through the entire collection of chunks. This is created by teachers using WHURLE. A lesson plan consists of a hierarchy of levels, each containing one or more pages. Pages consist of chunks transcluded by means of XInclude.

When the lesson uses adaptive technologies to adapt the content and presentation to the student's needs, the lesson plan will be more complex as it must represent the conditions, or "dependencies" which determine the inclusion and ordering of chunks and links.

3.2 Autonavagation

Autonavagation is essentially the use of forward, back, up, down and other buttons associated with travelling through the structure of a document. It is distinct from hypertext linking in that it depends on existing document structure and its purpose is to facilitate movement around the formal document structure, while links can move readers through arbitrary parts of the document or other documents. Autonavagation can be implemented using hypertext links (which makes it more difficult to distinguish between the two) but in WHURLE links and autonavigation are implemented in two quite different ways.

The teacher arranges pages into a hierarchy in a lesson plan, with a page being a combination of one or more chunks. Students can navigate through this hierarchy either breadth or depth-first, depending on their preference. However it can be time-consuming to create all the necessary links for forward, back, up, down etc, but also chunks can be included into different pages, so explicitly declaring these structure-navigating links may not be appropriate as the structure of lessons containing these chunks may vary.

To make the teacher's job easier, and to allow the reuse of chunks in a position-independent manner, WHURLE uses an autonavigation system, which uses XSLT to generate the structural links that comprise the navigational components of the virtual document.

XSLT makes it possible to express the relationship between nodes or pages, both in terms of ancestry and sibling (end-to-end and side-to-side) relationships. By looking where the current page occurs within the lesson plan, WHURLE can generate autonavigation cues for previous, next, sibling and up nodes in a lesson plan.

3.3 Linking

WHURLE implements a robust system of node to node linking at the chunk level. All links are two-way, and they do not break (i.e. if a link target is removed then links to it are not rendered – moreover if the target is reinstated then its links will still be in place).

The links are stored in a linkbase. This is an XML file that is either created by a teacher and specified in the lesson plan, or it created by the student and is a part of their user profile. Individual links are represented by the <link> element and the nodes (i.e. the link ends) are represented by the <node> element. Nodes specify the part of the chunk that forms either the source or the destination of the link. Links can be either one to one (“single” links), one to many (“hub” links) or many to many (“plural”).

Note that these are externalised links, i.e. they are links which are stored separately from the data being linked (Davis, 1995). This is the same in principle to the XML “out of line” links, but is not a feature supported by HTML.

In order to avoid a substantial performance penalty on the server, the links are not incorporated into the WHURLE node tree, rather they are inserted by a proxy system called GOATE.

3.4 Proxy-based linking using Goate

GOATE is an experimental linking proxy whose primary purpose is to intercept all incoming documents before they reach the reader’s browser and to preprocess to document to insert appropriate links into the browser’s copy of the document.

Standard open hypertext systems promote the use of external links in order to avoid the difficulties inherent in personalising links over data owned by others (Davis, 1995). This is invariably done as a “late binding” of links computed or stored elsewhere with the target document (Brailsford, 1999). GOATE uses the same late binding principle to compute or retrieve, and then insert links into a document immediately before it is displayed on the browser.

Goate is a link server. There are two conceptual parts, one of them being a link consolidation service which gathers links from a number of sources, stores them in a common, low-level format (IDO) and handles rationalising different languages generally. The second part is about taking a collection of links for a given page and presenting them to the browser in a way that achieves the desired effect. It could be said the first part is acting as a link server for the second part. In theory though, other clients could access the link server part of a Goate proxy (and distributed Goate proxies could work on this principle).

In terms of link recomputation: Goate itself does not actually compute any link end-points. End-point calculation is done by Goate’s associated Language modules which interface with the system. The same IDOs are used until it is detected that they are no longer valid. This detection is based on the end-points changing (for embedded links the source changing is also requires the specification to be reconsidered) or the Language module declaring a change in its link base. When this happens, the old IDOs affected are discarded and new ones produced by Goate making a call to the appropriate Language module.

The second conceptual part of Goate is still performed every time a document is loaded. That is, even if the IDOs haven’t changed since last time this document was displayed the process of working out how these collection of IDOs should be rendered is carried out in full.

Goate is currently specialised in rendering for the HTML environment. However, in terms of link source there is no particular bias to HTML or XLink. It is perfectly valid to embed links within HTML or XML syntax, although those links need not be accepted HTML links or XLink.

Non-embedded links are just as valid as embedded (and in fact are slightly easier to deal with). Language modules just declare that links exist, given a current ‘context’ of document displayed and the links that exist in the linkbase. The source and format of these links are invisible to Goate as the Language modules declare IDOs (or for this paper ‘a common, low-level, link declaration format’).

The GOATE proxy is described in detail in (Martin et al., 2002).

4. FUTURE DIRECTIONS

One of the new directions in the ongoing research and development in this project is that of localisation issues in the presentation and inclusion of materials in lessons. We noted in the introduction that there was not just a variety of student abilities and experience, but also potentially a diverse set of cultural backgrounds which could be influencing a student's comprehension, absorption and retention of materials. This requires more than just rendering materials in the appropriate language and script, and needs an awareness of the cultural mores and assumptions associated with that language. This is called "localisation" and is essentially to a sensitivity to the cultural context within which lessons are used. We are considering how educational guidelines vary from country to country, perhaps depending on the country's religious beliefs, commercial position or political agenda. Also we intend to investigate whether a literal translation accurately conveys teaching materials, as substantial attenuation of meaning can occur when materials are translated, especially repeatedly (Stewart et al 2003).

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THE EFFECT OF MASS CUSTOMIZATION ON DEMAND TURBULENCE

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ABSTRACT

It has been argued that market turbulence, which includes demand and structural dimensions, is increasing the level of applied and future mass customization at least in the physical product environment. However, previous studies have paid less attention to the fundamental differences between physical and digital products, and the potential impact of experience on demand turbulence and customization. Therefore in this paper we will empirically evaluate how accumulated experience influences demand turbulence and mass customization in the case of digital information products. Our empirical tests with data from 42 online newspapers revealed that only experienced online newspapers on the national market had started applying the customization business model. This supports the suggestion that the path from mass production to mass customization is not direct, but requires continuous learning and improvement also in the web publishing environment. In addition, we found only limited support for the proposition that more experienced companies should be able to control the demand uncertainty. On the contrary to previous findings in the literature, we were not able to validate the demand turbulence-customization relationship. Due to our small and homogeneous sample group, the generalizability of our findings requires further research.

KEYWORDS

Mass customization, market turbulence, demand turbulence, experience, online newspapers

1. INTRODUCTION

When customization is done on a mass basis, it is called mass customization (Pine 1993). Mass customization is basically a synthesis of the two management systems, mass production and customization. In the mass customization business model, the main aim is to create superior value for the customer, while keeping the production cost in control. Previously it has been suggested that companies operating in turbulent markets have a strong market orientation (Lusch and Laczniak 1987, Davis et. al 1991), which is closely related to the mass customization business model. This is consistent with Pine's (1993) findings, which suggested that the greater the market turbulence, which includes demand and structural turbulence dimensions, the more likely the industry is moving towards customization.

However, in our opinion Pine's considerable and extensive research with hundreds of companies gave less attention to the following things, which on closer thought might affect the demand turbulence-customization relationship. *First*, there are the fundamental differences between physical and digital products (Choi et al. 1997) and it has been argued that the unique characteristics of digital products by their nature demand either cost leadership or effective differentiation/customization (Shapiro and Varian 1998). Since it is obvious that only one company can be the price leader, all the others should have adopted the product differentiation/customization strategy, regardless of demand turbulence. *Secondly*, Boynton and Victor (1991) introduced a Product-Process change matrix and suggested that the path from mass production to mass customization is not direct. They argued that companies must learn mass customization through a continuous improvement process, before entering into the mass customization business model. This learning process requires time. *Thirdly*, the more experienced companies, which are also more familiar with their customers' needs and wants, should be able reduce demand turbulence. If experienced companies are also producing more customized products, like the theory suggests for the digital environment, then demand

turbulence is decreasing, but the level of customization is increasing. This is in contrast to Pine's suggestion. Based on the above-mentioned arguments, we believe that a company's accumulated experience should be an important factor affecting both currently applied and future customization, and current and future demand turbulence levels.

Because of these possible logical contradictions, the main aims of the present paper are: *first*, to analyze how accumulated experience influences customization and demand turbulence levels in the digital product environment, and *secondly*, to test if the demand turbulence is increasing the level of customization in the case of digital information products. Our empirical survey was carried out in a homogenous market, the Finnish online newspaper industry. Finland is one of the globally leading countries regarding the national IT infrastructure available for online services (Statistics Finland, 2002a). Also, the population's motivation to read newspapers on a daily basis is one of the highest globally (Statistics Finland, 2002b). Companies that operate in the same industry segment, yet belong to different strategic groups, can still face different business environments and competitive conditions (Porter, 1980). Therefore, even if our data are based on a single-industry sample, we expect variations in the applied customization approaches and demand turbulence. The paper is structured as follows. In chapter 2 we briefly present the body of knowledge on producing customized products. Then we introduce Pine's market turbulence map instrument, which he used to determine the level and type of demand turbulence. In chapters 3 and 4 we will report our research framework and methodology. Chapter 5 explains the results of our analyses, and finally, in chapter 6 we draw conclusions from our observations.

2. CUSTOMIZATION IN THE LITERATURE

The history of mass customization started over thirty years ago (Toffler 1970, Davis 1987 and Pine 1993). In the mass customization management system, the goal is to develop, produce, market, and deliver affordable goods and services with enough variety and customization that nearly everyone finds exactly what they want (Pine, 1993). In practice, mass customization means that customers can select, order, and receive a specially configured product - often choosing from among hundreds of product options - to meet their specific needs (Bourke and Kempfer, 1999). Other similar definitions and descriptions have been presented (e.g., Hart 1995, Anderson 1998). The reason why customized products are superior compared to standard products is the following (Pine, 1993). The company that better satisfies its customers' individual wants and needs will have greater sales. With higher profits as well as a better understanding of the customers' requirements, the company can provide even more variety and customization, which further fragments the market. Because it is outdistancing its competitors in variety and customization, market fragmentation allows its once again to better satisfy its customers' individual wants and needs, and so on.

Many different approaches are applied to produce customized products. Gilmore and Pine (1997) identified four distinct approaches to product customization and named them the collaborative, adaptive, cosmetic and transparent approach. In the collaborative customization approach, companies help end-users to indicate their individual needs. After this dialogue, the product that fulfills the identified needs is made. In adaptive customization, the product is designed so that end-users can modify it themselves without any direct interaction with the company. Both the collaborative and adaptive approaches involve the end-users heavily in the product's co-design process, which encourages the customer's purchase (Kahn and Huffman, 1998).

The following collaborative and adaptive customization approaches are commonly used in web sites. *First*, the modular product approach, in which end-users can modify page(s) in the web site using predefined modules like in the case of my.yahoo (Manber et al 2000), is claimed to be one of the best methods to produce products (e.g. Pine 1993). *Secondly*, there are different kinds of content recommendation approaches, which could be based on user preferences, content or user similarity to other users (collaboration). Manual decision rule-based systems allow web site administrators to specify rules based on end-user preferences, demographics or static profiles, which are collected through a registration process or session history (Mobasher et al. 2000). According to Balabanovic and Shoham (1997), in a pure content-based recommendation system recommendations are made on the basis of a profile, which has been generated by analysing the content that the end-user has rated in the past. On the contrary, a pure collaborative recommendation system does not analyse the content at all, but recommends items that other similar end-users have liked (Balabanovic and Shoham, 1997). *Thirdly*, search agents technologies are used

to transmit filtered information from single or multiple sources (Palmer and Eriksen, 1999) to the end-users via email or through mobile channels. *Finally*, it is also important that the web site can automatically and technically adjust itself to the requirements of different kinds of browsers, operating systems and screen resolutions, like for example razors adapt to different kinds of human faces.

Two other generic approaches introduced by Gilmore and Pine (1997), cosmetic and transparent, are fundamentally different from the above-mentioned approaches. A cosmetic customizer changes only the representation of the web site (e.g., colors), while the functionality or content of the web site remains the same to all users. The transparent customizers provide customized products without letting end-users know explicitly that those products have been modified for them. On the Internet, targeted advertising is probably the most common form of transparent customization. Instead of offering standard banner space, many web sites deliver dynamic ads to targeted people by analyzing end-users' demographics or preferences. Some of the customization approaches are more closely related to process design customization than product design customization. It has been argued that process design-oriented customization is the obvious choice for most firms (McCutcheon et. al. 1994). By creating flexible process and technical platforms, the company can provide quick response to customer throughout the value chain (Pine, 1993). In conclusion, we have identified two main dimensions of customization, product vs. process dimension. This classification is consistent with the findings of Sääksjärvi and Santonen (2003).

2.1 Measuring the demand turbulence

Market turbulence, the rate of change of customers and their preferences (Slater and Narver, 1994) indicates the amount of instability, uncertainty, and lack of control within a firm's market place (Pine, 1993). Market turbulence can also be defined as changes that are unpredictable and difficult to plan for (Dess and Beard, 1984). Market turbulence is also very similar to the market heterogeneity construct, which according to Miller (1987) refers to the change in diversity of production methods and marketing tactics required to serve the customers' needs. Companies operating in turbulent markets are more into market orientation than companies in general (Lusch and Laczniak 1987, Davis et. al 1991). Since the mass customization business model is closely related especially to customer orientation and interfunctional coordination, which are the market orientation dimensions (Narver and Slater, 1990), we suggest that this relationship might be inherited. This assumption is consistent with Pine's (1993) findings, which argued that the greater the perceived market turbulence is, the more likely the industry is moving towards customization.

Pine introduced and used the market turbulence map instrument to determine the level and type of the market turbulence. His instrument included as many as seventeen individual items, which were divided into demand (9 items) and structural (8 items) categories. According to Pine, demand turbulence indicates the degree to which a company can control, stabilize, and reduce uncertainty within its markets. Structural turbulence reflects the basic nature of an industry and is therefore less subject to manipulation by individual companies. Pine found out that all his seventeen items were not equally related to customization. He argued that averaging (or weighting) the first seven variables alone would provide clear indications of the need to adopt the customization strategy. The following four demand turbulence items belonged into this "first seven" group: 1) rate of change in customer needs and wants, 2) homogeneous versus heterogeneous demand, 3) level of pre- and postsale service and 4) quality consciousness. In addition to these four items, Pine's demand turbulence construct included the following five items: 5) stability and predictability of demand levels, 6) basic necessities vs. complete luxuries, 7) price consciousness, 8) easily defined versus uncertain customer needs and wants and 9) fashion and style consciousness. However, in our opinion only four of these items are directly related to demand turbulence (items 1, 2, 5, 8) while the others have a more or less indirect affect on demand. Therefore in the research method section, we will construct four generic demand turbulence items, which all are based on Pine's original instrument. Next we will present our research framework and method.

3. RESEARCH MODEL AND HYPOTHESES

3.1 Framework and hypotheses

In order to specify the research objectives, we designed our research framework (Figure 1), in which detailed hypotheses were constructed.

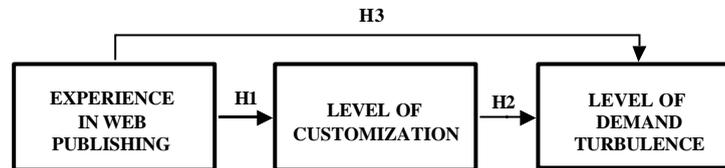


Figure 1. Research framework

According to Sääksjärvi and Santonen (2002) the learning effect regarding goal setting and goal attainment among online newspaper is evident. Also Boynton and Victor (1991) and Pine (1993) argued that companies must first transform their processes and re-engineer the product architectures to fit with the customized products production. These transformation processes are often time-consuming. Because of these arguments, we assume that customization should be more common among more experienced companies. Stated formally:

H1: The greater the experience in web publishing is, the higher the level of customization is.

Pine's (1993) previous research established that market turbulence, which includes the demand and structural turbulence dimensions, should affect customization in the case of physical products. Market turbulence is also expected to increase the market orientation construct, which is closely related to customization (Lusch and Laczniak 1987, Davis et. al 1991). Even if digital products are fundamentally different from physical products, and in most cases by nature require effective differentiation or customization (Choi et al. 1997, Shapiro and Varian 1998), we are assuming that this relationship is inherited. However, in contrast to previous assumptions, we argue that in the case of the demand turbulence-customization relationship, the interaction effect is actually reverse. Since the customized products fit the customers' needs and wants better, the demand level should be more stable and certain. It can be expected that:

H2: The higher the level of customization is, the lower the level of demand turbulence is.

It is, of course, possible that experienced online newspaper have discovered and selected other methods than customization to reduce the demand turbulence (e.g., content differentiation with a local focus or marketing). Therefore we suggest that more experienced companies in general might be able reduce demand turbulence regardless of whether customization is applied.

H3: The greater the experience in web publishing is, the lower the level of demand turbulence is.

4. RESEARCH METHOD

4.1 Data collection and response

We finalized and pre-tested the questionnaire in a few interviews with specialists of the Finnish Newspaper Association (later FNA) to make sure that all questions were semantically precise and understandable. The names of the newspapers and personal addresses of the most potential respondents were collected with the help of the FNA. The pre-tested questionnaire was addressed directly to the manager responsible for the online newspaper business activity. If there was no certainty over the right person, this was confirmed by a

telephone call to the newspaper. According to FNA annual statistics, 129 newspapers also published an online version in 2001 (FNA, 2001). The accumulated circulation of these newspapers covered 88 percent of the total circulation of newspapers in Finland.

After one follow-up letter and a few reminder phone calls to the largest online newspapers, we had 42 acceptable responses, which gave us a nice overall response rate (about 32 percent). The data provide a very satisfactory sample of the target market, taking into consideration the fact that over 70 percent of the largest newspapers (publication frequency 7 days per week) had responded. On an average these 42 online newspapers had a customer base of 11 000 weekly readers (October 2001). The average annual workforce was about 4 persons, while the average age of the online versions was about 3.6 years. Only 23 newspapers had generated revenue, which on an average (annual 2001) was about 46 000 Euro, and represented on an average less than one percent of the annual income of the parent print newspapers. However, all these above-mentioned figures varied significantly. In rough terms, our data consisted of 15 national-level newspapers, the rest clearly having a more restricted regional or only local readership. Accordingly, we classified the online newspapers into two markets: national (15) and regional (27).

4.2 Construction of demand turbulence measures

Pine's original market turbulence map instrument included as much as seventeen individual items, which were divided into demand (9 items) and structural (8 items) categories. In the literature section we introduced all the demand turbulence items and argued that only some of the items were directly related to demand, while other have a more or less indirect affect. As a result of this argument, we constructed the following four generic demand turbulence items: 1) The DALL item included all Pine's nine demand turbulence items, 2) DFOUR included only those items that were part of "first seven" group, 3) DDIRECT included four items, which in our opinion were directly related to demand uncertainty, and finally 4) DINDIRECT included all five items, which in our opinion were indirectly related to demand turbulence. All nine items were measured on 7-point Likert-scales, which asked for the respondents' opinion about the current and future (end of 2004) status of their business with respect to these items.

4.3 Construction of customization and experience measures

On the basis of the literature review, two different customization items were constructed. The first one was used to analyze pure customer-oriented customization (4 items), while the second item attempted to identify the more complex process-oriented customization approach (5 items). Also all 9 customization items were measured on 7-point Likert-scales.

The following very typical web customization approaches were selected to identify applied and future (end of 2004) customer oriented customization approaches: *first*, (C1) content recommendation based on user preferences or special keywords, *secondly*, (C2) modular page(s) like my.yahoo, *thirdly*, (C3) content recommendation based on end-user demographic profile or session history and *finally*, (C4) search agents, which send filtered information to end-users. The reliability of the applied and future customization constructs was estimated using Cronbach's alpha (applied customization 0.804, future customization 0.936). The average values of these four measures were used as a general customer-oriented customization items (CUS2001 and CUS2004). A correlation analysis was also conducted to make sure that individual customization items were truly related to the combined general customization items (Appendix Table 1). The correlations ranged from 0.797** to 0.940**.

The process-oriented customization items (PROS2001 and PROS2004) included the following five individual approaches: *first*, (C5) transparent customization, *secondly*, (C6) flexible process throughout whole value chain, *thirdly*, (C7) multi channel distribution (e.g., web, WAP, SMS and email), *fourthly*, (C8) the technically adaptive online newspaper, which is automatically able to adjust itself to different technical requirements (e.g., operating systems, browsers and screen resolution). and *finally*, (C9) the ability to produce dynamic ads to targeted people. Similar reliability tests were conducted. Cronbach's alpha in the case of applied process-customization was 0.748, while in the case of future process-oriented customization it was 0.919. The correlations ranged from 0.493** to 0.922** (Appendix Table 2). Based on these tests, we argue that both customer-oriented and process-oriented items achieved high levels of internal consistency, and hence can be used to measure applied and future customization among our sample group.

The age in months (EXP) was used as a base measurement of the web publishing experience, (based on the date when the online newspaper's first version was launch to the public). To make sure that we got valid measures, we also asked all respondents to identify both themselves and the online and print newspaper in question.

5. RESULTS

5.1 Testing the hypothesis H1

The hypothesis H1 assumed that online newspapers' experience in electronic publishing should increase the degree of applied customization. Based on descriptive statistics in Appendix Table 3, it is evident that online newspapers have not proceeded far in applying the customization business model. However, the importance of customization is expected to increase in the future especially among national-level online newspapers. The correlation analyses in the Appendix Table 4 indicated that experience affects positively both applied and future customization (correlation ranged between 0.454**⁻-0.588**⁻). Another correlation analysis was conducted to test how much the regional dimension (national vs. local readership) affected applied and future customization. Based on our results it seems that mainly national online newspapers are interested in the customization business model now and in the future (correlation ranged between 0.502**⁻-0.602**⁻). These findings evidently support hypothesis H1, which was accepted.

5.2 Testing the hypothesis H2

Hypothesis H2 assumed that the higher the level of customization is, the lower the level of demand turbulence is. Surprisingly, on the contrary to our assumptions, we could not find any statistically significant correlation between any of the customization and demand turbulence items (Appendix Table 4). As a result, we were forced to reject the hypothesis H2.

5.3 Testing the hypothesis H3

Our hypothesis H3 assumed that the greater the experience in electronic publishing is, the lower the level of demand turbulence is. Based on descriptive statistics in Appendix (omitted), the expected variations in the demand turbulence were found. The correlation analyses between experience and demand turbulence items had some mixed outcomes (Appendix Table 4). The experience affected negatively both the direct demand turbulence items (DDIRECT2001= -0.388*, DDIRCT2004= -0.403*), but also the DALL2004 item (DALL2004= -0.329*), which included all Pine's nine demand turbulence items. The other demand turbulence items did not correlate with the experience item. These results only weakly support our hypothesis H3, which was rejected.

6. DISCUSSION AND CONCLUSION

We found rather strong support for Boynton and Victor's (1991) suggestion that the path from mass production to mass customization is not direct and requires learning and continuous improvement. It seems evident that experience in web publishing has a strong effect on customization also in the online newspaper industry. In practice online newspapers with less than three years of experience had not applied any of the individual customization approaches, whereas customization is clearly most common among the most experienced online newspapers, which are competing in the national markets. Even if our research was not a true longitudinal study, it seems to support the fact that national-level online newspaper have consciously or unconsciously selected an incremental movement towards customization, which was one of the three main transformation strategies introduced by Pine (1993).

However, the mean value comparison indicated that the process-oriented customization approach was more commonly in use, whereas customer-oriented customization was still more or less in a very early and experimental stage. In the future, however, the balance between process and customer-oriented customization approaches was expected to become more even. In general the findings indicate that currently, but also in the future, the customization business model is not the main strategic option for online newspapers to attract and retain customers. It appears that many online newspapers have actually adopted a variety-seeking strategy since they have continuously and heavily increased the amount of content and services, and also planned to do so in the future. This could partially also explain why online newspapers have focused more on the flexible or even customized production process approach. The flexibility of the production process is essential for companies that have an extensive product line selection.

When online newspapers become more familiar with the electronic publishing environment and start to truly understand the nature of web publishing and the characteristics of digital products, they slowly start to adjust their products and process to fit with the new and fundamentally different conditions. It is also possible that when online newspapers face hard competition from other media companies or newcomers, they realize that something else than a standard repository of recycled print articles is needed to attract customers and remain competitive (e.g., personalization or unique content). This kind of environmental effect is closely related to Pine's structural turbulence dimension, and therefore deserves more detailed analysis also in the online newspaper environment.

Our findings are also somewhat consistent with Pine's (1993) suggestion that more experienced companies should be able to control the demand uncertainty. However, since we found only limited support for this proposition – only for the items that were directly related to demand turbulence – more extensive studies will be needed in the future. On the contrary to the previous arguments, we were not able to validate the demand turbulence-customization relationship in the case of online newspapers. However, it is possible that the suggested positive relationship between demand turbulence and customization exists also in the online newspaper environment, but we were not able to detect it because of insufficient statistical power, or because of the young, inexperienced and undeveloped nature of the industry segment in general. Also the general level of applied customization was extremely low (especially customer-oriented customization), which might at least partly explain why the benefits from the customization applied were not realized. Another area that deserves our attention are the online newspaper business unit managers. The data in this research were mainly based on their perceptions of the demand turbulence and customization. Since the main goal of online newspapers in Finland is to support the print version (Sääksjärvi and Santonen, 2002), it is possible that, e.g., managers responsible for print newspaper, which often are not the same as the managers in online newspapers, might have had different opinions about the demand turbulence and customization.

Due to the nature of the small and homogeneous sample group in our study, the generalizability of our findings calls for further research. Future studies with larger sample groups will validate or reject the demand turbulence-customization relationship in the case of digital products. The expanded sample group should include, not only online newspapers in different global regions or other paper-based electronic publishing industries (e.g., magazines), but also other kinds of digital products (e.g., software). This would indicate whether the online newspaper industry is the exception to the rule, or whether the web publishing industry and digital products in general react differently to demand turbulence than physical product markets. Furthermore, one should also analyse the level of applied customization directly on the web sites using content analysis methods. These additional analyses would result in more reliable and comparable applied customization measures.

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APPENDIX

Table 1 Individual customer-oriented customization items' correlation with CUS2001/2004 items. N=40-42,
** Correlation is significant at the 0.01 level.

		C1_2001/2004	C2_2001/2004	C3_2001/2004	C4_2001/2004
CUS2001	Pearson Corr.	0.834**	0.797**	0.829**	0.820**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
CUS2004	Pearson Corr.	0.940**	0.875 **	0.923**	0.934**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000

Table 2. Individual process oriented customization items' correlation with PROS2001/2004 items. N=40-42,
** Correlation is significant at the 0.01 level.

		C5	C6	C7	C8	C9
PROS2001	Pearson Corr.	0.678**	0.827**	0.794**	0.493**	0.817**
	Sig. (2-tailed)	0.000	0.000	0.000	0.001	0.000
PROS2004	Pearson Corr.	0.738**	0.902**	0.922**	0.873**	0.881**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000

Table 3. Generic customization items: descriptive statistics.

Region		CUS2001	CUS2004	PROS2001	PROS2004
Local	Mean	1.366	2.963	1.339	2.815
	N	28	27	28	27
	Std. Dev.	0.806	1.729	0.674	1.612
National	Mean	1.607	5.089	2.500	5.054
	N	14	14	14	14
	Std. Dev.	1.296	1.129	1.390	1.025
Both	Mean	1.446	3.689	1.726	3.579
	N	42	41	42	41
	Std. Dev.	0.987	1.844	1.104	1.785

Table 4. Correlation analyses between key variables

		CUS2001	CUS2004	PROS2001	PROS2004	EXP
EXP	Pearson Corr.	0.244	0.514**	0.454**	0.588**	
	Sig. (2-tailed)	0.140	0.001	0.004	0.000	
	N	38	37	38	37	
REGION	Pearson Corr.	0.82	0.554**	0.502**	0.602**	0.581**
	Sig. (2-tailed)	0.605	0.000	0.001	0.000	0.000
	N	42	41	42	41	38
DALL2001	Pearson Corr.	-0.123	-0.069	-0.078	-0.128	-0.278
	Sig. (2-tailed)	0.439	0.669	0.622	0.424	0.091
	N	42	41	42	41	38
DALL2004	Pearson Corr.	-0.103	0.057	-0.082	-0.016	-0.329*
	Sig. (2-tailed)	0.527	0.732	0.614	0.924	0.050
	N	40	39	40	39	36
DFOUR2001	Pearson Corr.	-0.069	0.020	-0.117	0.013	0.002
	Sig. (2-tailed)	0.663	0.901	0.462	0.936	0.992
	N	42	41	42	41	38
DFOUR2004	Pearson Corr.	-0.162	0.154	-0.210	0.072	-0.173
	Sig. (2-tailed)	0.317	0.349	0.193	0.663	0.314
	N	40	39	40	39	36
DDIRECT2001	Pearson Corr.	-0.141	-0.119	-0.134	-0.253	-0.403*
	Sig. (2-tailed)	0.372	0.459	0.396	0.110	0.012
	N	42	41	42	41	38
DDIRECT2004	Pearson Corr.	-0.069	0.006	-0.097	-0.119	-0.388*
	Sig. (2-tailed)	0.672	0.971	0.551	0.472	0.019
	N	40	39	40	39	36
DINDIRECT2001	Pearson Corr.	-0.071	-0.015	-0.012	0.006	-0.087
	Sig. (2-tailed)	0.655	0.926	0.940	0.972	0.605
	N	42	41	42	41	38
DINDIRECT2004	Pearson Corr.	-0.100	0.078	-0.036	0.092	-0.140
	Sig. (2-tailed)	0.537	0.637	0.824	0.579	0.415
	N	40	39	40	39	36

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

ADAPTIVE 3D INTERFACES FOR SEARCH RESULT VISUALIZATION

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ABSTRACT

A new approach to three-dimensional interactive visualization of data retrieved from web search engines as a result of execution of a user query is presented. In the proposed method, the visualization interface applied to a particular result is selected from a number of available interfaces depending on the search result properties and information provided by a user. Two types of interfaces are described in the paper: holistic interfaces for presenting data classified according to different properties of the result and analytical interfaces for presentation of detailed result information. The use of a particular interface depends on its readability in the context of particular search result. The general readability rules for 3D interfaces are also presented. Possible mappings of search result properties to different visual properties of the interfaces are discussed and examples of different visualization interfaces are presented.

1. INTRODUCTION

The World Wide Web consisting of billions of web pages may provide a user with almost every type of information needed. All kinds of content for education, research, entertainment and leisure can be found on the web. The main problem is to locate this bit of useful information in enormous volumes of not structured and not categorized data. To solve this problem search engines were created. However, as the amount of information gathered in the search engine databases grows, it becomes increasingly difficult to present them to the users in an understandable and manageable form.

Most of search engines offer only simple textual interfaces that do not permit users to fully exploit the search results. A typical search engine displays search results by dozens of documents in a page-by-page principle. Retrieval of the next part of the result requires user interaction. Since the retrieved data is presented in small chunks, the user cannot see a global picture of the result. It is not possible to group or categorize the presented data. The only possible user interaction with the search result is selection of one of the presented links. Most of the existing search engines also limit the maximum number of records presented to a user. Typically, after presentation of several hundred records, a user has to re-specify the query. This approach is imposed by a requirement to keep the response times minimal, but it also often restrains the user from accessing important information.

In the classical approach, documents constituting a search result are ordered arbitrarily based on a ranking algorithm specific to the particular search engine. Usually, the ranking algorithms used to calculate the relevancy factors of documents are sophisticated and take into account multiple different aspects of the user query and properties of the indexed documents. But even the most complicated algorithms can be deceived by a specific design of the web page, e.g. by repeating keywords in pseudo-phrases not appearing in the page contents or by the use of popular keywords which are not semantically connected to the page. As a result addresses that do not really match the specified query may be presented as the most relevant. Furthermore, since users cannot change the ranking algorithm they do not have influence on the final order of the presented documents.

At the current stage, progress in presenting the search results to users requires switching from classical textual to more advanced graphical user interfaces. There were several attempts to create graphical interfaces for search systems. In most of them 2D graphics has been used, but there were also attempts to apply 3D visualization. Several projects were carried out in HCIL [6] where the problem of visualization of big volumes of information has been addressed [5][17]. Other examples of projects applying 2D visualization are

Antarctica [1] and InXight [9]. The projects exploiting 3D visualization of search results resulted in development of several visualization methods like 3D cards augmented by visualization of semantic relationships between documents [10], city-like landscapes [1][14], or positioning of objects in the 3D space like in VR-VIBE project [2][18], or Cat-a-Cone project [3]. In the NIRVE project [4][11][15] the 3D visualization is enriched by a concept of data clustering. An example of a 3D visualization system accessible for web users is the ViOS system [16].

Most of the search engines with 3D visualization interfaces developed up to now have not reached technological acceptance and commercial use, mainly because of the following drawbacks:

- The applied 3D graphical interfaces visualized information in a single 3D environment; as a result, different volumes of information had to be presented in the same scene. In many cases this approach resulted in improper presentation of information and thus decreased user perception;
- A user was presented with a 3D environment, where each document was represented by a 3D object. In the discussed solutions there were no attempts to present aggregated information first, and then – in response to user interaction – more specific information;
- The proposed systems either allowed full user interaction with the interface but required installation of some dedicated software, or were based on open Internet standards (e.g., VRML) but lacked full interaction capabilities as a result of the shortcomings of the general purpose standards.

In this paper a new method of interactive adaptive 3D visualization (AVE) of search results returned by indexing search engines is proposed. The visualization interface applied to a particular search result is automatically selected from a number of available interfaces depending on the search result properties and information provided by a user. Different types of interfaces are available, e.g. categorizing interfaces for presentation of aggregated data, detailed interfaces presenting details of the documents found, and comparative interfaces for comparison of different search results.

The remainder of this paper is organized as follows. In Section 2 the concept of adaptive user interfaces is described. In Section 3 examples of different types of interfaces are presented. In Section 4 discussion over application of interface visual properties is presented. Section 5 summarizes the paper.

2. THE CONCEPT OF ADAPTIVE USER INTERFACE

The amount of information returned by an indexing search engine may vary significantly. As the response to a user query, the search engine may return several records or several hundreds of thousands of records. Consequently, it is not possible to create a single 3D environment capable to visualize the entire spectrum of possible search result volumes. In the AVE method, the visualization system selects from a number of available visualization interfaces the one that best describes the search result. Assignment of the appropriate interface is based on the search result quantitative and qualitative properties (see Figure 1) to maximize its readability. This process may be fully automatic, with the visualization engine using pre-programmed logic to select the best interface, or user-aided with a user selecting a set of preferred interfaces. The visualization engine may also present a user with a set of interfaces that fit the particular search result and a user may choose the best one in his/her opinion.

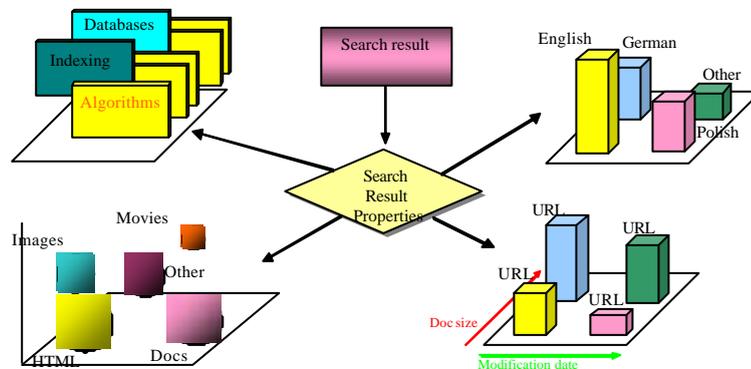


Figure 1. Selection of the visualization interface

The process of searching for the document of interest may be seen as a number of subsequent user queries where a query may narrow or broaden the previous search result. Using different levels of abstraction and applying the most appropriate 3D environment on each step, the AVE method permits to navigate from a high-level categorized, aggregated view of the entire search result, through categorized views of sub-results, up to precise visualization of information about particular documents of user interest. A user may formulate queries by adding and removing keywords, but also by interaction with 3D elements of the visualization environment (e.g., selecting objects by moving them to a predefined area). This multi-step process may be seen as a path through the visualized search results and is called *exploration path* (c.f. Figure 2). On this path the user is supported by an interface selection logic that helps to select appropriate interfaces. In sample exploration path presented, a user querying the search system with an ‘Initial’ interface, is presented with ‘Spheres’ interface, which groups results by domain. However, if all documents found are located on the same host, a ‘Spheres’ interface may be omitted and the result is visualized in ‘Hedgehog’ interface. Then a user may wish to visualize this same result using ‘City’ interface, and finally, browses documents of interest. Using specialized interfaces a user may also preview images and/or video files.

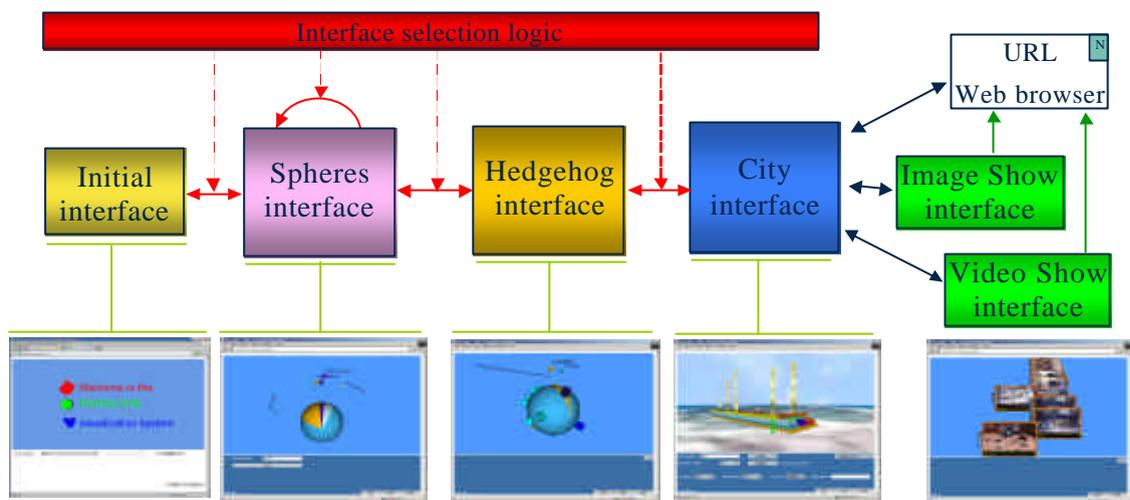


Figure 2. Sample exploration path

On each step of the AVE exploration path, the search result properties are mapped into one or more visual properties of a 3D scene. Each visual property, which may represent a single search result attribute, is called a *visualization dimension*. Visualization dimension may be represented as a property of an object (e.g., its color, size, shape, etc), or in another way, e.g., as a text associated with text node. Such assignment of document attributes to visualization dimensions may be dynamically changed by a user.

Selection of the appropriate interface, either automatic or manual, should produce a visualization that is readable to a user. While many different aspects of the readability may be discussed, some of them seem to be the most important in context of 3D environments. We assume that a visualization interface is readable if, and only if the following postulates are satisfied: (1) there exists a *viewpoint* from which all presented objects can be observed; (2) *size* of glyphs (where glyph can be defined as a single graphical object representing multivariate data object [20]) should allow their easy manipulation and interaction; (3) *occlusion* of each two glyphs in the scene should permit a user to interact with every glyph in the scene; (4) each interface dimension should represent a *unique* search result attribute (e.g., color represents document content-type); (5) the domain of each search result property is *properly transformed* into domain of a visualization dimension; and (6) *distance* between subsequent dimension values must be distinguishable by a user.

While both types of visualization – detailed and classifying – may be implemented by a single interface by changing only the meaning of visualization dimensions, in many cases a better visualization may be obtained by the use of specialized interfaces. Interfaces that are designed especially for presentation of detailed data are called *analytical interfaces* while interfaces designed to visualize aggregated data in a categorized way are called *holistic interfaces* (c.f. Figure 3).

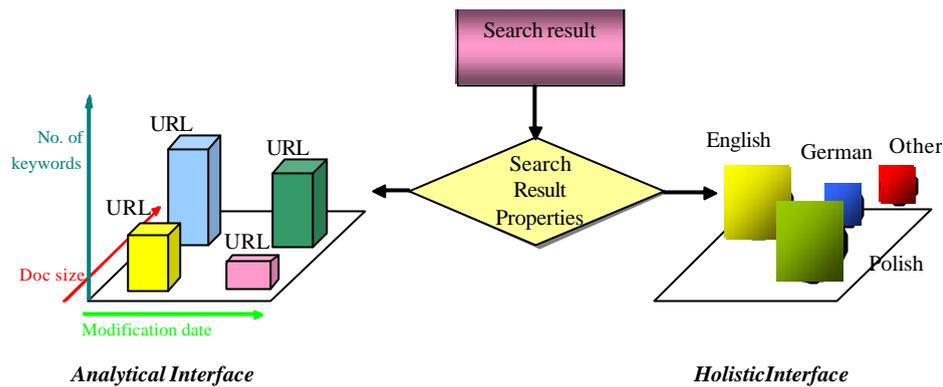


Figure 3. Selection of the visualization interface

An *analytical interface* is characterized by a high number of visualization dimensions (comparable with the number of search result attributes) and their visual separation. This permits detailed visualization of the search result allowing a user to observe and evaluate many different aspects of the displayed information.

Unlike an analytical interface, a *holistic interface* is characterized by a small number of visualization dimensions. Such interface can be used to present a generalized view of the search result where a user can instantaneously recognize the nature of the data but not the particular details. In a holistic interface, the categorization criteria are selected automatically based on the search result properties such as number of domains and/or sub-domains, number of sites, number of languages, document content-types, semantic relationships between documents, etc.

In both, analytical and holistic interfaces, the search result is always presented entirely. This permits a user not only to browse through the information but also to understand its nature. Appropriately constructed and applied interface permits a user to perceive trends in data faster and with bigger precision through clearly visible differences in colors, shapes, connectedness, continuity, symmetry, etc. A user may also apply different interfaces to the same search result in order to recognize different aspects of the same data set.

3. EXAMPLES OF VISUALIZATION INTERFACES

3.1 Analytical interfaces

Analytical interfaces are designed to present a user with detailed view of the search result. For this reason such interface should offer a high number of visualization dimensions. Typically, each object in analytical interface represents a single document, while the object properties reflect properties of the document. Therefore, with regards to readability prerequisites, such interface should be applied only to search results with relatively small number of records where visualization of document properties is also important.

In Figure 4, two examples of analytical interfaces are presented. The interface presented in Figure 4a has 5 dimensions: shape representing language, color representing document type, position on Y-axis representing hostname, position on Z-axis representing document size, and position on X-axis representing document modification date. The interface presented in Figure 4b has 7 dimensions represented by X-, Y- (height of the floor) and Z-axis, color, texture, height and movement of the object.

In Figure 5a, an example of an incremental analytical interface is presented. With the use of this interface, a user can successively specify keywords in subsequent queries. After each query, tiles representing documents containing higher number the specified keywords become more red, while tiles characterizing documents with lower number of keywords fade into light blue color.

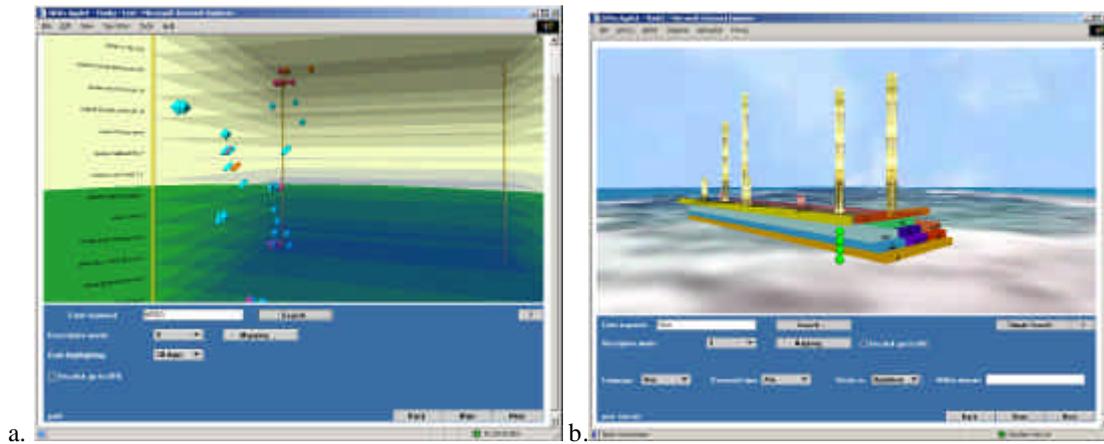


Figure 4. Analytical interfaces with (a) 5 and (b) 7 dimensions

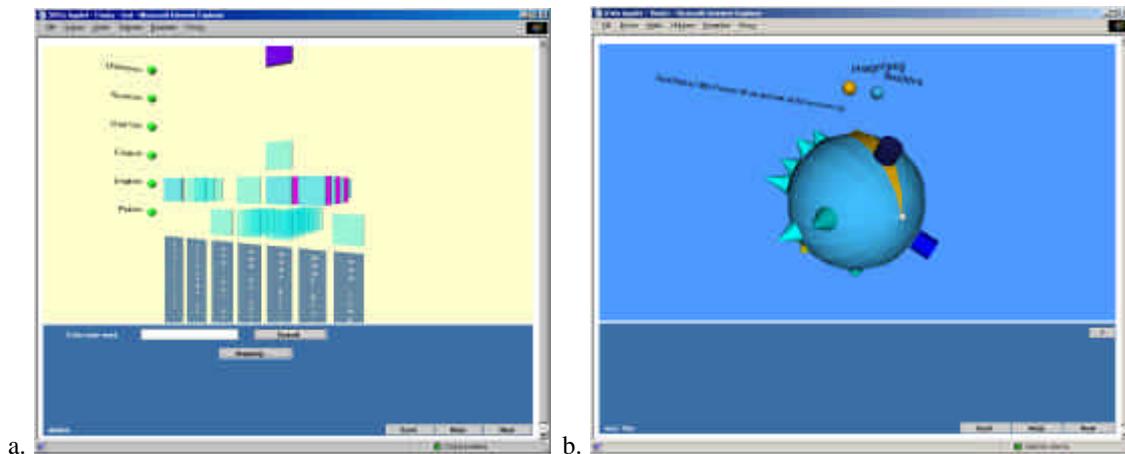


Figure 5. Specialized analytical interfaces: (a) with incremental selection and (b) showing links on one web server

The analytical interface presented in Figure 5b can be used to present documents of interest existing on the same host. In this interface, object shapes denote document type, their color represents language, while position on the sphere corresponds to the number of keywords found in a particular document.

3.2 Holistic interfaces

Holistic interfaces are used to present a classified view of the search result. A holistic interface may show a search result classified using either one or several criteria, thus it does not need many visualization dimensions. Such interface may also contain some analytical elements permitting better evaluation of the search result. In Figure 6a, an example of a holistic interface with one classification criterion is presented. In this example, a sphere is divided into multicolored slices representing different Internet domains. Size of a slice represents the number of hosts containing documents of interest, hence a user may instantly recognize domains, where the probability of finding useful information is the highest. To improve readability of the interface, a sphere is surrounded by small colored bullets with textual tags providing names of the domains represented by particular colors.

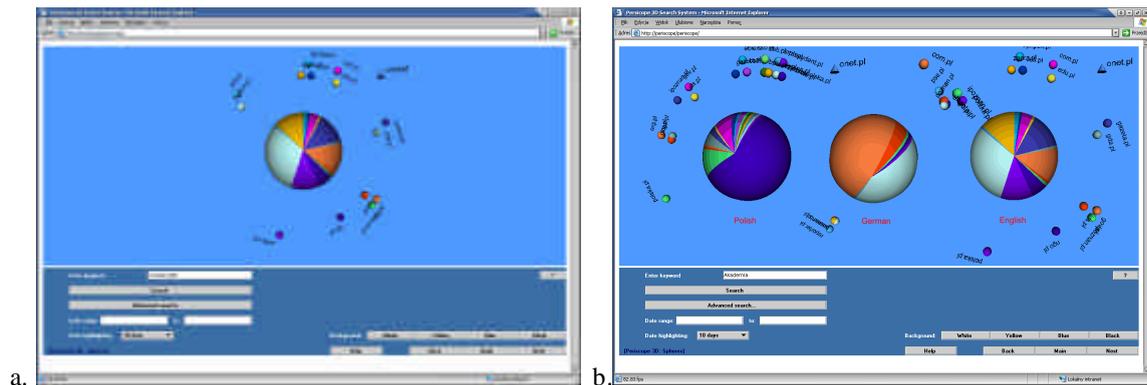


Figure 6. Holistic interfaces: (a) single criterion and (b) multiple criteria

An example of a holistic interface with two classification criteria is presented in Figure 6b. In this interface each sphere represents different languages of documents, while sphere segmentation represents Internet sub-domains.

In the Figure 7, a holistic interface which permits to compare two queries is presented. The interface is equipped with two input fields that permit a user to enter two different queries and compare their results represented as two series of coaxial cylinders. Each of cylinders symbolize one sub-domain containing hosts with documents of interests. Tiles attached to each of the cylinders represent documents. All documents residing on this same web server share the same color.

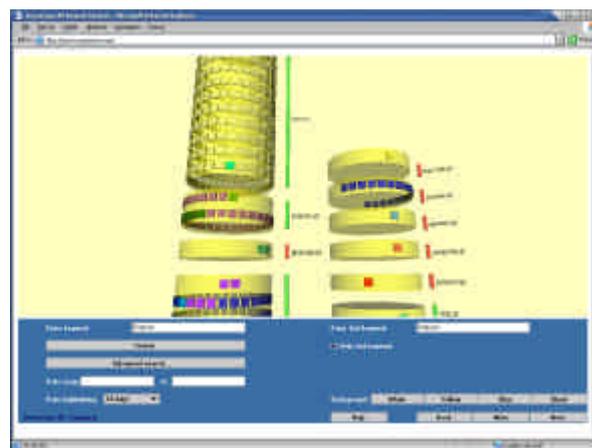


Figure 7. A holistic interface with analytical elements

4. USING INTERFACE VISUAL PROPERTIES FOR DATA VISUALIZATION

Creation of a readable interface that meets all prerequisites described in Section 2 requires understanding of the limitations of particular types of visualization dimensions. Each glyph can carry meaningful information through its position, size, shape, orientation, color and texture, and animation of each of the above.

Abilities to recognize differences in size and location are highly correlated. For example, if objects have dimensions of several meters, the difference in size or location measured in millimeters is unnoticeable. Although a size of a glyph consists of 3 dimensions, it is perceived by a user holistically. Assignment of different search result attributes to single geometric dimensions (x, y, and z) is possible, but is incomprehensible for a user and most likely would not be noticed.

Shape, with its potential variety, is a very capacious carrier of information. A high number of shapes can be recognized and distinguished by a user. The set of shapes that can be used for visualization consists of several geometrical primitives like sphere, cone, or cylinder; some well-recognizable polyhedrons like cube, tetrahedron or octahedron; and a big number of real-life shapes such as cars, books, furniture, trademarks, symbols, etc. The use of polyhedrons with growing number of vertices is limited because differences become difficult to distinguish (e.g. difference between dodecahedron and icosahedron).

Orientation of the glyph may be used only if the shape of the glyph permits to recognize the differences in orientation. Rotation of a cube may be in most cases easily noticed by a user, while the same transformation applied to a sphere cannot be identified. Small changes in orientation of a single glyph may be unnoticeable, but when this glyph is surrounded by a group of identical objects, even very small orientation differences may be immediately observed. Another problem is the change of orientation by certain angle along the glyph symmetry axis, which may lead to an impression, that no change was made at all (e.g. cube rotated by 90 degrees along an axis of symmetry).

Color of a glyph is a very flexible dimension. It has been estimated in [8] that a color monitor has between 2 and 6 millions of different colors available, but it is evident, that only a small subset of them can be perceived by a non-trained user. Other works [13] show that only a small number of colors can be used effectively as labels for expressing data. It is estimated that only 5-10 colors may be instantly recognized [7]. Moreover, recognition of color differences is highly related with luminance, hue value, contrast, saturation, monitor properties, and even human eye properties. A surface of the glyph may bring a large amount of recognizable information. A user may easily differentiate between plain color surfaces and textured surfaces. A number of distinguishable textures is nearly unlimited, while they vary in color and pattern. Even if two objects share the same pattern and color, texture orientation may be different (e.g., rotated by 45 degrees) bringing information to a user. This, however, applies only to well recognizable geometric patterns like parallel lines, squares etc. Rotation of texture imitating, for instance, stone surface, is unrecognizable.

Application of temporal dependencies to properties described above introduces additional informational dimension. Temporal coding is, however, limited in range and discreteness. The upper range limit depends on the property being animated: for some properties frequency of changes is limited by a visual inertia of a human eye and/or inertia of a display. For instance, a glyph changing its colors too fast is seen as having one. An object changing rapidly its position may not be visible on slow LCD screens. The lower limit of temporal coding is connected with: a) time when a user focuses on particular object (typically several seconds); and b) life time of the interface. An object property cannot be changed too slowly, because a user would not notice modification or the interface will be destroyed before.

The number of distinguishable levels in temporal coding is very low. A user may perceive a small difference in temporal changes of a particular property only if it can be compared to the original speed/frequency or another object. For instance, speed change of an animated object either has to be changed significantly or another animated object must be visible to permit speed comparison. The overall number of objects having time-dependent property values should be also kept small. In fact, temporal changes as an information medium may be used only sporadically. The interface, where a number of objects change their position, color, and shape in the same time is very likely to be unreadable.

The above issues should be carefully reconsidered while building interfaces, which may be used or designed especially for disabled people. In such case some properties cannot be used (e.g., color, when by people with inability to discriminate colors) or should be used with limited possible values (e.g. large differences in size of objects, in interfaces for people with partial blindness).

5. CONCLUSIONS

For testing and evaluation of the proposed AVE method, a prototype visualization system called *Periscope* has been developed [12]. The *Periscope* system is an intermediary system between users looking for documents on the Web and indexing search engines. The *Periscope* uses a set of interface models written in X-VRML language [19][21]. Interface models supplied with retrieved search result are presented to a user within standard VRML browser plug-in, like ParallelGraphics Cortona. Interface selection logic is also written in X-VRML.

First trials of the *Periscope* system connected to a custom search engine database containing information about 70% of sites within the Polish domain (.pl) proved that the AVE method can be efficiently used for Web searching. Although, the system response time is usually higher than in case of popular search engines (like Altavista or Google) reaching up to 30 seconds for complex queries, the end-users felt that the accuracy of the information retrieved was higher, especially in the cases when the initial constraints were not quite precise. During the tests it turned out that users often use several different visualization interfaces with the same query for better localization of the desired data.

Current tests focus on the ergonomics and perception of the 3D interfaces. Another group of tests is performed to determine what types of interfaces are the most preferred by end-users. Future works include optimization of the *Periscope* system architecture (faster response time, better load balance, higher security, etc.) and design of new interfaces, which consists of their graphical design, usability study, and proper inclusion in an exploration path.

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INDEXICAL REPRESENTATIONS FOR CONTEXT-AWARE MOBILE DEVICES

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ABSTRACT

Wireless mobile devices present a present a huge design and representational challenge for the discipline of human-computer interaction. Past approaches have focused on user, task and artifact. This paper argues that in addition to these factors an understanding of context can assist with meeting design challenges for mobile applications. It proposes a matrix of eight dimensions of context drawn from existent taxonomies in ethnography, socio-linguistics and human-computer interaction. The dimensions are described as time, absolute location, relative location, physical objects, activity, social setting, environment and culture. These are used to drive the design of interface representations for a route planning tool for use on the Melbourne public transport system. Central to the representations of information on the interfaces is the concept of index borrowed from semiotics and the idea of indexicality as an interface property. This paper illustrates how this concept can be used to develop interfaces for mobile devices and considers further applications and limitations of this approach.

KEYWORDS

Mobile applications, Human-Computer Interaction, context, indexicality

1. INTRODUCTION

A highly likely feature of any e-Society in the near future will be the widespread use of mobile devices and wireless technology. A key feature of such devices and technology will be context-awareness, whereby content and functionality are adapted to the user's situation. However, designing services for such context-aware mobile devices involves major challenges in terms of both defining use context as well as developing appropriate concepts relevant to the design of contextual information on mobile interfaces. This paper extends the concept of index discussed in Kjeldskov (2002) to inform the concept of context for mobile representations.

1.1 Background

The Gartner Group identified ubiquitous computing as a key trend that will emerge in Information Technology (Roberts, 2002). The group conducted a ranking exercise on 'technologies that are not yet widely adopted and that will have the biggest impact on enterprises between 2002 to 2007' (Roberts, 2002) and rated "always-on wireless data and communications devices" as one of these technologies. They have made a further prediction that "some 70 per cent of what it calls "office productivity workers" will own at least three mobile devices, while IT budgets will increase by 10 to 15 per cent every year to support enterprise wireless technologies and services" (Financial Times, 2002). The predictions do not end there. The Economist (Manasian, 2003) cites Forrester Research as predicting that 14 billion embedded and mobile

devices will be connected to the Internet by 2010. Such data indicates such technology will be a defining element of e-Society.

Historical data from Human-Computer Interaction has taught us that the role of context is critical in the understanding and development of information systems. Indeed a definition of Human-Computer Interaction quoted by Preece (1994:7) describes it as “a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of the major phenomena surrounding them.” This asserts the importance of context in understanding interactive computing systems along with the recent use of ethnographic approaches in system evaluation (e.g. Braiterman & Larvie, 2002).

Bannon (1991:27) critiqued HCI research in the 1990’s, asserting that within Human Factors “the human is often reduced to being another system component with certain characteristics...” The issue here is that a human is an actor within an environment and that the actor possesses a certain “thrownness in a situation” (Winograd and Flores, 1986:145). Winograd and Flores (1986:143) assert that “‘Doing’ is an interpretation within a background and set of concerns”. This means that user actions cannot be isolated from the environment in which they take place and, more radically, that actions cannot be understood without a context. They critique the conception of decision-making by a manager within an organization as a formal, structured activity, identifying this as “highly restrictive” (Winograd and Flores, 1986:145). They also identify two key issues: “thrownness in a situation, and the importance of background.” The problem posed to system development is that decisions are often not structured and we cannot map out all possibilities within a given context: “We are seriously misled if we consider the relevant space of alternatives to be the space of all logical possibilities.” Winograd and Flores (1986:149).

Mobile devices and applications are particularly susceptible to contextual change and the user’s interaction with that context. An analysis based on activity theory reveals the complexity of the relationships involved: the relationship between an object (e.g. a plan) and a user mediated by a tool, (Engeström, 1999), in this case the device. The relationship between a subject and a community is in turn mediated by rules and the relationship between an object and a community is mediated by division of labour. In this matrix, the layers of role that the user can play pose a design challenge. People, work, environment and technology can often not be separated. Preece (1994) implies this complexity when describing key factors in understanding a conceptual model for HCI as “people, work, the environment and technology” (Preece, 1994:43) and that “each component within the model interacts with the others...” (Preece, 1994:44).

These issues begin to provide an account that is relevant to mobile systems. A key attractor for mobile technologies among young people is usefulness and disappropriation criteria have been shown to include the technology being “unusable” (Carroll et al, 2001). Key usability problems encountered in the design of applications for such devices are that displays on mobile devices are small, means of input are limited and use-contexts are very dynamic (Kjeldskov, 2001). Thus Cheverst et al., (2001) identify three main ways of simplifying user interaction with a system: reducing the need for input, reducing the quantity of output and reducing the complexity of the user’s understanding of the system. The complexity of context is an additional factor to deal with: in a dynamic environment an actor may be behaving as an individual or as part of a community.

Previous work (Cheverst et al., 2001:9) describes how by carrying a mobile GUIDE unit, visitors to the city of Lancaster in England “can receive up-to-date information about the city’s attractions while following a structured tour of the city tailored to their specific requirements.” This system used the visitor’s location and the location of attractions within the city as context information. The developers recognized the importance of not being over-deterministic when designing user interaction with the system. It is argued at this point that an operational understanding of context can be useful in developing a system which is both flexible and useful. It is recognized, however, that there is a danger of over deterministic when presenting just-in-place information (Kjeldskov, 2002) through context-awareness.

However, Goodwin and Duranti (1992:2) note that defining context is very difficult and that one definition of context does not seem and may not be possible. This paper is firstly, an attempt to define context for mobile applications. We approach this through establishing a working definition and then by describing key dimensions of context. Even when context is defined and described, however, the definition may not be useful. Thus, this paper is secondly, an attempt to operationalise the dimensions of context to inform interface design for mobile applications. The concept of indexicality, based on an understanding of indexical type in linguistics and indexical representations in semiotics, is posited for this purpose.

The contribution of this paper is to utilize a definition on context within a mobile, context-aware device that is both rich enough to help with actual design and pragmatic enough to be used in real design activities

for mobile applications. This paper also aims to define the concept of indexicality for the first time and to illustrate how this property of an interface can be used to overcome some of the problems encountered when designing representations for mobile interfaces. Indexicality is rationalized as an important concept in designing for context. Then a design case that utilized both the understanding of context developed and the concept of indexicality is described.

2. CONTEXT, INDEXICALITY AND INTERFACE DESIGN

2.1 Context

Dey (2001:5) characterizes context in the following way: “Context is any information that can be used to characterize the situation of an entity. An entity is a person, place or object that is considered relevant to the interaction between a user and an application, including the user and the application themselves.” We argue that this definition is quite complete, although it fails to capture some of the key dimensions of context that can be useful in an operational definition. In addition, some key notions are not apparent: for example, work. Critical to an understanding of context is the idea of tacit knowledge and Norman’s (1990) concept of knowledge-in-the-world. The latter links the actor with the surroundings and is important in contexts which are highly dynamic as it offers an opportunity to associate interface with surroundings. It also suggests a relationship between the environment and an entity similar to that relevant to deictic words in linguistics such that three important concepts emerge: the referent, the “pivot” or origo relative to which the referent is identified and the relationship between the referent and the “pivot” (Hanks, 1992). Although this does not encapsulate all possible situations, we claim that these concepts are useful in producing an operational definition of context.

In order to operationalise this understanding of context, Table 1 describes possible referent-origo relationships. Hong & Landay (2001) have described context as knowing the answers to the “W” questions, such as Who is speaking. The y-axis of Table 1 is an articulation of those questions. The dimensions have been drawn from a number of approaches to defining context. Hymes (1972) defines context as part of a speech act or minimal communicative unit in his ethnographic analysis of language. He describes sixteen components of speech acts. The components relevant to our proposed dimensions have been reproduced here. Ochs’ (1979) four dimensional discussion of context focuses on defining context as a discrete concept, as he sees context as uniting language form and function. Fitzpatrick (1996) described five aspects specific to the interaction of social worlds to promote better understanding of collaborative environments. Dix (2001) offers a four-tiered taxonomy of context, more specific to computing and mobile devices and Agre (2001) offers three levels of context, again specifically aimed at analyzing wireless information services.

Rephrased as “W” questions the dimensions on the y-axis would become: 1. When?; 2. What position?; 3. Where?; 4. What else?; 5. What work?; 6. Who?; 7. What conditions?; and 8. What culture? Thus the first dimension addresses the time of day, the second the origo’s position, the third the origo’s position in relation to other people or objects, the fourth whether other devices are in the same space. The fifth dimension captures the goals, actions and operations of the origo the sixth the number of people present and the social occasion. The seventh dimension considers the physical environment and the eighth the cultural environment. Two additional dimensions were considered initially: strategy or plans (How?) and motivation (Why?). It was considered that these were captured by “Activity”, however. In addition, like Fitzpatrick’s (1996: 3) Locales, it was also considered that each of the dimensions could be applied to the context internal to the device (Fitzpatrick’s (1996) virtual domain) and also to the context external to the device in the physical world (Fitzpatrick’s (1996) physical domain).

We argue these dimensions of context can be utilised to assist designers in making decisions concerning the delivery of just-in-place (Kjeldskov, 2002) information to users moving through dynamic contexts. These dimensions offer a mechanism for translating requirements into representations for mobile devices.

Table 1. Dimensions of context

Dimension	Hymes (1972)	Ochs (1979)	Fitzpatrick (1996)	Dix (2000)	Agre (2001)
1. Time	Setting	Setting	Interaction trajectories		
2. Absolute location	Setting	Setting	Locale foundations	Physical Context	Architecture
3. Relative location	Setting	Setting	Locale foundations	Physical Context	Architecture
4. Physical objects	Setting	Setting	Mutuality	System Context Infrastructure Context	Architecture
5. Activity	Purposes – goals Purposes – outcomes	Language Extrasituational context	Interaction trajectories	Domain Context	Practices
6. Social setting	Speaker, addressor, Hearer, Addressee Norms of interaction Norms of interpretation	Behavioural Environment Language	Locale foundations Individual views	Domain Context	Institutions Practices
7. Environment	Setting	Setting	Locale foundations	Physical Context	Architecture
8. Culture	Scene Norms of interaction Norms of interpretation	Behavioural Environment Language Extrasituational context	Civic structures	Domain context	Practices Institutions

Notably Hymes' (1972) components and Ochs' dimensions are clustered around social setting and culture and to some extent activity. This is not surprising as understanding language within these contexts presents a considerable challenge. Along with Fitzpatrick (1996) they group several dimensions of context together; under "Setting" and "Locale foundations" respectively. We have separated these into distinct dimensions as we believe they will inform design more effectively instantiated in this way. Dix's four tiered taxonomy focuses on technology-specific issues including the relationship of the origo to other devices, applications and users (System Context) and the device-specific contextual issues such as network bandwidth available (Infrastructure Context). Agre's three level analysis acknowledges the loosening of the connection between activities and physical places by placing the emphasis on social and cultural constructs in the form of Practices or "the ensemble of embodied routines that a particular community has evolved..." (Agre, 2001:5) and Institutions or "the ensemble of social roles and rules that constitute those [human] relationships" (Agre, 2001: 5). This focus on practices and institutions is mirrored in Fitzpatrick's (1996) Locales Framework, which utilizes social world or "locales" as a primary unit of analysis.

2.2 Indexicality

From a semiotic perspective, there exists a dynamic among an object, representation or interface and interpretation or subject: the object's interpretation is mediated by the representation. In the same way, we argue that the context's interpretation can be mediated by index. Indexes are ways of representing information with a strong relation to contextual information (Kjeldskov, 2002). These relationships are illustrated in the figure below.

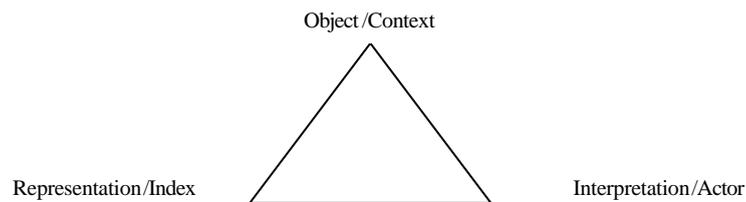


Figure 1. Semiotic triangle showing mediation of relationships

Thus index has a critical role to play in communicating information valuable in a particular context. Horn (1988:116) describes indexicality in the following way: “the interaction between the context of utterance of an expression and the formal interpretation of elements within that expression constitutes a central domain of pragmatics, variously labeled deixis, indexicality or token-reflexivity.” Here we define indexicality as a property of an interface representation that is defined as having a context-specific meaning. This means that it is dependent on a referent with which it has a relation for its meaning. For example, if a digital display in a Metro carriage in Lisbon reads “Baixa-Chiado” when approached Baixa-Chiado Metro station it is indexical, because it has a proximity-based relationship (a relationship based on relative location) to the station and has a full meaning of “Baixa-Chiado is the next station”. An interface element that has the property of indexicality can only be understood in a particular context. If an interface element exhibiting indexicality is extracted from its context the meaning of the element will be compromised. For example, if “Baixa-Chiado” appears when leaving Baixa-Chiado station it has a completely different meaning.

Thus, including indexical-type representations can not only mediate context in interface design, but also exploit knowledge-in-the-world thereby maximizing the communicative power of representations.

2.3 Using Indexicality for Mobile Representations

The definitions and dimensions of context and the concept of indexicality discussed above were used to inform the representation of information on a context-aware mobile information system. In order to exemplify the mediation of context through indexicality in the representation of information on a context-aware device, a number of central characteristics of this design are described in the following sections.

2.3.1 The TramMate Project

For the purpose of supporting the use of public transport systems in Melbourne, Australia, we have designed and are currently implementing a functional prototype of TramMate. TramMate is a mobile information service that provides users with a route-planning tool integrated into an electronic calendar on a PDA. The design of TramMate was based on field studies on the use of transportation by business employees who, during a typical workday, have to attend appointments at different physical locations. As an example of a potential context-aware mobile device application of future e-Society, TramMate intends to support the use of public transportation by keeping track of contextual factors such as the user’s physical location, upcoming appointments and real time information about trams and traffic conditions. TramMate thus exemplifies what a context-aware mobile application might offer and look like by exploring the dynamic use context of mobile information services in interface representations.

In association with the Department of Geomatics at the University of Melbourne, a location-aware trip planning functional prototype was evaluated in parallel to the design of TramMate. The objective of this evaluation was to inform the implementation of TramMate. The application evaluated exploited a global positioning system, tram timetable, stop and network information and maps to serve up WML pages in a PDA browser. Trip planning algorithms acted as the middle layer between the tram data and the representation of information. Field, laboratory and expert evaluations were conducted on system and the results are currently under analysis. Work is currently underway developing an agent-based prototype to capture context variables.

2.3.2 Example Interfaces

The interface of TramMate was designed with the concept of indexical information representation in mind and exemplifies how indexicality can be used for exploring and mediating different dimensions of the user’s context discussed above in interface design for mobile devices. The overall aim of the TramMate mobile information system was to support the use of transportation for attending appointments at different locations and times. Given this, some of the dimensions of context discussed above immediately seemed more important than others. Thus, decisions concerning the relevance of certain dimensions to a design situation were made on the basis of the initial requirements gathering exercise and the user’s key activities. In the situation of catching the right tram for example, cultural and environmental context seemed less important than time, location and desired activity. In other situations or applications, however, this is likely to be very different.

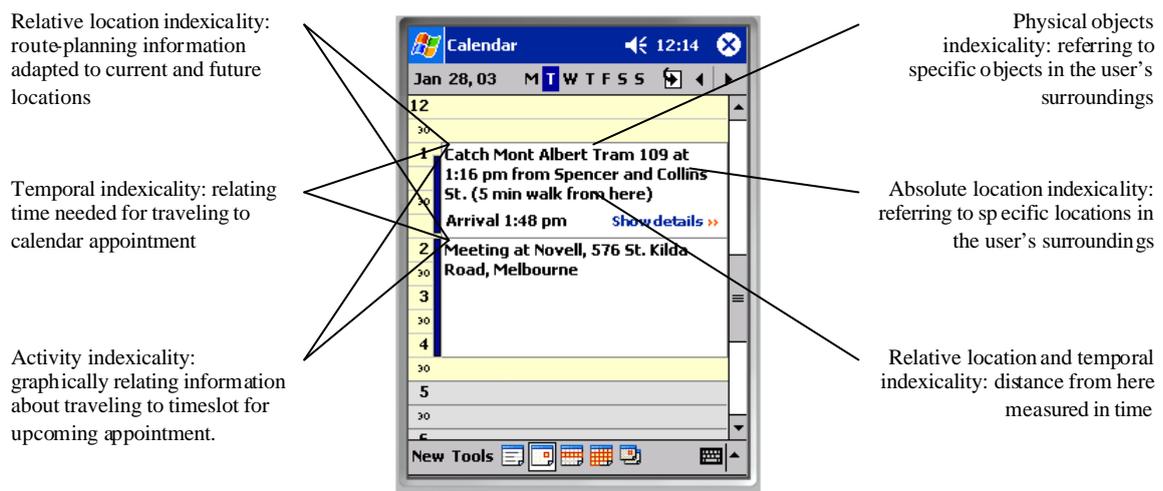


Figure 2. Exploring contextual indexicality in mobile device interface design: Calendar view of TramMate

The idea behind TramMate was not to reduce the complexity imposed on the user in terms of need for input and quantity of output as suggested by e.g. Cheverst et al. (2001). To accomplish this, we designed a possible extension to PDA-based calendars, providing dynamic route planning information directly related to the user's schedule for the day. TramMate thus requires very little additional interaction other than using a calendar. The driving contextual dimensions for TramMate are instantiated in the user's schedule for the day in terms of activities at specific times and locations. When a new activity is arranged in the form of an appointment, the user is asked to specify its time and physical location. Following this, TramMate automatically schedules a special time slot for getting there. When an appointment is due, this timeslot adjusts itself in accordance with the location of the user and the estimated time needed to get there, based on information about the public transport system (figure 2 above). User location information can be captured using a GPS and related to data describing tram routes and locations. Apart from specifying the first step of the route plan to an appointment, the calendar also provides direct access to additional details on the suggested route: estimated travel time, required walking distance and the number of times the user has to change routes. The latter features are currently implemented within location-aware trip planning application described above.

This design mediates contextual information by means of indexical information representation in a number of ways. The design utilises location indexicality by adapting the content of the special "time for traveling" timeslot to current as well as planned future locations. Temporal indexicality is utilised by adapting the actual graphical size of this timeslot to estimated travel time for the described route. Locating the timeslot for traveling graphically next to the associated appointment explores activity indexicality. Physical object indexicality is utilised by referring to specific objects in the user's surroundings (such as a tram). Finally, absolute location indexicality is explored through references to specific physical locations and relative location and temporal indexicality are explored through references about distance from current location measured in walking time.

Based on the time required to walk from the user's current location to the first tram stop on the route proposed, TramMate notifies the user when it is time to leave in order to make the upcoming appointment. The reminder contains simple information on the related appointment, what tram to catch, how soon it leaves, where it leaves from and how to get there (figure 3 below).

This second design utilises indexicality for mediating contextual information too. The design uses activity, temporal and location indexicality by presenting a calendar reminder adapted to current location, time and an upcoming appointment. The user's current and desired location is displayed on a map with instructions on how to get from one to the other. This utilises absolute as well as relative spatial indexicality. In the specific text of the reminder, the reference to getting to an appointment explores activity indexicality. Finally, displaying the relative time from now to the departure of the tram explores temporal indexicality.

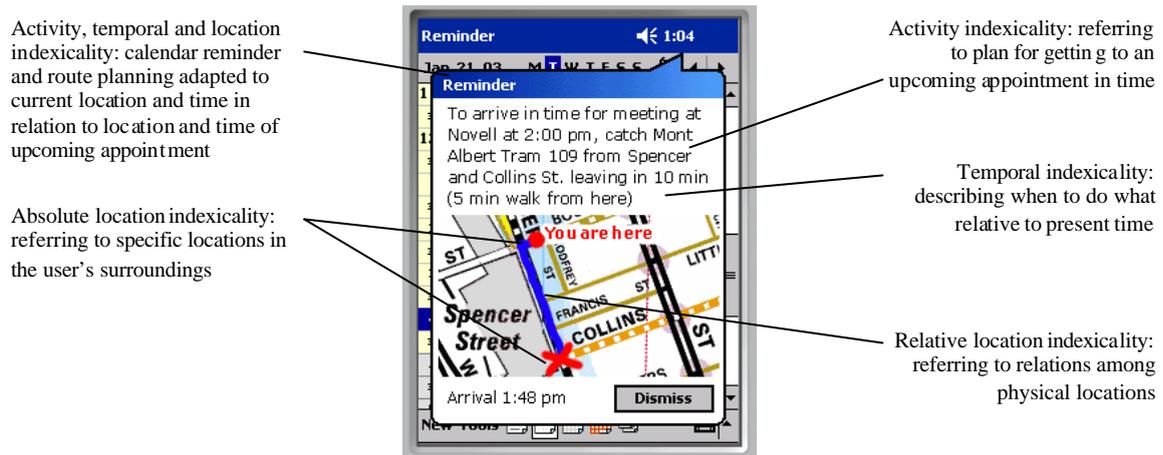


Figure 3. Exploring contextual indexicality in mobile device interface design: Calendar reminder in TramMate

While traveling to an appointment, the TramMate timeslot continuously updates itself with information about the next step of the route, maintaining the activity, location and temporal indexicality of the information representations. On the tram, TramMate notifies the user when to get off and the next step to take by means of reminders indexed by activity, location and temporal aspects as shown above. Having arrived at the destination, a map provides the location of the appointment as well as the user's current position, thus maintaining the absolute and relative location information representation from the reminder.

3. CONCLUSION

This paper has described eight key dimensions of context for use in mobile application development. We do not claim that this matrix of dimensions is complete, merely that it is operational. Field work and, in particular, the results of recent evaluation of the location-aware trip planning application described above will help to establish the matrix's completeness. For instance, it is acknowledged that the temporal dimension lacks the richness of Fitzpatrick's (1996) "Interaction trajectories" and, more generally, that the dimensions fail to capture the individual's interpretation of context against a group's. This paper has also defined the concept of indexicality and utilised it in the development of a mobile route-planning application for use on public transport. Indexicality was found to be very useful in this regard. However, the ease of translating requirements into interface designs in all contexts using this concept has yet to be established or evaluated. In addition, through the utilization of Time as an indexing criterion it became apparent that Absolute Time was less useful than the user's time relative to a Physical Object.

Broadly, the design of TramMate illustrates how focusing on the dimensions of context discussed above can help inform the specific design of context-aware mobile devices interface through applying different types of indexical information representations to the user interface. The use of indexical representations not only strengthens the relation between information system and use context, it also reduces and simplifies the information necessary for an interface to make sense, as a vast amount of the information needed is implicitly given in the user's surroundings. This access to the user's tacit knowledge and knowledge-in-the-world reduces the need for the representation of complex and extensive information on the user interface. As the graphical design space of mobile devices is typically very limited, this property may prove very valuable in future interface design for mobile and wireless devices. However, it has yet to be established if the use of indexicality will result in an over-deterministic (Cheverst et al., 2001) system where the wrong information is indexed at critical times. We believe results of the evaluations, in particular the field evaluations, of the functional prototype described above will provide further insight into the utility of indexical representations for mobile applications based on context awareness and further refine indexicality as a useful design concept for context-based representations for mobile devices.

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A VIRTUAL POWER PLANT BASING ON DISPERSED AND DISTRIBUTED GENERATION

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ABSTRACT

The paper presents a concept of virtualisation of the power generation processes, based on the transition of the large scale effect that is still present in the power industry. The transition is to lead to small scale generation, promoting local and clean sources of energy, including the renewable ones. Two basic elements constituting a virtual power plant are presented: the “hard core” of a virtual enterprise (small scale generation sources integrated via electrical power and data communication networks) as well as data communication and electrical power networks.

KEYWORDS

A virtual power plants, distributed generation, electrical power and data communication networks.

1. INTRODUCTION

A virtual enterprise is a form of co-operation between legally independent companies, institutions, and natural persons who provide goods and services to a market on the basis of a common business relation, acting as a uniform enterprise before other economic subjects (Grudzewski, et al., 2000).

There are three main elements of a virtual organisation, namely: a virtual enterprise, a network (Zimniewicz, 1999) and e-business modes.

A virtual enterprise comprises a „hard core”, that is a company existing in the real world. It is there that all marketing strategies (product, target groups) are defined and production managed. The “hard core” is bound with co-operatives, dealers, distributors, manufacturers, service companies, outside co-operatives. The whole structure forms a virtual enterprise (Vartiainen, 2001).

A network is based on long-term co-operation and consists of contractors, institutes, key-competences and integrators.

E-business modes enable the Internet application for establishing and maintaining relations between enterprises and within the virtual enterprise. Individual and reliable information is provided in the real time, what distinguishes a given organisation from other competitors. An e-business mode enables the users to develop an Internet strategy of long-term, direct contacts, providing safety, activity, scaling possibility and integration with the global market at the same time.

Integrated IT technologies with ERP II class systems have to operate in the organisations forming virtual structures (e.g. SAP-R/3, IFS Applications, ORACLE). The systems must also include SCM (Supply Chain Management), EDI (Electronic Data Interchange), CRM (Customer Relationship Management), e-commerce, c-commerce (Kuceba, 2001).

The concept of a virtual power industry enterprise being the topic of the paper is based on micro- and mini- power plants, connected into one system. Such a situation is defined as virtualisation of sources that is co-operation of subjects differing in technology, size and localisation within one common electric and computer network (Malko, 2001) (Malko, et al., 2002). The process has been defined as integration of

renewable gas and oil sources within one virtual power industry enterprise. Information and data communication technologies make the establishment of a virtual power plant of the power equal to the standard ones a real vision. Virtual power plants will be formed by integrated local power plants e.g. wind, sun, stationary fuel cells and small gas generators.

The advantages of the virtual power plant are the following:

- ❑ Concentration on the basic aim of the business activity – energy production,
- ❑ Maximum economy achieved thanks to structural and procedural simplifications,
- ❑ Radical decrease of costs,
- ❑ Development of innovative products and special allowances,
- ❑ Flexibility,
- ❑ Openness to any changes (Zimmiewicz, 1999).

2. DISPERSED AND DISTRIBUTED GENERATION – BASIC ELEMENTS OF A VIRTUAL POWER PLANT

In the virtual power plant in question, the „hard core” of the enterprise are the sources of small scale generation (frequently called dispersed and distributed generation) integrated by electrical power and data communication networks.

DISPERSED GENERATION – electric energy and heat ranging from several kilowatts to 1MW produced by associated sources.

DISTRIBUTED GENERATION - electric energy and heat ranging from 1MW to several MW produced by associated sources.

The concept of dispersed and distributed power sources of small installed power has been already applied in the past as a stand-by electric energy source in structures that require constant power supply. However, at that time, the distributed technologies were characterised by low production efficiency. The cost of synchronising a production unit with an electrical power system was too high. Such situation resulted in the fact that the cost of obtaining one energy unit in small scale generation was higher than the unit cost of the energy generated in professional power plants. Presently, when the power efficiency of small associated sources is high (about 80%) and the whole power generation and network synchronisation process is monitored and controlled by data communication systems (Malko, 2001) the interest in these sources is growing. Only within one year 1998 –1999 over 5200 associated sources of low installed power (9600 MW altogether) were established in the world. This corresponds to the double of the installed power of a large power plant in Poland – the “Belchatów” Power Plant. Various gas fuels are applied in small associated systems: natural high-methane gas, natural nitrated gas, various types of bio-gas from gasified wood, as well as renewable energy sources such as: biomass, solar energy, geothermal energy, wind energy. The application of clean energy sources in these technologies lowers the CO₂ emission from 50% to 60%, and the NO_x emission from 20% to 25 %.

Presently there are two types of distributed sources:

- **AUTONOMIC SOURCES;**
- **NETWORK SOURCES;**

In the autonomic sources the electric energy associated with heat is only generated to cover the needs of a specified group of recipients. Such sources are not connected with a transmission / distribution network. In the network sources on the other hand, the excess energy generated is transferred to the transmission / distribution network.

The basic characteristics of dispersed and distributed generation are the following:

- independence from the central planning of sources procedures;
- renewable energy sources promotion;
- decrease in solid fuel consumption,
- local energy sources promotion;
- exclusion from the area subordinated to the Transmission System Operator (central power distribution);
- possibility of direct co-operation with the networks subordinated to power distributors;
- constant increase in the installed power value.
- possibility of co-operation and integration of independent, power generating sources achieved by the establishment of virtual power plants

There are also economic profits connected with the power industry integration:

- fuel diversification, required by the power industry safety regulations;
- reduction of transmission and distribution costs;

The introduction of dispersed and distributed generation as well as the establishment of integrated virtual organisations may result in breaking the monopoly on the electric energy market. The energy produced in these sources may be transmitted with the omission of the Transmission System Operator. Figure 1 presents the Polish National Power System after reorganisation, with the dispersed and distributed generation as well as virtual power plants taken into account. As clearly seen on Figure 1, the application of local sources – small scale generation – shortens the transmission distance between the manufacturer and the recipient. The lack of intermediaries in power transmission processes results in the reduction of transmission costs. However, there are some barriers that limit and slow down the process of reorganisation in the power industry. These problems concern the implementation of dispersed and distributed generation and the establishment of virtual power plants as well. The barriers restricting the application of small scale generation include:

- well developed technical, organisational and institutional infrastructure of large sources that blocks the application of small scale generation;
- supplying unreal prices of conventional fuel and energy (no external costs, including the ecology ones taken into account), subsidies granted to mines, mine fuels distribution and energy;
- no uniform power policy that would stimulate the development of renewable energy sources and distributed sources application;
- insufficient technology and appliances supply;
- psychological barriers of potential investors, resulting from the lack of information and trust for new solutions;
- lack of uniform standards and protocols of data communication networks in the power industry

There is a chance of overcoming these barriers. However, such situation would imply the necessity of opening the power market for new investors, as well as:

- flexible investment amortisation rates;
- fiscal relieves for third parties financing an investment;
- subsidies for the construction of an installation;
- subventions and cheap credits for small and medium sized enterprises (including the resources from the employment funds);
- financial stimuli for consumers who buy the appliances and services utilising renewable energy in dispersed and distributed generation.

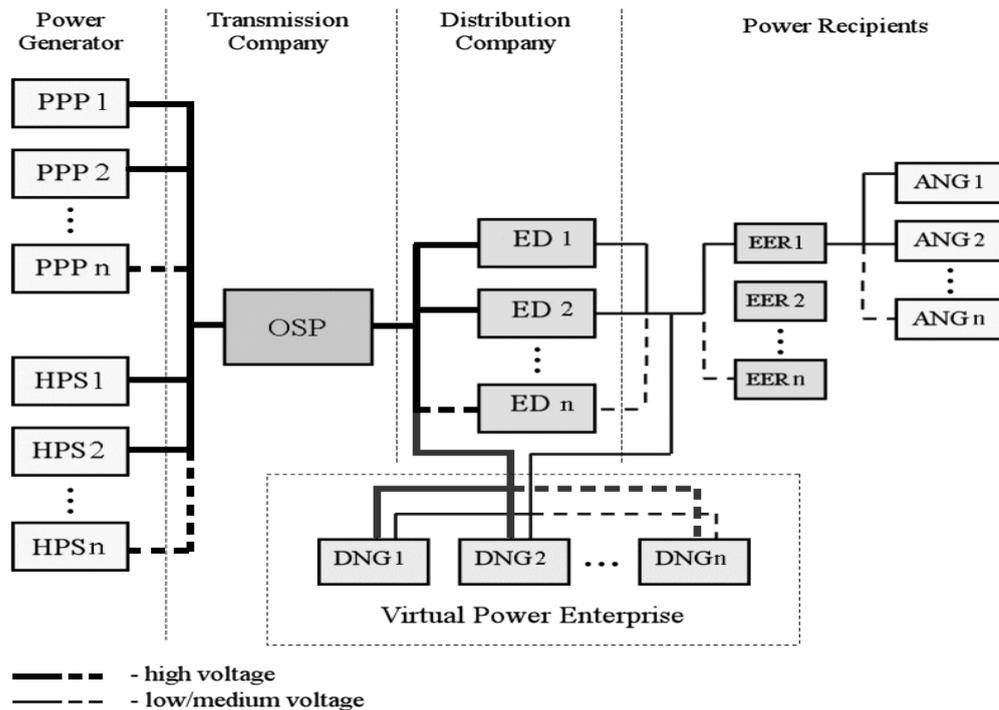


Figure 1. An electrical power subsystem model, taking into account small scale generation - *own analysis*

PPP – professional power plants, HPS – heat and power stations, ED – energy distributors, EER – electric energy recipients, DNG – distributed network generation, ANG – autonomic networks generation.

3. A PROPOSITION OF COMMUTATION NETWORK ARCHITECTURES IN A VIRTUAL POWER PLANT

There are two types of commutation networks that connect particular energy sources being parts of one uniform organisation – a virtual power plant, namely: electrical power and data communication networks.

Electrical power networks transmit and distribute electric energy. Particular power generating sources being parts of a virtual power plant will be connected via electrical power networks with the uniform and integrated European Power System, in accordance with the Third Party Access principle, binding in Europe. Due to the limited space only a simple scheme (Figure 1) showing the connection of distributed network energy sources with the Polish Power System (the Polish Power System is connected with the European System via the TEN's networks) may be presented. On the basis of Figure 1 one may state that particular distributed network sources being part of a virtual organisation may be independently connected to the electrical power network at different points, from the Transmission System Operator, power distributors or directly to the electric energy recipients. Connecting particular distributed network sources into one uniform power system enables the establishment of a uniform and large virtual enterprise.

Data communication networks are a very important element of a virtual organisation, enabling the transmission of data and information within the organisation as well as communication with its environment. In case the distributed network sources are situated in a small area, the exchange of information may be provided by LAN networks. Recent solutions applying light pipes for data transmission provide the transmission speed of about 100 Mb/s. There are different types of LAN networks. However, the best solution in the virtualisation of power generation processes seems to be the Token Ring network. Token Ring are ring topology networks where the central point is a concentrator from which star-like cables spread. The ring is situated in the concentrator and particular stations are connected by a transmission medium. The aim of such configuration is to protect the system from a disadvantageous situation when the circuit is broken as the result of one station finishing its operation. FDDI (Fiber Distributed Data Interface) as well as IEEE

MAN (Metropolitan Area Network) standards are usually applied within the Token Ring topology in the communication between distributed network sources.

In case the power generation sources being parts of a virtual power plant are situated far away from each other one should apply the public network resources in order to provide the functional characteristics of the virtual organisation network. An example of such network service may be the VPN (Virtual Private Network) that provides safe communication with any place on Earth. VPN combines two elements of one computer network via another network. In the author's opinion, the VPN networks are the simplest method of connecting Intranets belonging to particular units of a virtual organisation, situated far away from each other. They provide safe encoding of internal organisation traffic. Figure 2. presents an example of a VPN application. VPN processes data that may be then encoded and surf the Internet via a virtual communication channel. The principle of a virtual channel operation is a logical connection between the computer of a user and the server. The protocol providing transmission is here called the tunnelling protocol. VPN networks are based on the following protocols: PPTP (Point-to-Point Tunnelling Protocol), L2TP (Layer 2 Tunnelling Protocol) or IPSes (IP Security). These protocols provide privacy and information integration. Thanks to special protocols it is possible to create VPN networks that are based on popular operating systems such as: Windows, Linux or UNIX. (Kieltyka, 2002)

Electric energy and data/information transmission may be implemented by two different transmission channels: electrical power lines and (for example) light pipes or by the application of one common transmission medium – electrical power lines. In the latter case it is suggested to apply the PLC (Powerline Communication) or OFDM (Orthogonal Frequency Division Multiplexing) technologies.

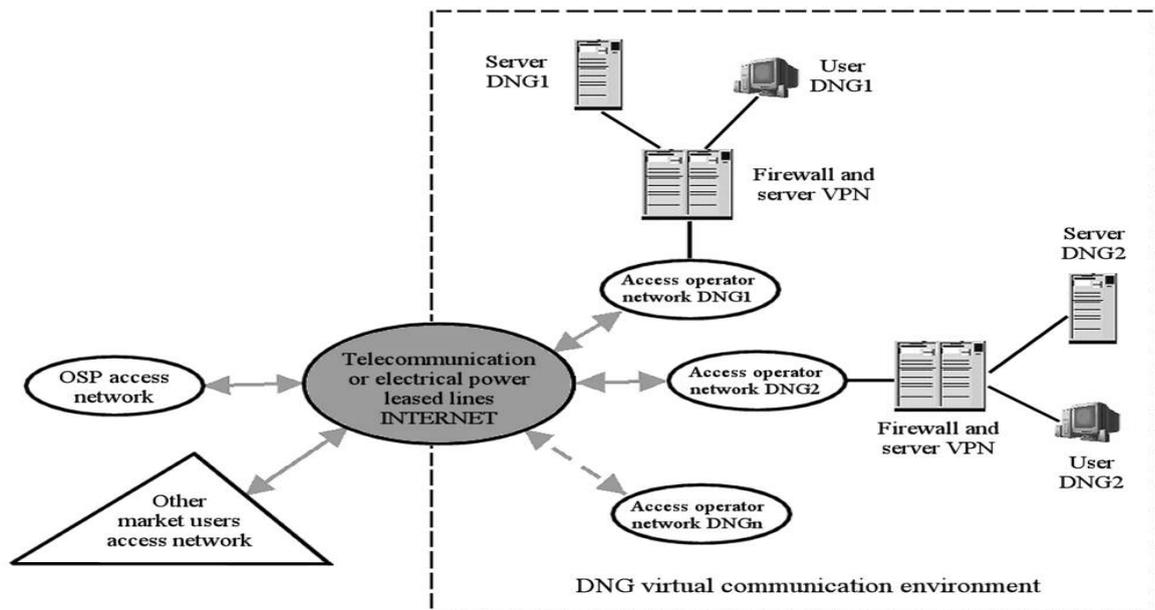


Figure 2. An example of the application of VPN in the virtual power plant environment (source: own analysis)

SUMMARY

The concept of a virtual power plant presented in the paper is to complement national political, legal, administrative, economical and market initiatives of the European Union and of the countries which will access it in the year 2004. It is to create advantageous market conditions with no excessive financial burdens.

Dispersed and distributed generation as well as virtual power plants may cause a breakdown of the natural monopoly on the power market. The new competitors for large scale generators will be virtual power enterprises that are based on distributed sources and e-technologies, that are flexible in their creation of a virtual product and that constantly improve all management processes.

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VIRTUAL TEAMS PERFORMANCE: AN ANALYSIS BASED ON INDICATORS

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ABSTRACT

Virtual teams have been an alternative way of work in several organizations lately. The efficient management of virtual teams is a key-component in the management of the organization itself. The objective of the present work is to analyze the performance of two of these virtual teams. It consists of an exploratory research. Data collecting was based on interviews, surveys, meetings minutes and direct observation. Through the accomplishment of this study we verified that support offered to virtual teams was not being effective enough, once the particular characteristics of the virtual teams were not taken into account, as well as their complexity. Yet, we highlight the importance of considering success factors in virtual teams: adequate technology, Human Resources policy of offering support to the virtual work, leaders and members training, standardized work procedures and leadership skills.

KEYWORDS

Virtual Teams – Performance – Virtual work

1. INTRODUCTION

The work world has been changing rapidly, and technological development is a determinant factor of this change. With this technological advance, the Internet advent and the distance communication facilities (e-mail, audio and videoconference) a new possibility of teamwork is created – people start to develop their projects even if they are not in the same physical environment.

Virtual teams arise within this context: they are groups of workers geographically distant that interact through computer-based communication.

As the work of these virtual teams is rapidly becoming a common way of work in several organizations, the efficient management of these teams constitutes a key-component in the organizations management.

The objective of this work is to answer the following question: What are the indicators of virtual teams performance?

2. VIRTUAL TEAMS

Virtual teams are part of the most recent phase in the organization evolution. In the nomad era, the small group was the first invention of people's organization. This convention evolved very quickly and people started to organize themselves in cities. In the industrial era a more bureaucratic form of organization was required. Today, the world is in the information era and another mode of organization starts to arise — the networked organization (LIPNACK e STAMPS, 1999). It is within this new organization that virtual teams are embedded.

According to ZIMMER (2001), “virtual teams are work groups composed of people that interact at distance, in a provisional or permanent way, in a company and/or network of which they take part, and that, using advanced technological devices keep in touch and carry out their tasks, trying to reach common goals.”

This kind of team, as any other, is a group of people with different opinions and different levels or relationships, guided by an objective. They are different from traditional teams in that they work in different places, time and organizational boundaries.

DUARTE and SNYDER (1999) comment on the existence of critical success factors of virtual teams. The factors that affect the probability of a team to obtain a high performance are technology, human resources policy, training and development for leaders and team members, organization and team processes patterns, organizational culture, leadership and leaders’ and members’ competence. Yet, according to these authors, there are seven kinds of virtual teams:

- networked teams: those with a capacity of aggregating members who are not from the same organization, such as participants of the clients/suppliers network or even autonomous experts. For example, to contract an expert on aeronautics to take part in the design development of a new aircraft model for the virtual team of an aircraft builder company.
- parallel teams: those that “carry out missions, tasks or special missions that the organization does not want or is not equipped enough to perform” (DUARTE e SNYDER, 1999, p.6). Typically their acting is for a short period of time and they aim at suggesting improvements of internal processes or specific business issues.
- project or product development teams: they are intended to develop new products and organizational processes or, moreover, the creation of information systems, not being used for routine tasks. These teams have higher lifecycles, besides the possibility of implementing their decisions — not only suggesting recommendations.
- work or production teams: applicable to the routine and ongoing works, they often affect a department.
- service teams: destined to carry out services for clients, such as consulting, for example.
- management teams: composed of “moving” businesspeople, who meet each other through video or audio conference to discuss and take decisions. In these teams, members are part of the same organization.
- action teams: used with the aim of “offering immediate answers, often in emergency situations” (DUARTE and SNYDER, 1999, p.8).

As for the advantages of virtual teams, we verified that they comprehend both employees and employers. Employees are benefited because they save time that was once spent going to other company units to take part of meetings, and thus they have more time to dedicate to work.

Projects can be developed using communication technologies extremely agile and fast, such as e-mail and videoconference. Participants of virtual teams may have in a videoconference the same level of understanding they have in a traditional meeting, besides receiving the information at the same moment. Besides, there is the possibility that members of these teams count on the participation of people from anywhere in the world, or from the company.

The organization may also benefit from this practice reducing costs on physical spaces, travel expenditures and other operational expenses.

However, the organization must be prepared to implement and maintain the technology necessary for the teams work. It is also necessary that the company provides training and all the support in what concerns communication and collaborative technologies. Employees need to have discipline and work in differentiated times, they need to know available tools and must be aware of the difficulties the lack of physical contact may bring: possible communication noises, lack of motivation or even of confidence.

3. RESEARCH METHODOLOGY

This work consists of a case study. For data collecting we used qualitative research, using techniques such as interviews, surveys sent by e-mail, e-mail messages and direct observation of the works involved, besides meetings to clear up the research goals. All members from two teams collaborated with our research. The

company where we carried out the research was *Effem Brasil*, a north-American company which represents food products in Brazil.

4. EFFEM BRASIL VIRTUAL TEAMS: HISTORY AND FUNCTIONING

Based on observations and interviews, we could report the history and functioning of Alfa and Beta virtual teams from *Effem Brasil*.

4.1 Alfa team

Alfa team has been working since November 2001 and counts on the participation of 17 members from the units of Eldorado do Sul (Rio Grande do Sul state, Brazil) and Mogi Mirim (São Paulo, Brazil). Not all participants know each other personally. The objective of this team is to launch again a very well known trademark of the company.

The team leader, responsible for the trademark in Brazil, counts on the support of representatives from all necessary areas, such as business (food products sale), research and development, purchasing, and services and finance. Each member has a role within the team, according to the area under his/her responsibility.

The team is undergoing a moment of decisions and changes due to the company and of problems in finding sales goals. There are no expectations of deadlines, projects or funding approval. This is because the company is facing a merging period, and projects must wait for the directorate approval. According to the team members, this is generating some lack of motivation and commitment. The leader has tried to maintain information as transparent as possible to warrant understanding and confidence of all members.

4.2 Beta team

Beta team has been working for around four years. The team objective is to strengthen the brands of a certain business segment, besides reaching financial goals. For that end, they count on a group of 15 members from the units of Eldorado do Sul (RS-Br) and Recife (PE-Br). Not all members know each other personally.

The team leader conducts the meetings, and starts reading the last meeting minute in order to check what has not been solved. Each ongoing project leader presents the current situation of activities.

Communication is clear and objective, via telephone, e-mail and videoconference. All processes are documented and considered official in order to avoid communication problems.

Beta team is in a moment of motivation, members are interested and there is significant participation. Although the company is in a changing period, apparently this team is not suffering with this situation. Maybe this difference in behavior is because this team had great results last year, what makes the company interested on developing their projects, releasing funds and approving their projects more rapidly. This way one can realize that the external set has an influence on the team performance.

5. RESULTS ANALYSIS AND DISCUSSION

This research identified and analyzed possible indicators of performance of virtual teams:

Both teams have different realities, they act in different branches and have different goals. Alfa team is undergoing a complicated moment, and the company is redefining the focus of their work. This fact has produced a lack of motivation in its members. Beta team is in a great phase, in which members are committed and interested, besides having their projects accomplished.

Members were asked as to the factors responsible for the high and low performance of a team, besides important factors for the work of a virtual team. Factors mentioned as responsible for the high performance of a team included mainly commitment, clear goals and members motivation.

As important factors for the virtual work, the most cited were adequate communication, leadership and guiding.

Alfa team considers that the possible cause for their low performance in this moment is due to the company indefiniteness as for what must be accomplished. In contrast, they believe that leadership is a factor that will be responsible for the eagerly expected performance, when definitions were finally set. Moreover, they say that the team is integrated, all of them have well defined roles, what may help the team to obtain a high performance. Beta team commits their good performance to the team integration, to the clear objective and to the commitment of all its members.

Many of these characteristics and factors that may make the success of a team, as mentioned by SCHOLTES (1992) and DREXLER and SIBBET (1995), besides being very similar, work both for traditional and virtual teams. However, some of which are most critical in virtual teams.

The first characteristic is orientation. It is extremely necessary that all members know why they are taking part of a team and have an understanding on the reason why the team exists.

In a virtual team, where there are not many links between people, it is essential that one knows what the team goal is. Therefore, to warrant guidance must be the first point to be set in the process of a team development. In our observations we verified that both teams are very well oriented as for their mission and the reason why their members are part of them.

After the first phase is accomplished, another critical characteristic is confidence. To trust on people when they are close and you see their performance at work is easier than trust on someone that you do not know personally and do not see how the individual works. Building confidence is extremely essential in a virtual team, because working at distance and without a rigid control requires people to really believe that their team partners are developing their work as previously arranged. Maybe the fact that Beta team has already obtained positive results together, confidence on the other members and on their work becomes an easier task.

The third phase is to make what the team is doing very clear. It is necessary to define very well the roles and to have clear objectives. For that end, communication is an extremely important factor. In a traditional team, it is possible to see signals, gestures and expressions of understanding, besides language, what is not possible in a virtual team. Besides sending a message, it is essential that a virtual team warrant that the person who is receiving the message understood it. Beta team worked out this phase very well. Alpha team, however, does not have its objectives defined due to the organization indefiniteness.

Both teams worked out the two first phases very well. However, the third phase was not solved for Alfa team. This suggests that the external scenery makes some influence on the team, because even under orientation and knowing why they are in the group and trusting on the other members, the objective is not clear for Alfa team, once the organization has not defined it. That is, even being motivated, oriented and confident they could not obtain a high performance without an objective.

Later on, it is important to set a commitment to all members, making them define how they will carry out their activities. The commitment is a critical factor in a virtual team. If the participant does not have a commitment with tasks and the team, all activities of the group could be damaged. In a team, each member plays a crucial role, and if someone does not accomplish an activity, the team may present a low performance. Clear communication and feedback are essential in this phase.

Investment in these first phases increases the chances of obtaining a high performance of the team. Therefore, a well-oriented team that trusts on its members, has well-defined objectives, identified roles and knows how to have tasks accomplished has many chances of obtaining a high performance. This way, the more the team, the company and the human resources department work to accomplish these phases successfully, the more the teams will have the chance to succeed.

The fifth phase mentioned is implementation. Who makes what, when and where must be defined in a consensual way. All members must take part actively from this phase, in order to keep the commitment with the tasks. After all these phases are finished, the team can go for the high performance. However, teams are dynamic. And after the high performance, they should ask themselves why to go on. Here is important to keep what was learned and prepare for a new cycle of action.

Besides these characteristics described above, it is important to consider critical success factors of a virtual team in order that it has a good performance.

The company should select the adequate technology to the virtual work. Besides, it must warrant that this technology works when it is required, because virtual teams depend on that to develop their projects. In the case of *Effem Brasil*, this factor is not critical because the company supplies all the technology necessary, such as e-mail, intranet, videoconference, telephone and same time (immediate communication via computer)

It is desirable to provide training for leaders and members of the teams, not only in the use of technology, but also in facilities skills, projects management and tools for meetings conduction.

Effem Brasil is already providing its members and leaders with this kind of training, however it would be interesting that all could take part of them. It is important that teams work within a pattern, once this reduces the time that the team would spend to start or eliminate unnecessary processes. The meetings minute is used as a mode of storing the teams' processes. It is important that all members have continuous access to them.

The team leadership has a fundamental role in the good performance of the team. That is why it is important to provide this person with the necessary tools and skills. The leader should have a strong communication power, to set expectations, to allocate resources and to model necessary behaviors. The organization we studied has been successfully accomplishing works in the development and formation not only of leaders but of team members.

With the present study we could make some recommendations to the company, leaders and team members.

Effem Brasil has much more virtual teams than traditional ones in their structure. The company culture suggests this methodology, because their members must develop projects with people from other parts of the country. This way, it is necessary that the company starts to take into consideration the characteristics of virtual teams mentioned in this study, in order to make their work easier and foster better results.

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SUBJECTIVE VALUE OF INFORMATION: THE ENDOWMENT EFFECT

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ABSTRACT

Value judgments about information and its value are vital for a functioning information society. Subjective valuations, formulated by individuals determine the demand for information and trading in it. Theoretically, these subjective value determinations should be influenced by ownership rights, a phenomenon coined the “Endowment Effect” in psychological study of trading situations. This study examines the Endowment Effect in the context of evaluating information. In a simple computer simulated game fifty five participants conducted a task in which they were provided opportunities to buy or sell information. The bidding mechanism was incentive compatible. Results show that, in agreement with Endowment Effect theory, people value information they own much more than information not owned by them. Our findings indicate that the ratio between Willingness to Accept (WTA) and Willingness to Purchase (WTP) for information is similar to that for market goods, and as with market goods, other than rational. Participants exhibited a strong inclination to purchase but not to sell information even though profit data suggests that the use of information had no objective benefit for profit-making. This preference is attributed to risk aversion rather than to loss aversion which is the most widely-accepted explanation of the Endowment Effect. Holding on to information and undertrade in it have strong implications for the information society.

KEYWORDS

Information economics, perceived value, ownership, endowment effect.

1. INTRODUCTION

The information society is often defined by the centrality of information production and consumption functions (Machlup 1962; Porat 1977; Toffler 1980). Information’s centrality is determined in the demand for it, and by the degree this demand is met. Hence, another way to view the viability of the information society is by assessing the vitality of information exchange and flow within it. This paper is an investigation of the subjective value attached to information by prospective users of it. The perceived (subjective) value of information affects the demand for it, and is therefore a critical condition for the information society.

What is the value of information? How can that value be determined? How does this translate into the demand for information? Is the demand for information rational? The present research proposes to investigate the subjective value of information by combining economic and psychological theory with information systems research. We use an experimental/simulation approach to suggest possible answers to these questions.

Information has several unique characteristics which render it difficult to value. Information is an unusual good in many aspects - production, distribution, cost, and consumption. Information is both an end-product and an instrument or input into the production of other goods, decisions and information. It is expensive to produce and cheap to reproduce (Bates 1989; Shapiro and Varian 1999). In fact, distribution is accomplished mainly by reproduction or copying. The same content can be distributed by different media, and the price is often derived from the medium rather than from the value delivered by the content itself. In point of fact, people consume information both by sharing and by purchasing, while most other goods are consumed via purchasing only. The cost of information can be either direct or indirect. The quest for the value of information is further complicated by the fact that information is an experience good, meaning that its value is revealed only after consumption (Shapiro and Varian 1999; Van Alstyne 1999).

Information is transmitted via two main routes: Sharing and trading. The value of information is believed to be a central determinant of the propensity to share and of the willingness to buy or sell information (Steinfeld and Fulk 1988; Rafaeli and LaRose 1993; Newhagen and Rafaeli 1996; Butler 2001). Furthermore, the flow and exchange of information via trading or sharing are important qualities of the information society.

A central antecedent of sharing is the perception of the locus of ownership (Constant, Kiesler et al. 1994; Constant, Sproull et al. 1996; Jarvenpaa and Staples 2000; Jarvenpaa and Staples 2001). In this paper, we focus on trading rather than sharing, but are still interested in ownership of information. While perceived ownership has been widely documented to affect trading of a host of private and public goods (Kahneman, Knetsch et al. 1990; Thaler, Kahneman et al. 1992; Horowitz, McConnell et al. 1999), the effect of the locus of perceived ownership has not yet been explored in an information trading scenario. Specifically, prior findings suggest that ownership leads to higher valuations of goods. An owned object is valued higher than the same object lacking an assigned ownership. This effect was called the Endowment Effect (EE) (Thaler 1980).

The purpose of the present research is to explore the effect of ownership on the perceived, or subjective, value of information in a trading environment. If ownership is an antecedent to value formation in trading, then this will form common ground for information sharing and trading behavior. It will also provide a broad understanding of users' behavior toward information in many situations: Consumption and provision of information for free or for a fee.

We begin by explaining why the value of information is subjective, and we then describe the EE and its application to the study of information. Following an outline of our research tool, which is a computerized business game, and the experimental procedure, we present findings that support the significance of ownership on the perception of the value of information.

1.1 The value of information

The E-economy is predicated, to a large extent, on the value of information. Information is costly to produce but very cheap to reproduce. It is therefore difficult to assess its value (Shapiro and Varian 1999). Neither cost nor the value of the information produced are related to the quantity of the product. As information has indirect utility in the support of decisions, direct utility measurement is inappropriate (Van Alstyne 1999). Theoretically, there are three ways to assess the value of information (Ahituv and Neumann 1986): Normative, realistic, and subjective. While user utility should be the base for calculating the price of information, utility varies by person and circumstance. Information is an "experience good", the value of which is revealed only after use (Shapiro and Varian 1999). Realistic methods are ex post and consequently inappropriate for evaluating information content (also referred to as the "inspection paradox") (Van Alstyne 1999). We therefore focus on the subjective value of information.

The tradition of studying decision-making under uncertainty has addressed patterns of information use and the value assigned to information. This literature sets the backdrop for understanding information society trends. The heuristics experiments (Tversky and Kahneman 1982) as well as later studies (Kahneman and Lovallo 1993) demonstrated that people tend to ignore available information such as prior probabilities, sample size and the like. Instead, decisions are based on other subjective methods such as representativeness, availability, and adjustment and anchoring (also known collectively as heuristics). Earlier experiments have also shown that people tend to be conservative and undervalue information available for the revision of a prior opinion (Branthwaite 1975). A recent study (Bastardi and Shafir 1998) tested the

pursuit of information for daily decisions. Participants preferred to seek information and to base their choices on (objectively) noninstrumental information. In other words, people assigned positive subjective value to objectively worthless information. Theory also suggests that people seek information because it seems the right thing to do (Feldman and March 1981), implying over-demand for information and a high subjective value. People tend to accumulate information “just in case” they may need it in the future, again leading to excessive demand (Van Alstyne 1999). The theoretical tension is, therefore, between studies indicating that information is under-valued and research showing that information to be over-valued.

1.2 Value measurement

Subjective value has been studied experimentally for many types of market goods (also called private goods) and nonmarket goods (also called public goods). One very interesting finding of experimental research on subjective value is the discovery of a disparity between the highest amount one is willing to pay (WTP) for a good and the lowest amount one is willing to accept (WTA) as compensation for giving up the same good. Traditional economic assumptions imply that, when income effects are eliminated, the difference between WTP and WTA should be negligible (the difference should amount to the decreasing marginal utility). However, experiments with various types of goods have shown that WTA is significantly greater than WTP. By definition, WTA and WTP values are neither normative nor realistic. Instead, they are subjective values, since they represent an individual’s personal perception of an object’s worth for him or herself. We apply the WTA/WTP methodology as used for various types of goods in order to investigate the subjective value of information with a view to determining what characterizes information as a good.

1.2.1 The WTA/WTP disparity

The consistent, unexpectedly large and uni-directional difference between WTA and WTP observed in relation to traditional goods and services has generated much research interest. Attempts were made to explore whether the discrepancy can be explained by economic theory or whether the difference belongs to the realm of less than- or bounded- rational choice and is rooted in psychological origins. We will summarize some of the pertinent literature on the WTA/WTP disparity and the explanations offered by economists and psychologists highlighting the common denominators of these two approaches.

Commonly, bidding is employed as the general experimental approach for researching the values of WTA and WTP. Participants in experiments are offered the opportunity to bid for the purchase of an item, or to state a reserve price for the sale of an item. There are many bidding mechanisms and there is no specific experimental design common to all the experiments described below. A comprehensive methodological review detailing the types of bids used in different papers can be found in (Horowitz and McConnell 2000). Using the various bidding mechanisms, researchers have demonstrated a significant disparity to exist between the values of WTA and WTP for common market goods such as chocolates, pens, and mugs (Kahneman, Knetsch et al. 1990; Bateman, Munro et al. 1997), and a much larger disparity with regard to nonmarket goods such as health (Thaler 1980; Shogren, Shin et al. 1994). Trading induced-value tickets, or tokens of known value, have not shown a WTA/WTP disparity (Kahneman, Knetsch et al. 1990; van Dijk and van Knippenberg 1996; Irwin, McClelland et al. 1998). Induced value tickets or tokens are characterized by having only pure monetary value. In this case, of “induced value” items, the expected number of trades took place, the expected number of trades being half of all possible trades. Herein lies one of the important implications of the disparity, namely that the existence of a significant difference between WTA and WTP leads to a reluctance to trade and results in undertrading. This was further confirmed by trading induced-value tickets of unknown value (van Dijk and van Knippenberg 1996; Irwin, McClelland et al. 1998) as well as lottery tickets (Knetsch and Sinden 1984; Bar-Hillel and Neter 1996), which resulted in a WTA/WTP disparity and undertrading. Interestingly, uncertainty was not the cause for the disparity observed in the mugs experiment (Kahneman, Knetsch et al. 1990), since the bids were made on mugs marked with clearly visible price labels.

The studies mentioned here as well as dozens of others (Horowitz and McConnell 2000) reveal a continuum ranging from induced (known) value tickets, where WTA is found to equal WTP, through market goods, where the disparity exists, and on to nonmarket goods where the disparity is largest. The WTA/WTP ratio approaches unity for induced value items, being usually about 3 for market goods, while for nonmarket goods that ratio is very large, usually about 10.

1.2.2 Theoretical foundation of the WTA/WTP disparity

The main psychological explanations of the WTA/WTP disparity are loss aversion (Kahneman, Knetsch et al. 1990; Thaler 1991; Bateman, Munro et al. 1997) which is based on Prospect Theory (Kahneman and Tversky 1979), and the degrees of similarity and uncertainty in the cases of induced value tokens and lottery tickets (Knetsch and Sinden 1984; Bar-Hillel and Neter 1996). The main economic explanations are the substitution effect (Hanemann 1991; Shogren, Shin et al. 1994), the tradeoff between the price of information and the expected payoff (Kolstad and Guzman 1999) and intrinsic value (Boyce, Brown et al. 1992).

The Prospect Theory approach received experimental economic substantiation (Horowitz, McConnell et al. 1999). Similarity observed in psychological experiments (Chapman 1998) is equivalent to economists' explanations of the substitution effect. Psychologists also acknowledged that lack of commensurability is necessary for the EE to manifest itself (Kahneman, Knetsch et al. 1990), again a hint for the substitution effect. The immunity of induced value tickets to the Endowment Effect also supports the substitution effect explanation as such tickets have perfect substitutes when their values are known. The degree of uncertainty or the amount of information provided have also been researched both by psychologists and by economists. The results in all cases show similar trends. Psychological theory proposed in order to explain the WTA/WTP disparity is based on observations of human behavior. This is in line with economic models, which in this area of research are inductive and based on experimental markets rather than on traditional economic assumptions. Overall it can be said that economic and psychological research are moving in the same direction, thus lending support to each other. The main underlying causes of the EE seem to be loss aversion and the substitution effect with their respective outgrowths. Variables that influence the EE are the type of good traded (induced-value, market, nonmarket) and the existence and availability of substitutes, which imply the availability of information on the market.

1.2.3 Implications for the subjective value of information

A choice to pursue information for decision making is a result of the desire to reduce the uncertainty that characterizes certain decisions. Information in this sense is not a regular consumer good; it is more like a raw material consumed in the production of other goods down the value chain. The decisions as to what kind of information will aid in reducing the uncertainty, where to look for information, and what is the information worth are in themselves made under uncertainty. One rarely knows in advance what kind of information one will find, what will be the quality of that information, and to what extent will it actually reduce uncertainty. All this stems from the fact that information is an experience good, the value of which is revealed only after consumption and from a lack of access to meta-information. Research that would shed light on the value of information prior to consumption or what influences value formation will be of importance to information consumers, content providers, decision makers, and information system designers.

The result of the WTA/WTP disparity, or of the EE, is that it creates undertrading. Fewer trades take place than should have occurred under standard economic assumptions. As cited earlier, lack of information contributes to an increase in the WTA/WTP divergence and hence leads to undertrading. Conversely, abundance of information suggests an accelerated pace of trade. Information is an economic catalyst. Increasing its perceived value and the demand for it should be the objective of any market-oriented organization in wishing to increase the number of trades. Naturally, this is especially true for information vendors. Since information is often a crucial component of market goods, enhancing the value of that information would enhance the overall value of the goods and diminish undertrading.

Substitution effect theory should predict a large WTA/WTP disparity for information. This is due to its inherent nature as an experience good, each item of content being unique. On the other hand, the abundance of free information on the Internet and searchers' inclination to seek free content suggest a low subjective value for information producing parity between WTA and WTP. In light of this contradiction we have chosen to begin our investigation with a fundamental question about the WTA and the WTP for information in order to form a basis for further research on factors influencing these values and other issues of importance. Our research question is: Where is information found on the WTA/WTP disparity continuum? Our hypothesis is that the WTA/WTP ratio for information is greater than unity. We expect the ratio to be similar to the standard set for market goods because the experiment involves a very simple market situation.

2. RESEARCH METHODS

2.1 Experimental instrument

A Java-based computer simulation of an easy-to-understand business game called “The Lemonade Stand” was used as the experimental instrument. In this simulation the player owns a lemonade stand and must operate it so as to maximize his/her profits by selling to passers-by. A detailed description of the simulation game can be found in previous manuscripts ((Rafaeli and Raban under review; Rafaeli, Raban et al. under review).

2.2 Procedure

The experiment was preceded by a detailed in-class presentation of the simulation along with handouts that consisted of the instructions and sample screenshots. A prize was offered to the player who would achieve highest profits. Participants were told that profits could be made in two ways: 1. By trying to optimize the inventory, lemonade quality, and price per cup depending on the weather data (if available). 2. By trading information (selling generates direct income, while buying information can generate indirect payoffs if played wisely).

A description of the experimental session can be found elsewhere (Rafaeli and Raban under review). Market prices of the information trades were built into the simulation but were not known or revealed to the players. They were only told that market prices were to be determined randomly and that trades would be executed at market prices if the bids they offered were acceptable. This was done to ensure incentive compatibility according to the Becker-DeGroot-Marschak principle (Becker, DeGroot et al. 1964), known in the literature as the BDM method. In BDM, trade takes place only if bids are compatible with current market prices. BDM is therefore a useful method in eliciting private values and is a popular tool in studies of the Endowment Effect.

Participants: Fifty five students in two groups of, respectively, thirty one and twenty four participated in the experiment as part of a class requirement. One group was presented first with the selling scenario, the other started with the buying scenario. The players were seated in a computer lab with an individual computer for each player. They were not allowed to interact with each other but were allowed to ask the experimenter for clarifications. The experiment yielded two or three WTA values and two or three WTP values of the weather information for each participant. All results were combined into one set based on the finding by us and by others ((Boyce, Brown et al. 1992; Morrison 2000; Rafaeli and Raban under review) that there is no learning effect in bidding. The entire experiment lasted an hour and a half, which included the presentation, the warm-up games, and the six games with bidding.

A brief introduction to the game, a Powerpoint presentation, and a link to the game itself are available at: <http://gsb.haifa.ac.il/~draban/lemonade/>

2.3 Measures

Two measures were collected by asking the players for input into the computerized simulation of The Lemonade Stand: Stated value for the willingness to pay (WTP) and willingness to accept payment (WTA) for weather information. WTA and WTP bids were entered in response to an online question such as: “Please state the price you are willing to pay in order to purchase weather data for the entire game period. The trade will take place only if your bid complies with the current market price.” Participants were asked to reconfirm their bid (with an option to change) prior to proceeding with the game.

Data recorded automatically included: Game profits, all quality and inventory parameters entered, use of the online help option, reputation (number of clients who came following a recommendation by satisfied clients) and popularity (derived from the number of clients who bought lemonade out of the total number of clients).

2.4 Analysis

Paired samples t-tests were performed to compare the means of WTA and WTP within the group. T-tests were performed to place the WTA/WTP ratio on the ratio continuum described in the introduction comparing the ratio to a value of 1 (WTA=WTP) and to a ratio of 3, the ratio for market goods. Independent samples t-tests were performed to establish whether the use of information was associated with a larger profit from selling lemonade.

3. RESULTS

The present results reveal that the WTA/WTP ratio for weather information in the Lemonade simulation is about 3 and that there was a strong preference to play with information. Results shown here represent 135 observations collected from 55 participants. Six extreme outliers were removed from the original set of 141 observations. The criterion for removal was an input of two or more extreme values. Table 1 lists the results of the paired-comparisons t-test comparing the values of WTA and WTP.

Table 1. Paired samples statistics to test differences between WTA and WTP

Variable	N	Mean	Std. Dev.	t	df	p
WTA	135	18.84	20.44	5.04	134	.00
WTP	135	11.56	16.99			

Table 2 shows the mean values of the WTA/WTP ratio (mean of ratios), the t-value and its significance for a one-sample test once with the test value being one and once with the test value equaling three. The results indicate that the mean ratio is significantly different than one but not significantly different from three.

Table 2. One sample statistics to test differences between the mean WTA/WTP ratio (denoted "ratio" in the table) and values of 1 (meaning WTA=WTP) or 3

Test Value	Mean Ratio	Std. Dev.	t	p
1	2.68	3.11	6.29	.00
3			-1.19	.235

In order to examine whether the use of information produced an objective benefit for the participants we examined the players' profit data. These data with the results of an independent samples ttest are summarized in Table 3. The difference in profits with and without information was not statistically significant for lemonade profits alone but was statistically significant when the profit accounted for the trading of information. In fact, the results presented here suggest an advantage for playing without information. Nevertheless, participants showed a strong preference for purchasing and not selling information as shown in Table 5.

Table 3. Mean profits in the warm-up games with and without weather information.

Profit Elements	Mean game profits		t	p	df
	With Information (N=181)	Without Information (N=89)			
Lemonade sales	7.47	9.48	-1.92	.06	268
Lemonade sales+information trading	4.62	11.46	-5.38	.00	

Table 4 summarizes the percent of trades that took place indicating a strong preference to use information despite its seeming lack of usefulness for the bottom line profit. The data reveal a stronger tendency to purchase than to sell information.

Table 4. Percent of games played with weather information

Type of bid	Percent of successful trades
WTA	23.70
WTP	57.78
Total	40.74

4. DISCUSSION

Both WTA and WTP averaged higher than the market price set under game conditions. This indicates a high overall subjective value for information. While both WTA and WTP are high, interestingly players did not strategize toward the market price. Rather, they demonstrated true private values as reflected by the WTA mean. As predicted by the Endowment Effect theory, WTA for information was significantly larger than WTP for information (Table 1). In other words people assign higher subjective value to information they own, as compared to the same information that is only a prospective purchase. This finding places information in line with other consumer products, subject to the endowment effect identified by contemporary literature. The high value of WTA implies not only the reluctance to sell but also the value assigned to non-use of information for the purpose of playing the game.

Further support for the existence of a substantial disparity is found by the mean of ratios (Table 2) which was found to significantly diverge from unity but was not different from the repeated research-reported level of about three. This means the numerator (willingness to accept payment for information, WTA) is three times larger than the denominator (willingness to pay for information WTP).

A widely used slogan is that information is (or is becoming) a commodity. Nevertheless, information still has its peculiarities. It is easier to duplicate, easy to share, and ownership of it proves more difficult to enforce. A weighted overall mean ratio of 2.68 obtained here for WTA / WTP is typical of regular market goods (Horowitz and McConnell 2000). Does this imply that information is a regular market good? The relatively low WTA/WTP ratio for market goods is usually attributed in the literature to the existence of fairly good substitutes. But does information, which is an experience good, have substitutes? We believe further interpretation of the results as well as further research is called for before making conclusions about the nature of information as a good.

Mean profit values with and without the use of weather information in the games were not significantly different when looking at game performance only as seen by profits from selling lemonade (Table 3). The difference became significant when the trading of information was accounted for. Table 3 clearly shows that over-buying of information had a negative effect on total profits. High subjective values were assigned to information despite the lack of objective value for the information presented. The players were shown their profit data at the end of each game so they were free to avoid purchasing information that did not prove instrumental. However, results show that even in the face of objective uselessness of the information, participants valued information and wanted to buy it. They exhibited a bias in favor of buying more than selling, although buying and not selling had an effect on subsequent profits (buying meant paying from one's budget while selling meant earning and enlarging one's budget). This is in agreement with the observations of (Bastardi and Shafir 1998) and with (Grant, Kajii et al. 1998) who found that preference for information does not imply expected utility.

The strong preference to purchase information is also reflected in the percent of trades which actually took place as seen in Table 4. We assume a 50% expected percentage for trades. For WTA we see major undertrading while for WTP we observe considerable overtrading. Participants were reluctant to sell and eager to buy information for the game as also manifested in the number of games played with information (67.04% of the games played with information). The overall average of the trades that took place was about 41% which shows a fairly small trend for undertrading. These results suggest that information may be a more marketable good than many other market goods because the desire to buy information is very high.

It can be argued that the relatively high bids are a result of the BDM procedure which is incentive-compatible only for the market value. In the Lemonade game a player can enter a high bid but is assured of actually paying only the market price so the player bids high strategically out of risk aversion and his/her will to verify that the bid will achieve its goal (buying or not selling). Possibly the high bids both for WTA and for WTP for information and the moderate ratio of these values can be better explained by risk aversion rather than loss aversion which is the most widely-accepted explanation for the EE. Bidders wanted to ensure access to information and did not want to risk playing without it. The relationship between information and risk aversion has been addressed by a theoretical model (Grant, Kajii et al. 1998) establishing that intrinsically information-loving people are also risk-averse. Risk aversion has also been linked empirically to lack of information (Kahneman and Lovallo 1993). The present results do not, however, demonstrate strategic bidding because the number of extreme values was low as reflected by the mean and the standard deviation.

Another explanation for the high bids is that bidders had no information about the market price and received only indirect feedback whether they succeeded in purchasing or selling information from the new game settings presented to them after the bid. Lack of information tends to produce higher bids (Kagel 1995). This corresponds well to the theory put forth by (Kolstad and Guzman 1999) who showed there is an inverse relationship between the amount of available information and value of goods traded.

The present research gives rise to many questions. Information as content is an experience good. We neither have prior information on information nor do we have substitutes. How, then, can we explain the information economy in light of these findings? Can the EE phenomenon be related to the decrease in the relative demand for information while production is increasing (Lyman and Varian 2000)? One explanation can be the problem of information overload. We cannot handle and absorb the very large amounts of information at our disposal. Perhaps we suffer from information overload, as suggested earlier (Bastardi and Shafir 1998), because we misuse information, and, as shown in this paper, we tend to hoard information. We pay attention to the wrong information for the wrong reasons. How can we reduce uncertainty regarding information and be better consumers of information? If we value our time so dearly as suggested by experiments (Ortona and Scacciati 1992; Hoorens, Remmers et al. 1999), why do we spend so much of it looking for useless information?

5. CONCLUSION

The findings reported here suggest that society has not yet adjusted its information consumption patterns to the present situation of information abundance. Further research into the value of information may help in developing better training programs for information consumers as well as in designing information systems that account for bounded-rationality behavior.

Clearly, a viable information society should be fueled by lively information exchange. An imperfect information flow scene is to the detriment of many of the optimistic predictions and expectations of the information society. The endowment effect predicts undertrading in information, has been shown to operate here, and is therefore one possible explanation for less than utopian outcomes in reality. This line of study points to less than optimal attitudes toward information and its use. These findings could shed light on suggested policy and information literacy interventions.

In the experiment presented here a certain type of information was used in a specific setting. In order to generalize or differentiate various types of information and find their places on the WTA/WTP ratio continuum further experiments are needed using different types of information in different settings. For example, it can be hypothesized that information regarding a person's health will yield a high WTA/WTP ratio, possibly similar to that of public goods. Variations of the present or other simulations may be developed for training purposes to highlight the value of information and suggest ways for more efficient utilization of it.

We elicited the subjective value of information by developing a theory-based experimental procedure. The main contribution of the present research is to suggest that ownership influences the subjective value of information in trading. Future research may seek out the effect of ownership both in trading and in sharing information. Additionally, the present research shows the subjective value of information to be consistently high by a number of parameters, including the WTA/WTP ratio and the number of games played with

information. This experiment also indicates that the consumption of information may be less than rational. Decisions related to such consumption are possibly caused by risk aversion. Several experimental variations and refinements are called for in order to establish a coherent theory about the subjective value of information.

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STILL GOING GLOBAL, LOCALLY: THE IMPACT OF TEAM MODE IN A DISTRIBUTED COLLABORATIVE LEARNING ENVIRONMENT

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ABSTRACT

This paper presents analysis of a thirteen week quasi-experimental field study of a distributed graduate seminar, consisting of 35 post-graduate students from four research universities, two in the United States and two in South Africa. In this study, we are particularly interested in the impact of team mode on student satisfaction and performance in this collaborative environment. Seminar participants were randomly divided into FTF and Distributed teams, and were pre-tested on a range of variables. Using a suite of commercially-available rich-media CMC tools, these teams met weekly for a synchronous three-hour seminar where they completed a series of unstructured strategy and decision-making tasks. Data were reported in both quantitative and qualitative analysis from participant surveys and narrative evaluation essays. The most important finding was that FTF teams and Distributed teams did not exhibit significant differences in terms of participant's satisfaction and performance.

KEYWORDS

Distance learning, virtual teams, trust, satisfaction, performance

1. INTRODUCTION

Increasingly, many types of organizations (e.g., industrial, scientific, and policy) are using web-based collaboration tools to support the work of geographically distributed teams within their institution. This approach opens up new opportunities for all organizations, in all countries, but particularly for those in developing countries. By minimizing the impact of distance through various socio-technical approaches, developing countries have a greater potential for involvement in globally distributed knowledge work, ranging from scientific laboratories and distance-independent learning to electronic commerce and the global trade in services.

However, in order to take full advantage of these possibilities requires an enhanced understanding of the social and technical factors that support distributed collaborative knowledge work between developed and developing countries. Central to this understanding is greater insight into the factors most influential in the

success of globally distributed teams. Previous field and laboratory studies have identified a series of variables that appear to influence a participant's perception, performance, and satisfaction when working in distributed teams. However, many of these studies have not taken into consideration sufficiently the impact of cross-national cultural factors, likely to affect real teams that are distributed between multiple institutions in multiple countries. From this voluminous literature, we know that an initial Face-to-Face (FTF) meeting is invaluable to the functioning of distributed teams. However, in many instances, logistical or financial constraints prevent any such FTF meeting including any expectation of eventually meeting ones distributed team members. Given constrained travel budgets, and the reduced certainty about international travel, this condition is becoming more common. In such instances, we argue that through principled design, a highly interactive rich-media distributed collaborative learning environment can be created developed.

This paper explores the prospect that in such an environment, the output of distributed collaborative teams can approach that of FTF teams, including on measures of satisfaction and learning. As such, we seek to identify the social and technical factors that make it possible to overcome some of these challenges and that allow students from multiple nations and cultures to collaborate more effectively in geographically distributed knowledge work. This understanding will help to strengthen our ability to build effective distributed learning teams. Further, this ability could create new opportunities for socio-economic development within the context of a global knowledge based information economy.

2. LITERATURE REVIEW

2.1 Collaborative learning

Since the type of knowledge work that we are interested in often requires the ability to learn with others working in collaborative teams, we have explored the literature on distance-independent and distributed collaborative learning. While there have been some notable exceptions (Cadiz, 2000; Jarvenpaa, 1998), most studies of Computer-Supported Collaborative Learning (CSCL) have been of asynchronous approaches (Hazemi, Hailes, and Wilbur, 1998). Nonetheless, from this important body of literature, we know that learning is social, and 'peer networks' or collaborative learning is equally important to faculty interaction, and can enhance student performance (Hiltz, 1990). Tiffin and Rajasingham (1995) suggest that the balance between human-interaction and computer-interaction is a critical factor in the success of a virtual learning environment. The balance is even more important when the learning environment becomes more complex, and more geographically distributed. Hiltz (1990) finds that 'collaborative learning' enhances student ratings of virtual courses. Thus, we expect that students engaged in distributed teams that evolve into 'learning communities' will have more collective and individual success in the seminar, and will be high satisfied with the seminar.

2.2 Technology for distributed learning

Nearly all of the CSCW (Computer Supported Collaborative Work) literature suggests that the appropriate mixture of various technologies is important to support the development of distributed collaborative communities. More sophisticated and media-rich CMC (Computer Mediated Communication) environments, such as those that include video, audio, electronic messaging, multi-media visual stimuli, and shared tools, may help to minimize any differences between CMC and FTF environments (Kiesler, 1984). Also, students are often more willing to interact with their professors in CMC environments than in FTF (Kiesler, 1984; Welsch, 1982). However, due to the instantaneous nature of electronic communications, students may have increased expectations for immediate feedback and become frustrated and dissatisfied when that does not occur (Welsch, 1984). As such, there are seven key design considerations to keep in mind for our technology environment. The considerations include the following: (1) creation and manipulation of virtual spaces; (2) multiple forms of representation; (3) continuous but not continual communication; (4) management of the metaphor; (5) diversity of access points; (6) interactivity; and (7) socialization (McLellan, 1997; Norman, 1998; Tiffin, J. and Rajasingham, 1995).

2.3 Team Dynamics

Performances, as one of the most important measurements of team dynamics, are related with several variables, such as team composition, trust and cohesion, which refers to the tendency for teammates to stick together (Sproull & Kiesler, 1991). Team composition refers to the nature and attributes of team members, and it indicates the diversity of teams. The diversity in team composition has been generally considered having negative impacts on team integration, communication, and usually leading to higher turnover (Lau & Murnighan, 1998; Williams & O'Reilly, 1997). People tend to group themselves according to their visible, i.e., demographic attributes, such as gender, age, race. As such, teams that are more diverse in genders tend to have slightly low levels of effective collaborative process. Females are generally viewed as less competent and motivated in computers and technologies in learning environment (Nass, Moon and Green, 1997), which could be another important factor on team performance in Distributed teams. Although diversity on races and cultures has been of great interests for years, the study remains inconclusive (Guzzo, 1996).

2.4 Trust

Distributed teams are generally more diverse in composition than FTF groups (Johnson et al., 2001), because team members usually are located in different physical places from different organizations, communities, or even countries. The high level of team diversity is as such believed to relate negatively to team cohesiveness and trust development (Sproull & Kiesler, 1991). According to the so-called 'diversity thesis,' these distributed teams should have the highest level of conflict and lowest levels of trust due to the tremendous variability in the team members. On the other hand, communications media affects cooperation and self-reported trust in team work. In FTF groups report highest levels of cooperation, followed, by video, audio and then chat conditions (Bos, et al, 2002). It is generally more difficult to establish and maintain cohesion and trust in distributed teams than in FTF teams. Former research shows that distributed virtual teams lose the various abilities supported by FTF meetings, such as the ability to see others' reactions to the speaker, to elicit easy side conversation, to follow up fluidly, to be able to see the environment the others work within and how it shapes their attitudes and actions, and the ability to have physical influence (Furnas, 2000). However, higher levels of team participation have been found in CMC environments. CMC teams may also be more 'disorganized, democratic, unrestrained, and perhaps more creative than groups communicating more traditionally' (Kiesler, et al, 1984; Williams, 1977). The high and unrestrained communication and interaction can help build trust. One effective way to build and enhance trust in CMC environments is to employ various getting-acquainted activities (Bos, Olson, Gergle, Olson, and Wright, 2002; Rocco, 1998; Zheng, Veinott, Bos, Olson, and Olson, 2002).

3. HYPOTHESES AND STUDY DESIGN

3.1 Hypotheses

Hypothesis 1: Students satisfaction

- (a) Students working in FTF team mode will develop higher level of satisfaction in terms of team cooperation and interaction than those working in Distributed team mode.
- (b) Generally speaking male students will have a higher level of satisfaction than female students.

Hypothesis 2: Team cohesion:

- (a) Students in a FTF team will have a higher perception of their team as a learning community than those in a Distributed team.
- (b) Genders show no significant difference in terms of the perception of their teams as learning communities.

3.2 Study design

This study builds on a three-year pilot study (1999-2001) in geographically distributed collaborative learning between the United States and South Africa. Due to self-selection, and the inability to select completely random subjects, the study has a quasi-experimental design (Cook & Campbell, 1979), organized as a between-subject comparison of team modes (FTF vs. Distributed) and gender (male vs. female). The study takes a form of a thirteen-week online seminar entitled 'Globalization and the Information Society: Information, Communications Policy and Development.' We have 35 post-graduate students (there was one exception allowed for an advanced undergraduate student to participate in the seminar) from four research universities, two in the United States and two in South Africa. All of the students participated were divided into team modes: half in FTF teams, and the other half in Distributed teams. In each session throughout the thirteen weeks, these teams completed an unstructured policy decision making task. They were also required to accomplish a team project, using a suite of rich-media CMC tools. The seminar ran from January –April 2002.

At each university, participants were randomly picked and divided into two groups (Group 1, Group 2) in the beginning of the semester. For the next six weeks of the thirteen-week seminar, students in Group 1 operated as local FTF teams (with all of their team members at their university). In FTF team mode, all members of a team are students at the same university and using voice, sight and shared tools to communicate. Correspondingly, students in Group 2 operated as completely distributed teams (with no more than one team member physically located at the same university). Team members in a Distributed team had no opportunity to meet face-to-face. All team members are virtual (not at the same university) and using CMC tools to communicate. They were provided with a suite of rich-media tools and encouraged to communicate as interactively as possible. Team size is another factor that influences team behaviour. In order to control the impacts of team size, we kept all teams (FTF and Distributed) small in size, comprising of 3-5 students. The unequal sizes of teams were due to the quasi-experimental nature of the study. In order to control for insufficient computer competency of the participants, the first seminar session was devoted to training. Each participant received three hours of contextually-based training on the collaboration tools to be used in the study. In each case, the site coordinator was physically present with the students during the training. These students were assessed, and deemed to be able to achieve an acceptable level of proficiency in the required skills. Rocco (1998) has shown that the use of get acquainted games can help build trust in distributed environments, and to minimize the differences in performance between FTF and Distributed groups. Since we are not studying the impact of these get acquainted activities, we decided to apply them evenly to both FTF and Distributed groups. Thus, in the beginning stage of team constitution, all of the teams were put into virtual breakout rooms and went through a 'Getting Acquainted Exercise.' This exercise included two components: (1) a personal information exchange exercise; and (2) a team building exercise. The personal information exchanged involved each team member using audio/voice and text to provide the following information: name, brief background, education, family, travel experiences, work experiences, languages, hobbies, special skills and resources, and interests in the seminar. For the team building exercise, each team was asked to define a team charter. In the study, the faculty member's location changed in every session, so in some sessions the professor was face to face with one university of students (some of whom were working in FTF; others in distributed teams) and distributed with others (this is also why the term 'distance-independent learning' is so appropriate for this seminar). The instructor rotated among the sites during the whole semester, making it possible for each university to have the professor physically present at least twice.

During each week of the study, all teams participated in a three-hour online session consisting of the following elements: (1) one hour introductory lecture and presentation of information and ideas to be used in the task; (2) one and one-half hour for each team to engage in an unstructured decision making task; and (3) thirty minutes for teams to report back on the assigned decision-making task. From the literature, we know that the degree of realism in a particular task and its duration may affect individual and team performance, with more realistic and sustained tasks leading to higher levels of performance in most groups (Arrow et al, 2000). As such, in this study we have tried to design very realistic tasks (very relevant to policy formulation and strategic decision-making environments). We designed the report-back as a mechanism to reduce any social loafing effect. Students participated in the seminar from a computer lab located at their respective university, with one exception. One student in South Africa was allowed to take the seminar from home, so

she was assigned to Distributed teams throughout the whole semester. Each university had an assigned site coordinator (usually an advanced graduate student or staff member) who was physically present in the lab during each session and responsible for providing administrative and technical support. They were accessible via email or in fixed virtual hours in Centra out of the session time to answer both logistical and substantive questions. A staff member at Michigan was responsible for supervising and maintaining the technical system, thus, minimizing the technical crashes during the semester.

4. TECHNICAL INFRASTRUCTURE

Following the design considerations identified in the preceding literature review (McLellan, 1997; Norman, 1998; Tiffin, J. and Rajasingham, 1995), we have designed a highly interactive, rich-media, collaborative learning environment, consisting of both synchronous and asynchronous collaboration tools including the function of real-time communication, email, and document repositories. The primary synchronous tool used in our study is a commercially available tool called Centra Symposium™. We chose Centra Symposium because it allowed for seven key actions identified in the literature as important to support the development of distributed teams, which are as follows: (1) creation and manipulation of virtual spaces; (2) multiple forms of representation; (3) continuous but not continual communication; (4) management of the metaphor; (5) diversity of access points; (6) interactivity; and (7) socialization.

Creation and Manipulation of Virtual Spaces: Centra symposium allows for the creation of a virtual seminar room. As such, this software is the centerpiece of our highly interactive collaborative learning environment. *Multiple Forms of Representation:* It allows all of the participants in a virtual session to be represented continuously by a “nickname.” Holding the cursor over the nickname will reveal the first and last name of each participant. In addition, the leader of a session is clearly identified, as are all of the co-presenters. Participants can be promoted to co-presenters at any time during the course of a live session. *Continuous but not Continual Communication:* Communications are critical to learning and collaboration. Our CMC environment consists of several ways to provide continuous communications, such as Voice Over Internet Protocol, video over IP, and text chat. Anyone in the seminar room can raise their hand, be given a microphone, and then be allowed to speak in the seminar. However, the leader of a session has the ability to control the microphones, and may take away that privilege at any time. *Management of the Metaphor:* The Centra system uses the metaphor of a symposium, which we articulate as a ‘seminar room.’ The metaphor is maintained and strengthened through the media window, recognition and identification of the seminar room participants. Further, ‘break-out rooms’ may be used for small group discussions and team assignments. The groups performed their experimental tasks within the break-out rooms. *Diversity of Access Points:* Most students participated in the seminar from the computer lab located at their university. The computers in the lab were connected to the Internet at a speed of 28.8kpm (or higher), each equipped with a headset and microphone to facilitate the audio broadcasting. However, the software allows for access to the seminar room from anywhere that one has access to the web. For example, there was one exception, when a student in South Africa was allowed to take the seminar from home; and other ad hoc exceptions, allowing a student to attend a session from their offices, a hotel room or cyber café). Also, given that there were differing levels of technology access within the seminar, our CMC environment had to be able to accommodate this diversity, including lower bandwidth environments. Centra allows for content to be pre-cached. The Centra video over IP allows for video webcasts to be transmitted to the participants with a variable frame rate ranging from 5, 10, 15, 20, 25, or 30 frames per second. The actual frame rate is based on the leader’s video hardware and the available bandwidth. The average video broadcast to the seminar is estimated to have been 15 fps. Finally, the symposium sessions were all recorded, and made available to the seminar participants asynchronously. *Interactivity and Socialization:* Interactivity and socialization are seen as two of the most important aspects of learning, and are often lost in the design of computer-mediated learning environments. Our system facilitates high levels of interactivity, both during a synchronous seminar session, and beyond. In Centra during a session, any participant may ‘raise their hand’ at any time. The computer is able to queue the questions, and the leader may give the participants the floor in any order. Participants may continuously indicate their agreement or disagreement with questions or issues by clicking green ‘checks’ (to indicate ‘yes’) or red ‘exes’ (to indicate ‘no’). Additionally, emotions such as laughter or applause can be indicated during a session by clicking emoticons. Participants may also be polled or surveyed at any time during a session, allowing them to indicate their perspectives and knowledge on particular issues. Throughout a

session, all participants also have the opportunity to send public and private text chat messages. A range of multi-media content for a session can contribute to interactivity as well. Types of content available within a Centra session include: PowerPoint slides, websites, Windows movies, graphic images, PowerPoint slides, white boards. Finally, any or all participants may, at any time, be given 'mark-up tools' which can be used on a white board, or to mark up the PowerPoint slides. All of these features were used during the course of this study; most were used for each of the weekly seminar sessions.

Instant messaging tools have been shown to support a variety of informal communication tasks in workplace (Nardi, et al., , 2000). Correspondingly, our study made extensive use of presence awareness packages, such as MSN Messenger, AOL Instant Messenger, and ICQ. All participants had access to the PA addresses of all seminar participants, site coordinators and the professor. Team members were encouraged to add the colleagues' MSN user names into their buddy list. In addition to these synchronous tools, we added UM.Worktools as an asynchronous shared workspace and e-mail mailing list for the seminar. Worktools allows participants to access course material, files, e-mail archive, and the digital library for the seminar. Further, each team (both FTF and distributed) had their own Worktools site, including e-mail list, and was able to use it as they desired.

5. DATA COLLECTION

5.1 Data collection means

As we mentioned above, the primary research question for this field study is the following: 'In a globally distributed collaborative learning environment, what are the effects of team mode and gender on students' performance, satisfaction, and trust within teams when working on unstructured tasks over an extended period of time?.' Our study includes both qualitative and quantitative data collection. Three online surveys were administered in the study using a survey web server www.zoomerang.com. We had an initial survey, a mid-term survey and a final survey in the first, the seventh, and the thirteenth week respectively. The instructor sent the links of the surveys to the students via email. The participants were told that all surveys were completely optional. However, in order to help improve the seminar to better facilitate their needs, they were highly encouraged to take and submit them. Their responses to survey questions were strictly confidential, and by no means would be connected to their final grades. The pre-test questionnaire collected demographic data on the participants (age, gender, nationality, language, education, and income) and baseline measures of their pre-existing trust level. The other two questionnaires were given in the middle and the end of the term respectively, each of which collected general perspectives on the seminar and the levels of satisfaction and trust developed within their teams. In addition to the surveys, seminar participants were asked to complete mid-term and final narrative evaluation essays. The mid-term self-evaluation essay had a template of 10 open-ended questions designed to assess a range of measures including satisfaction, learning experiences, the comments on faculty modes, and the working style of their teams. The final essay contained 15 questions, which were required to submit right after the final team project was due. Again, they were told that those essays would be anonymous and be strictly confidential to others except the researchers. We had 24 final self-evaluation essays in total. Emails among group members were saved and analyzed concerned with the team performance as well as the different communication patterns that exhibited in different team modes. Seminar recordings were also saved as another measurement for team performance, especially the team performance of every session task.

5.2 Measurement

Performance was measured in a 100 scale score. We had two levels of scores: the team scores and the individual scores. Team scores were granted by the instructor according to the feasibility, validity, and persuasiveness of the paper and presentation. The individual score was given by the instructor on a comprehensive basis taking into account the score of team he/she was working in, as well as the in-class interaction. Scores for all participants were granted on a non-discrimination basis.

The variable of satisfaction we are interested in contains three aspects: overall satisfaction with the seminar, satisfaction in terms of participants' objectives being met, and satisfaction in terms of the perception

of the team as a learning community. Overall satisfaction with the seminar was measured on a 5 scale in the online surveys, 5 indicating high satisfaction and 1 no satisfaction at all. In the mid-term survey, participants were asked to report whether they enjoyed the course, and were asked about the level and quality of the course readings. In the final survey, questions were asked about to what degree they agreed that it was an excellent seminar, and to what degree they learned a lot. Satisfaction in terms of objectives being met was measured in mid-term and final self-evaluation essays. In other essays participants were asked two same questions: (1) what were your academic/learning objectives in taking this seminar? To what degree have they been achieved; why or why not? (2) what were your personal objectives for taking this seminar? To what degree have they been achieved; why or why not? We believe that participants' satisfactions with the seminar depended by a large scale on their initial academic and personal objectives on the seminar. If the objectives were met through taking the seminar, they would feel high satisfied; vice versa. As overall satisfaction, it was also coded on a 5 scale, 5 indicating high satisfaction, i.e., their academic and personal objectives were met to a high degree, while 1 indicating low satisfaction. We had two research assistants doing the coding independently. After finishing all essays, they gave a consensus to each essay. If their coding was different, they were asked to discuss between themselves and came to a final score.

Trust is another important variable in this study. We were especially interested in the trust generated between team members, both in FTF and Distributed teams. Trust, also on a 5 scale, was measured in mid-term and final surveys. Participants were asked about 10 questions regarding their trust on team members. Questions were like whether the participant trusted that his/her team members would keep the promises they made, whether they were competent in performing their jobs, whether they expressed the true feelings about important issues, whether they contributed to the success of the team, whether they would acknowledge their own mistakes, whether he/she would confide his/her difficulties to team members, whether he/she thought the team was very trustworthy, whether he/she could rely on team members, and whether all members put sufficient efforts to team projects. Previous studies have argued that diversity in gender, initial trust and technical competency could have impacts on team dynamics. However, because we randomly assigned students to teams, we had reasons to believe that these factors were not significantly different in both teams. We ran an Analysis of Variance (ANOVA) to test gender mixture, initial trust levels and technical competency levels in both team modes. Gender mixture in FTF teams and Distributed teams was not significant: $F(1, 24)=.025, p=.877$. Initial trust was measured in the initial survey at the beginning of the semester. Participants were asked their general aptitudes about dealing people. For those who answered "people can be trusted," their initial trust levels were high; for those who answered "you cannot be too careful with people," their trust levels were low; for those who answered "depends," their trust levels were medium. Although it was measured six weeks before the second semi-semester, we still used it as a pre-test measurement, because in the second semi-semester, participants would be working in a team different from that in the first semi-semester. The trust developed in the first six weeks was not likely to have a significant impact on the trust developed in the new team. It is the initial baseline trust that could be a determinant for trust development. The ANOVA test indicated that participants initial trust levels in both team modes were not significant either: $F(1, 12)=.282, p=.606$. Similar with initial trust, technical competency was also measured in initial surveys. Students were asked to self-rate their experiences with the following information technologies: email, off tools, web browsing and searching, application sharing, document sharing, distance learning, video and audio conferencing, and web-conferencing tools. Score of 5 indicated very computer literate, while 1 indicated low technical competency. ANOVA test showed that students working in FTF teams and Distributed teams in the second semi-semester did not have significantly different computer competency: $F(1, 13)=.573, p=.464$. Although this variable was measured six weeks before the students worked in their new team in the second semi-semester, we think the ANOVA test is still valid, because six weeks is relatively a short time period to significantly change people's technical literacy.

6. FINDINGS

6.1 Satisfaction

Upon initial analysis, we reject H1 (a) and (b). There appears to be no significant relationship between any of the measures of satisfaction and neither group mode, nor gender. On all measures taken, participants reported

very high levels of satisfaction. The vast majority of participants remarked that their personal and academic goals of taking the globalization seminar had been achieved. Students showed various levels of satisfaction with both the content of the seminar and the form of teaching and learning used here. For example, one student said that,

Therefore, my objectives as well as my expectations have been more than met. This class has successfully provided me with a new prospective on telecommunications and helped me to formalize my long-term goals.

Another student commented that,

...my personal objectives for this course are to enhance skills that are necessary for becoming a project planner (discussion, presentation, analytical skills) and knowledge about globalization and its related issues. This [These] objectives have achieved almost 100%.

Out of 23 final essays respondents only one student expressed dissatisfaction, saying that:

I'm not sure what I liked the most or least. What I can say is that any good that came out of this course has been overridden by the negative experience in the second semester.

6.2 Group Cohesion

The level of team cohesion was measured as to what degree the participants valued their teams as learning communities, i.e., to what degree a student perceived the contributions of his team members to his individual learning experience in the seminar. Generally speaking, most students (68%) when working in both global and collocated teams, agreed that their team became a 'learning community' and that their team members contributed to their understanding the material in the seminar. Several participants noted that they benefited from discussions with their other team members. One female participant from the United States working in a FTF team said that:

...discussions and collaborative work with syndicate group members were great opportunities for me to consider the global issues....I learned from them a lot...

A number of students remarked that the diverse backgrounds and geographic locations in Distributed teams played positive role in their learning experience in the seminar. One female SA participant from a distributed team commented that:

The syndicate contributed to a large degree. As explained before, one of the unique values of this course was to put people together from different backgrounds.

Another distributed syndicate member said that:

Brainstorming with my group members definitely contributed to the overall learning experience because of the different backgrounds we come from.

While both teams of students valued their team as a learning community, participants working in FTF teams valued their team as a learning community slightly more frequently (75%) than did those participants working in Distributed teams (63%), which confirmed our initial hypothesis H2 (a).

Interestingly, hypothesis 2 (b) that gender will not have significant impacts on team development, were rejected according to the data analysis. Males (8, 80%) valued the teams more than females did (7, 50%). It is interesting to see that even in the same team males were more positive to consider the team cohesiveness than his female team members.

In terms of the relationship between geographic location and team cohesiveness, US participants (10, 77%) assessed more cohesiveness in their teams than SA students (5, 45%). We attributed the relative less cohesiveness to the difficulty that SA participants had experienced during the collaboration, which to some degree reduced their willingness to contribute. As one female SA students in a FTF team mentioned,

... they were more relaxed and late. It was also difficult to motivate the students to attend [the seminar] when the lecturer was not here... My Syndicate did not contribute to my learning experience. If anything my Syndicate was frustrating and difficult to work with.

An interesting finding emerged when we consider how to build trust within teams. As we mentioned above, we did not manipulate the get-acquainted-activities when we set up the teams. Instead, we asked all team members to exchange photos and personal profile with their partners. It turned out the majority students considered this to be highly helpful in building trust and understanding among members, especially in distributed teams. Of all the responses 18 (75%) agreed that the exchange of photos enhanced their interaction between partners. Some suggested that the video from all members should be provided also.

As one female US student working in a FTF team remarked,
...seeing photos of each other helps put a face to a name, personalizing the other member of the team.

Another US female FTF team member expressed similar ideas,
It would have been nice to have video photographs of team members in other countries because sometimes, I felt like I was working with "virtual people."

7. DISCUSSION

Our results clearly showed that the Globalization Graduate Seminar was a success, even with the challenges of organizing the seminar between two countries with different cultures, time zones, and economic development status. Participants can achieve satisfactory technical proficiency after a 3hour training session, and feel comfortable collaborating with their distantly collocated team members. The performance for participants working in both FTF teams and Distributed teams were not significantly different, although Distributed teams had more challenges resulting from communication delays and lack of sufficient facial clues. Participants felt satisfied with the overall quality and delivery of the seminar, regardless of team mode, and their academic and personal objectives were met to a large degree throughout the thirteen weeks' study in Globalization Seminar. Most students from both types of teams agreed that working in teams contributed to their individual learning experience. As such, both team modes could be perceived as a learning community. As expected, FTF teams developed a higher level of within-team trust than Distributed teams. We believe that this is accounted for because FTF teams have the ability to elicit easy side conversation, to follow up fluidly, to have physical influence, and the ability to generate cohesiveness even by spontaneously physical greetings outside the seminar. Simply providing video links showing talking heads does not take care of these needs. However, in our study, these different levels of trust did not influence students' performance and satisfaction with the seminar.

The findings observed in the study encourage us to further our study towards such directions as (1) expanding to other subjects; (2) including more cultures; and (3) realizing a complete cyber-seminar. The success of Globalization suggests that students can achieve high levels of satisfaction even if the course is conducted using some CMC tools rather than held in a traditional classroom. The researchers are very interested in introducing this seminar model to other subjects, and expect to find that the Globalization model works well as long as the subject content is well prepared and can be delivery using computerized communication media. Also, cross-cultural issue is of special interests. In this study, cultural influences are not explicitly analyzed, and those data will be explored in future studies. A complete cyber-seminar is another future direction. Since the findings show that FTF teams were not significantly better than Distributed teams in terms of performance and satisfaction, FTF factor could be eliminated from the seminar. In that case, the cost would be greatly reduced with the removal of computer labs in each university, because students can login in from wherever they want. Although in Cyber-seminar students may feel isolated from other participants and find it takes longer to develop certain identity, the introduction of collaborative distance-independence teams would help reduce the negative influences to the maximum degree.

The study does have some important limitations. One primary limitation is in the nature of quasi-experimental designs with non-random selection of subjects. We attempted to address this limitation by taking our self-selected subjects and randomizing them into one of the two group modes (i.e., FTF or distributed). Another problem with the self selection is that those students willing to attend the seminar, knowing how technologically demanding it would be, were at least comfortable with the concept of the online learning model. It is reasonable to assume that they might have higher technical competency than other university students, thus they might not represent the general student population at each of these universities. We are also concerned about the small sample size. We had 35 participants in the 2002 seminar, but the responses to the initial, mid-term and final surveys as well as the two evaluation essays were increasingly less. The limitation of surveys and subjective self-evaluation also call into question that some data may not be consistent with what students really felt with the seminar. Those who were not satisfied may simply disregard the surveys and self-evaluation essays (thus accounting for the high rates of non-completion). Even if they did submit, their subjective values may be influenced by various factors; for

example, they may be afraid that their response would have negative impacts on final scores, although they had been told this would never happen.

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A SCANONCE ALGORITHM FOR LARGE DATABASE MINING IMPLEMENTED IN SQL

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ABSTRACT

In support of the trend of data mining on large data warehouses, we propose a ScanOnce algorithm for association rule mining which just needs to scan the transaction database once to generate all the possible rules. In contrast, the well-known Apriori algorithm requires repeated scans of the databases, thereby resulting in heavy I/O accesses particularly when considering large candidate datasets. Since PL/SQL is seamlessly integrated with Oracle's database, we implement this algorithm in an Oracle9i environment. Attributing to its integrity in data structure, the full itemset counter tree can be stored in a relational table without any missing gap. The power of generating ad hoc queries in PL/SQL ensures fast access to any desired counter. The experiments show that this ScanOnce algorithm implemented in PL/SQL beats classic Apriori algorithm for large problem sizes, by factors ranging from 4 to more than 10, and this gap grows wider when the volume of transactions further grows up.

KEYWORDS

SQL, data mining, relational database, data warehouse, association rules, I/O bottleneck

1. INTRODUCTION

An ever increasing number of organizations are installing large data warehouse using relational database technology [Colliat, 1996]. Data mining on these data warehouses is becoming more and more important [Clifford, 2001][Borgelt, 2002]. Efficient algorithms are needed that restrict the search space and check only a subset of all rules, but, if possible, without missing important rules.

Among the best known algorithms is the Apriori algorithm [Agrawal, 1993][Agrawal, 1996]. This algorithm works in two steps: In a first step the frequent itemsets are determined. These are sets of items that have at least the given minimum support (i.e., occur at least in a given percentage of all transactions). In the second step association rules are generated from the frequent itemsets found in the first step. Usually the first step is the more important, because it accounts for the greater part of the processing time. In order to make it efficient, the Apriori algorithm exploits the simple observation that no superset of an infrequent itemset (i.e., an itemset not having minimum support) can be frequent (can have enough support). It is generally acknowledged that the Apriori technique works well in terms of reducing the candidate set. However, there are some criticisms [Han, 2000][Zheng, 2001] where there are many patterns, long patterns or low support thresholds: 1. Many candidate items sets must still be generated; 2. Requires repeated scans of the databases thereby resulting in heavy I/O accesses particularly when considering large candidate sets.

In order to find the frequent itemsets, we have to count the transactions. The simplest way of processing the transactions is to handle them individually and to apply to each of them the recursive counting procedure described in Apriori algorithm [Agrawal, 1993]. However, when considering large candidate datasets, the recursion is a very expensive procedure involving frequent I/O operations and degrading the system performance. Therefore it is worth considering how it can be improved.

Addressing the above problems, we propose a ScanOnce algorithm implemented in PL/SQL for coupling association rule mining with relational database system, well-used in organizations and communities. This algorithm just needs to scan the transaction database once to generate all the possible rules. In this article, we will first discuss some issues about PL/SQL programming environment, including how to introduce PL/SQL cursors and records to process the transaction database efficiently. Secondly we design a new method of organizing a full itemset tree in a relational table. Thirdly, the proposed ScanOnce algorithm is implemented in Oracle PL/SQL. Fourthly, we present a performance comparison of the ScanOnce with the classical Apriori algorithm against a synthetic database. We will finally conclude the paper by giving four features of this algorithm to explain why it is experimentally an order of magnitude faster than Apriori in very large databases.

2. PL/SQL PROGRAMMING ENVIRONMENT

PL/SQL is Oracle’s procedural extension to SQL. SQL is good in defining the structure of the database and generating ad hoc queries. However to build applications, the power of a full-fledged high-level programming language is needed. PL/SQL provides such an environment to develop application programs. It supplements SQL with several high-level programming language features such as object-oriented features [Sunderraman, 1996]. Thus, PL/SQL can be used to build sophisticated database applications, like implementing our ScanOnce algorithm in this article.

2.1 Data Transformation

Since we are implementing our ScanOnce algorithm in PL/SQL, a Boolean database D needs to be transformed to relational representation. Each transaction and each item is uniquely identified by an integer (for ease of demonstration, we use alphabetic letters to identify different items in the article). The two column representation is implied by the set characteristic of the transactions. That is, the number of items typically contained in a transaction may vary largely. Moreover, a maximal transaction size may not be determined in advance.

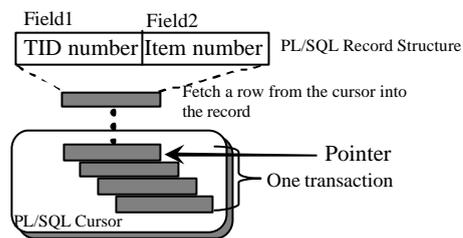


Figure 1. A PL/SQL cursor allows the program to fetch and process transactions from the database into the PL/SQL program. A PL/SQL record is also used, whose structure is based on the select-list of a cursor.

2.2 Database Access Using Cursors and Records

PL/SQL provides cursors for processing a query resulting in more than one row. A PL/SQL cursor allows the program to fetch and process information from the database into the PL/SQL program. The relational transaction table (Table 2) should be loaded into a predefined cursor, as shown in Figure 1, one transaction (consisting of a number of rows) at a time. Cursor variables provide a pointer to the cursor work area and thereby increase the flexibility of the use of cursors. Once a cursor has been declared, it can be processed using the open, fetch, and close statements. PL/SQL provides for loop to be used with cursors. This loop is very useful in our situation where all rows of the cursor (one transaction) are to be processed.

A PL/SQL record is a composite data structure, similar to a structure in a high-level programming language. In Figure 1, a record is used, whose structure is based on the select-list of a cursor. The record into which the cursor rows are to be fetched must be compatible with the cursor row type. The below coding list (Figure 2) declares a cursor-based record and then processes the cursor using the record. Within the body of

the loop, the individual fields of the record can be accessed. The loop terminates automatically when all rows of the cursor, i.e., the current transaction, have been scanned.

```

declare
cursor ta_line is      //cursor definition
select item
from transaction ta
where tid=i;  //i is a loop variable for scanning
//the entire transaction database
ta_rec ta_line%rowtype;  //record definition
begin
open ta_line;
loop
fetch ta_line into ta_rec;
exit when ta_line%notfound;
ScanOnce Algorithm in PL/SQL (see Figure 6)
end loop;
close ta_line;
end;
```

Figure 2. Declaration of a cursor-based record and then processing of the cursor using the record.

3. MANAGEMENT OF THE FULL ITEMSET COUNTER TREE

After the whole database is scanned, the counters for the all possible itemsets, organised in a complete itemset tree, is obtained, as shown in the left part of Figure 3. This is a full itemset tree for the five items 'a', 'b', 'c', 'd' and 'e' exemplified in database D shown in Table 1. Organising the counters in a full itemset tree not only allows us to store them efficiently (using little memory), but also supports generating the rules. In the figure, each canonical attribute sequence S denotes a counter for an itemset S. The circled itemsets (infrequent itemsets) will be pruned since they do not have minimum support.

How to store this full itemset counter tree efficiently? Different from traditional linked-list tree representation, we use a very simple relational table to store this tree. It is possible to do so because what we maintain in the ScanOnce algorithm is a full itemset tree without any missing gap. As shown in Figure 3, node by node, level by level, we push the counter tree (nodes) into a

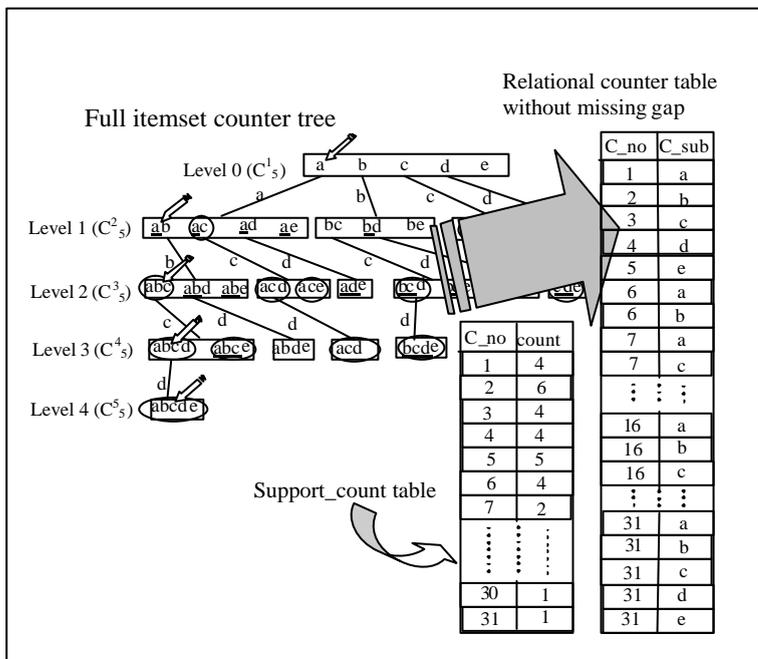


Figure 3. The relational representation of the full itemset counter tree.

relational table “Counter”, which records the composition of each itemset counter. Each counter is uniquely identified by an integer C_no. Such a relational representation of an itemset counter is flexible as the number of item identifiers in a counter may vary largely. Moreover, a maximal number of the counters may not be determined in advance. Another relational table “Support_Count” is also maintained for storing support count for each counter. The counter identifier (C_no) links “Counter” and “Support_Count” tables.

To locate a desired counter on this tree becomes another important issue. Not only in the first step of itemset appearance counting, but also in the second step of generating association rules, there are frequent accesses to those counters. The power of generating ad hoc queries in PL/SQL ensures fast access to any desired counter. The below coding list (Figure 4) shows an example of locating a desired counter corresponding to 3-itemset ‘abc’. An intermediate variable “pass”, declared as support.count%type, is used to transfer the previous count number from the “Support_Count” table, which will be updated by a new count number.

Declaration

... (see Figure 2 for details)

```
select s.count
into pass      //pass is a predefined intermediate variable
from support s
where s.c_no=(
  select c1.c_no
  from counter c1, counter c2, counter c3
  where c1.c_sub='a' and c2.c_sub='b' and c3.c_sub='c'
  and c1.c_no=c2.c_no and c2.c_no=c3.c_no
  and c1.c_no in
  (select distinct c.c_no
  from counter c
  group by c.c_no
  having count(*)=3));
```

Figure 4. Locating a desired counter corresponding to 3-itemset ‘abc’.

4. SCANONCE ALGORITHM IN PL/SQL

Our ScanOnce algorithm is described in the pseudo-code in Figure 5. This is a purely sequential (rather than recursive) counting procedure which is well compatible with the relational representation. To count a certain transaction (represented by a PL/SQL cursor), we merely start at the first row (item) in the cursor and then sequentially traverse the cursor by following the pointer as indicated in Figure 1. In computing the counters for 1-itemset a, b, c, d, e, we will scan each of the 5 items in the transaction D. “Is there a way to avoid having to rescan all these items for the computation of other counters, such as ab, abc, abcd and abcde?” The answer is yes. When any item (if exists) is scanned, its contribution will be comprehensively taken into account. For example, when the first item ‘a’ in the transaction is being scanned (say, for the counter of the 1-itemset ‘a’), all of other $k(k>1)$ -itemsets ‘ab’, ‘ac’, ‘abc’, ‘abcd’ and ‘abcde’, relating to ‘a’ (inversely, ‘a’ is subset of these k -itemsets), will be simultaneously computed. That is, each counter of the four ‘a’-relating 2-itemsets, ‘ab’, ‘ac’, ‘ad’ and ‘ae’, each counter of the six ‘a’-relating 3-itemsets, ‘abc’, ‘abd’, ‘abe’, ‘acd’, ‘ace’ and ‘ade’, each counter of the four ‘a’-relating 4-itemsets, ‘abcd’, ‘abce’, ‘abde’ and ‘acde’, the counter of the ‘a’-relating 5-itemset, ‘abcde’, should be incremented then as well. In other words, such a multiway computation aggregates to each of these related $k(k>1)$ -itemsets while a single item is being examined. In computation, the counter for the 1-itemset ‘a’ is incremented by 1. Note that the counter for the ‘a’-relating 2-itemset ‘ab’ should be incremented by 0.5 only as $a=1$ just contributes 1/2 to the ‘a’-relating 2-itemset ‘ab’, and so on. Similarly the counter for the ‘a’-relating 3-itemset ‘abc’ is incremented by 0.334 (0.334 rather than 0.333 is used to compensate the machine representation error of the decimal number) as $a=1$ contributes 1/3 to ‘abc’. The 4-itemset is incremented by 1/4; The 5-itemset is incremented by 1/5, and so on. After the first single item ‘a’ is examined, the second item ‘b’ of the transaction, currently being scanned, is examined

in a similar way. When $b=1$, $ab=ab+0.5$ is carried out, which makes the final count number for 'ab' is 1, fairly reflecting the contribution from its two subsets 'a' and 'b'. After the current transaction is completely inspected, a post-processing is needed, i.e., a function $\text{floor}(x)$ in PL/SQL, which finds the largest integer not greater than x , is carried out to rounds down each counter. The insufficient contributions (less than 1) will be removed, which implies the corresponding itemset is not supported by the current transaction (that pattern does not appear in the transaction).

```

if (ta_rec.item='a') then
  select s.count
  into pass      //fetch the previous count number
  ...           //see Figure 4 for details

  update support
  set count=pass+1 //increment the count by 1
  where c_no=(
    select c.c_no
    from counter c
    where c.c_sub='a' and c.c_no in          (select distinct c_no
    from counter c
    group by c.c_no
    having count(*)=1));

  select s.count
  into pass      //fetch the previous count number
  ...           //see Figure 4 for details

  update support
    set count=pass+0.5 //increment the count by 1/2
  where c_no=(
    select c1.c_no
    from counter c1, counter c2
    where c1.c_sub='a' and c2.c_sub='b' and c1.c_no=c2.c_no and c1.c_no
in          (select distinct c_no
    from counter c
    group by c.c_no
    having count(*)=2));

  select s.count
  into pass      //fetch the previous count number
  ...           //see Figure 4 for details
  update support
    set count=pass+0.34 //increment the count by 1/3
  where c_no=(
  select c1.c_no
  from counter c1, counter c2, counter c3
  where c1.c_sub='a' and c2.c_sub='b' and c3.c_sub='c' and c1.c_no=c2.c_no
and c2.c_no=c3.c_no
    and c1.c_no in          (select      distinct
c.c_no
  from counter c
  group by c.c_no
  having count(*)=3));
  ...

```

Figure 5. Pseudo-code of the ScanOnce algorithm implemented in PL/SQL. Note that fetching of the previous count number, to be updated here, from the "Support_Count" table (through variable "pass") has been ignored. See coding list in Figure 4 for details.

The above is so-called first step of association rule mining, in which the frequent itemsets are determined. The second step of generating association rules from the frequent itemsets is straightforward. Note that there is no need to scan the original transaction database any longer as the counters organised in the full itemset tree have retained sufficient information for rule generating.

Based on such a purely sequential counting algorithm, a very large transaction database can be split into several small parts without incurring serious penalty, each of which fits into the main memory. When handling a large transaction database on disk, which is large than the main memory space, just a subset, which fits into the memory, of it will be loaded for counter tree construction. A (disk) file pointer is recorded to mark the interrupted point of that file. Then the current subset in memory will be discarded (no need to rescan those previously-scanned parts) and the new (following) subset will be loaded to carry on counting on the existing counter tree. Such a procedure will be repeated until reaching the end of the disk file. This algorithm is a sequential counting procedure and heavy I/O overhead has been avoided which degrades the mining performance.

5. EXPERIMENT RESULTS

In this section, we present a performance comparison of ScanOnce with the classical Apriori algorithm. The performance of a data mining system is determined by two criteria: processing time and memory utilization[Webb, 1999]. The ScanOnce association rule mining algorithm in PL/SQL described in this article is designed to economize storage space and accesses, and we must show that this overriding concern for speed is compatible with a reasonable utilization of available space. Our experiment with association rule mining algorithm is based on a simulation program coded in Oracle PL/SQL. The program runs on an Intel Pentium IV machine under the Windows 2000 Advanced Server operating system. The CPU frequency is 1.2 GHz. The physical memory size is 128 MB (we deliberately chose such a small size memory because our attention is

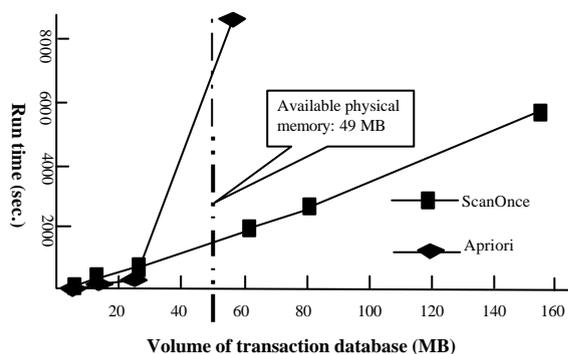


Figure 6. Mining time as a function of volume of the transaction database. 49MB (available physical memory size) is an important threshold for classic Apriori algorithm. When the threshold is overtaken, the mining time for Apriori increases exponentially whereas the time for ScanOnce in PL/SQL still increases linearly.

focused on the performance change around the physical limit of the main memory) and virtual memory size is 610 MB.

Since the association rule mining algorithm is designed to handle large volume of data, real-time visualization of memory usage by far the most important point. For this purpose, the System Performance Monitor in the system tools was used. We report experimental results on a synthetic database. These synthetic data sets were generated using the procedure described in [Agrawal, 1996]. In this data set, the average transaction size and average maximal potentially frequent itemset size are set to 25 and 10, respectively. The number of transactions in the dataset ranges from 200,000 to 5 millions, which occupies up to 160 MB space.

Figure 6 summarizes the experiment results on Windows 2000 advanced server machine. The simulation confirms that both ScanOnce algorithm and Apriori algorithm show linear scalability with the volume of transaction dataset when this size is below a certain limit. As can be seen in Figure 6, this limit is 49 MB, which is available physical memory. In this instance, the physical memory is 128 MB and the data mining application space (commit memory) plus operating system space (kernel memory) is around 79 MB. Below this threshold of the available physical memory size, all the operations are internal without accessing the external storage devices (except for the initial loading of the database).

When the threshold is overtaken, virtual memory technique would be activated and frequent disk-block accesses would be involved. It takes a relatively long time to fulfill an operation. As mentioned above, when

handling a large transaction database on disk (bigger than the available physical memory space), it will be split into several small parts. At any given time, just one subset resides the memory. Then the current subset in memory will be discarded and the consecutive subsets will be loaded in turn to carry on counting on the existing counter tree. Normally we just count the number of disk accesses into access time. The running time for ScanOnce algorithm is still proportional to the volume of the transaction dataset even if the threshold is overtaken. ScanOnce scales much better than Apriori. This is mainly because the wasteful operations of unnecessarily rescanning those previously-scanned subsets have been avoided by this new algorithm.

The available physical memory size (49MB in this instance) is an important threshold for classic Apriori algorithm as it requires repeated scans of the databases. When the threshold is overtaken, the mining time for Apriori algorithm increases exponentially whereas the time for ScanOnce algorithm still increases linearly. Overall, ScanOnce is about an order of magnitude faster than Apriori in large databases, and this gap grows wider when the volume of transactions further grows up.

6. CONCLUSIONS

The new association rule mining algorithm just needs to scan the transaction database once to generate all the possible rules. To count a certain transaction, we merely start at the first row (item) in the PL/SQL cursor and then sequentially traverse the cursor by following the pointer. The contribution from each row (item) will be comprehensively taken into account. However, it is not without drawback with this new algorithm. In the first step of finding frequent itemsets, we even count those itemset which are not frequent although they will be pruned eventually. Based on the observation that if any given set of attributes S is not adequately supported, any superset of S will also not be adequately supported and consequently any effort to calculate the support for such supersets is wasted. However, considering the advantage of performance improvement brought by avoiding heavy I/O operations as the transaction database is just scanned once, this new algorithm presents us with a broad range of trade-offs based on speed requirement and storage requirement. The experiments show that this ScanOnce algorithm in PL/SQL beats classic Apriori algorithm for large problem sizes, by factors ranging from 4 to more than 10. As the volume of transactions grows up further, the difference between the two methods becomes larger and larger. In summary, this algorithm has the following features:

1. **ScanOnce.** The new algorithm in PL/SQL for association rule mining needs to scan the transaction database once to generate all the possible rules. A very large transaction database can be split into several small parts, each of which fits into the main memory. Those previously-scanned parts will not be re-scanned and will be discarded after support counting. In contrast, the well-known Apriori algorithm requires repeated scans of the databases, thereby resulting in heavy I/O accesses particularly when considering large candidate datasets.
2. **Simple Data Structure.** Simple data structure with integrity (no missing gap). The entire full itemset counter tree can be stored in two relational tables.
3. **High-speed.** Easy to locate any desired counter in the relational table owing to the power of generating ad hoc queries in PL/SQL.
4. **Flexibility.** The full itemset counter tree organized in this algorithm is independent of the minimum-support. In contrast, the classic Apriori algorithm is dependent on the minimum support. If the user wants to choose another minimum support, all the previous efforts have to be discarded and the (incomplete) frequent itemset tree needs to be re-constructed.

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A COLLABORATIVE LEARNING ENVIRONMENT FOR COMPUTER NETWORK TEACHING USING PBL AND CBR APPROACHES

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ABSTRACT

Nowadays technological professionals have differentiated their skills and motivated great changes in their academic training. Normally the teacher-centered approaches, widely used in traditional education, induced a passive behavior in the students and did not prepare them for teamwork or to be lifelong learners. Student-centered approaches based on constructivist principles and collaborative learning stimulate self-learning skills and critical reflection and have been proved to be more appropriate, mainly within the technological area, which is always in constant improvement. This paper presents a Collaborative Learning Environment to support learning in Computer Network domain, using the Problem Based Learning approach integrated to a Case-Based Reasoning System used for Computer Network problems diagnosis.

KEYWORDS

Collaborative Learning, Problem-Based Learning, Distance Learning, CBR, Computer Networks Teaching.

1. INTRODUCTION

The demand for professionals in the Computing domain is constantly changing nowadays. The conceptual-technical knowledge began to gain the same importance as other equally important characteristics, such as self-learning, critical thinking and teamwork skills (Nadjim-Tehrani, 1997; Koch & Teege, 1998; Greening et al., 1997). These changes have been motivated by the constant expansion of technological infrastructure, which is a result of a greater use of computer services and also the growing interconnection between the networks and organizations.

Traditional teacher-centered approaches do not prepare professionals for this new technological environment, especially in the Computer Network domain, and the use of student-centered approaches that can form lifelong learners is suggested. The approaches based on constructivist principles (Savery & Duffy, 1995) and collaborative learning, such as Problem-Based Learning (PBL) (Barrows, 1985), aim at offering the students knowledge construction and learning through collaborative learning. In spite of the great use of PBL by many institutions around the world and the existence of some softwares especially developed to support it (Guzdial et al., 1997; Koch, 2001; Lautenbacher, 1997; Miao, 2000), there are no softwares developed for PBL that are able to support the development of authentic problems by the instructors and that can offer alternative features to help students solve these problems, mainly in the Computer Network domain. This gap can be filled by using case libraries, where students can seek information and which can also be used as a base for the development of new problems by the instructors (Kolodner et al., 1996). These characteristics have already been explored in approaches based on Case-Based Reasoning, such as Learning By Design (Kolodner et al., 2000) and Goal-Based Scenarios (Schank, 1992).

In this paper we present the description of the AAERO, a collaborative learning environment using PBL for learning in Computer Networks integrated to DUMBO, a CBR system specifically developed for Computer Network domain. The paper presents the following structure: Section 2 comments on PBL concepts and related ideas, section 3 shows the convergences between the PBL and CBR approaches while section 4 briefly describes the DUMBO System and section 5 describes the AAERO learning environment. The last section focuses on final considerations and research directions.

2. PROBLEM-BASED LEARNING

Problem-Based Learning is a case-centered and learner-directed method, which makes use of collaborative learning as a way to promote learning (Koschmann, Kelson, Feltovich & Barrows, 1996). This approach arose from the lack of motivation in medical students during their academic instruction in the preclinical years (Koschmann, Kelson, Feltovich & Barrows, 1996), and also from the questioning of professors and researchers of how traditional teaching approaches, so full of lectures, could actually teach medical students to solve problems, interrelate different knowledge, make decisions and work in teams (White, 1996). Influenced by the ideas of Dewey (Delisle, 1997, Koschman, 2002) through the Theory of Inquiry (Dewey, 1938/1991), which describes man's natural investigation process and its importance in the acquisition of knowledge, these researchers started to develop and use PBL. This approach, which has evolved to many areas including Computer Sciences (Nadjim-Tehrani, 1997; Koch & Teege, 1998; Greening et al., 1997) and in institutions all over the world, also contemplates the constructivist principles for learning environments (Savery and Duffy, 1995), enabling the construction of knowledge according to Piaget (1969) and the social interaction proposed by Vygotsky (1978) and his followers (Leontiev, 1978; Luria, 1977).

Learning in PBL happens in small groups through the collaborative resolution of domain problems, where they do not have any previous knowledge (Barrows, 1985, Rhem, 1998): they define hypotheses, look for new information and for a solution for the problem (Barrows, 1985, Delisle 1997). The instructor has a coaching role where he is no longer the provider of knowledge, but the tutor of the development of the groups. The students are not passive; they start being responsible for their own learning.

3. CASE-BASED REASONING AND PBL

The Case-Based Reasoning (CBR) approach (Riesbeck & Schank, 1989; Leake, 1996; Aamodt & Plaza, 1994) is used in Artificial Intelligence (AI) and it focuses on the resolution of problems by using past experiences (Kolodner & Guzdial, 2000). Despite its use in problem solving, the CBR can be used to promote learning and according to Kolodner et al. (1996), focuses on aspects that complement the PBL approach. Even though it is quite consolidated nowadays, the PBL approach does not offer indications of how real experiences can be used to propose new problems, or how to seek knowledge in our past experiences to solve the problems proposed (Kolodner et al., 1996). One of the main contributions of CBR for learning and for PBL is the use of case libraries as a feature that helps students in the problem solving process (Kolodner et al., 1996; Kolodner & Guzdial, 2000; Schank, 1992). CBR also supplies PBL with problem suggestions that have all the characteristics and complexity that represent the real world (Kolodner et al. 1996).

Aiming at the specific use of PBL for Computer Network Learning with CBR systems, the goal of the present project was the development of a collaborative distance learning environment prototype, based on the PBL approach and integrated to a CBR system. In order to promote such integration, this paper tries to profit from a project that has already been developed by the same research group at UFRGS, the DUMBO System.

3.1 DUMBO System

DUMBO (Discovering Solutions by Operating on an Occurrence Basis) is a problem management system developed by UFRGS that uses CBR to diagnose Computer Network problems (Melchior, 1999), adding

reasoning procedures to a Computer Networks Trouble Ticket System (TTS developed at UFRGS, called CINEMA TTS (Madruga, 1994).

Each case in the DUMBO system corresponds to a trouble ticket in CINEMA TTS. DUMBO cases were classified in different categories and subcategories that contain symptom properties and other information, creating a hierarchical tree of problem types. This information is modeled in a hierarchy of characteristics, which are part of the DUMBO case data and will be used in the reasoning process.

The reasoning process in the DUMBO system starts with the context definition module, which obtains the first information about the problem. Immediately afterwards and based on the information previously obtained, the search module brings a few similar cases that can be observed or refined through the answer for some specific characteristics. Then, the recovery process is re-started based on this new information, and may also recover other cases. This process is repeated until the user can solve his problem, based on information from the cases researched. In situations where the system is not capable of proposing useful cases, the learning module is executed and is included in the knowledge base when the problem is concluded.

4. THE AAERO SYSTEM

The AAERO (Learning Environment Problem Oriented in Computer Networks learning) system was designed as a Collaborative Distance Learning Environment that integrates the PBL and CBR approaches through distance learning to teach Computer Networks.

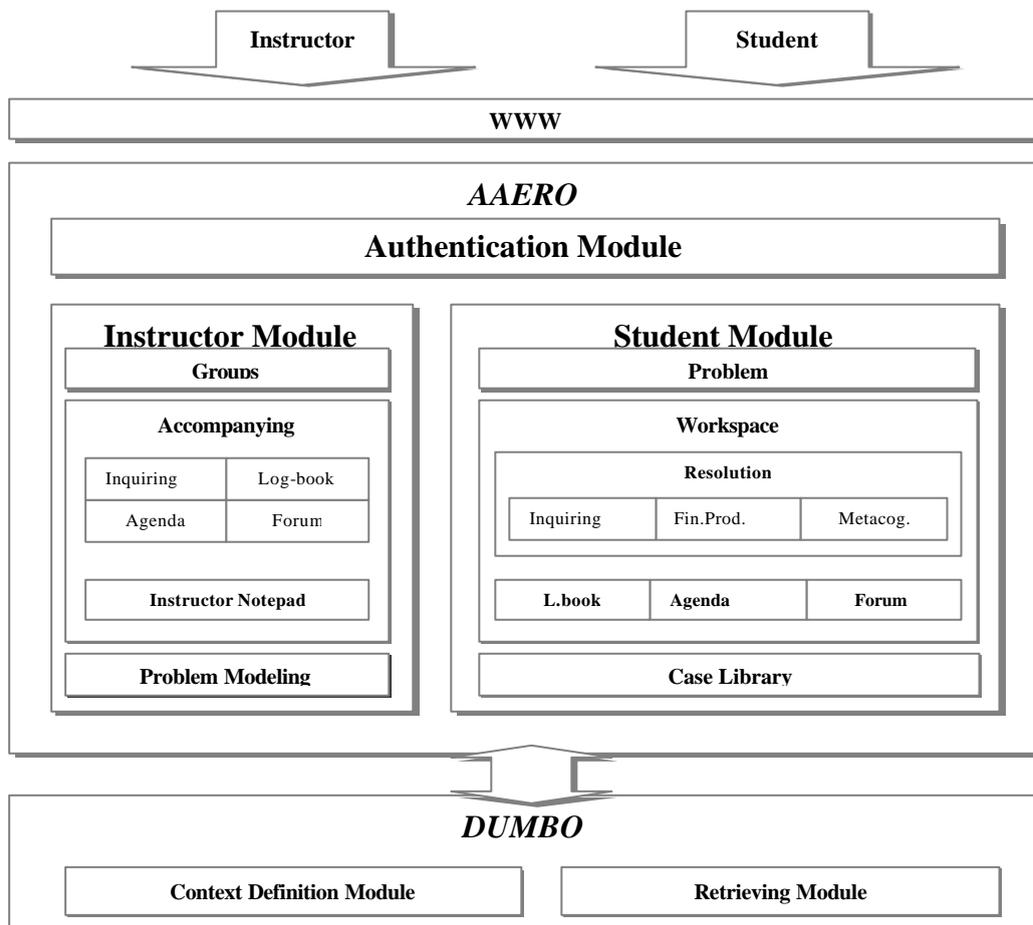


Figure 1. AAERO Architecture

The system has three modules: the Authentication Module, the Student Module and the Instructor Module. The WWW interface offers the system users the possibility of having geographically scattered students, apart from a more effective use of the Internet as a research tool. In this interface the user finds the main menu in the upper window, an auxiliary menu or a form in the lower right window, shown accordingly to the option selected in the main menu and a main window in the lower right window. In the so-called main window data or forms for environment interaction are shown. In some specific cases the main window is subdivided into two other windows where the upper part asks for more information for research and the lower part shows the data requested. In the student module, apart from the information already mentioned, the student has access to the instructor's Notepad, shown in a fixed window in the lower part of the window, through which the instructor can guide or question either the group as a whole or individual students.

4.1 Student Module

The objective of the student module is to offer the student the possibility of learning about Computer Networks through the PBL approach collaboratively and at distance. In this case the students are offered resources for problem visualization and to investigate and solve these problems in groups including access to the DUMBO case library.

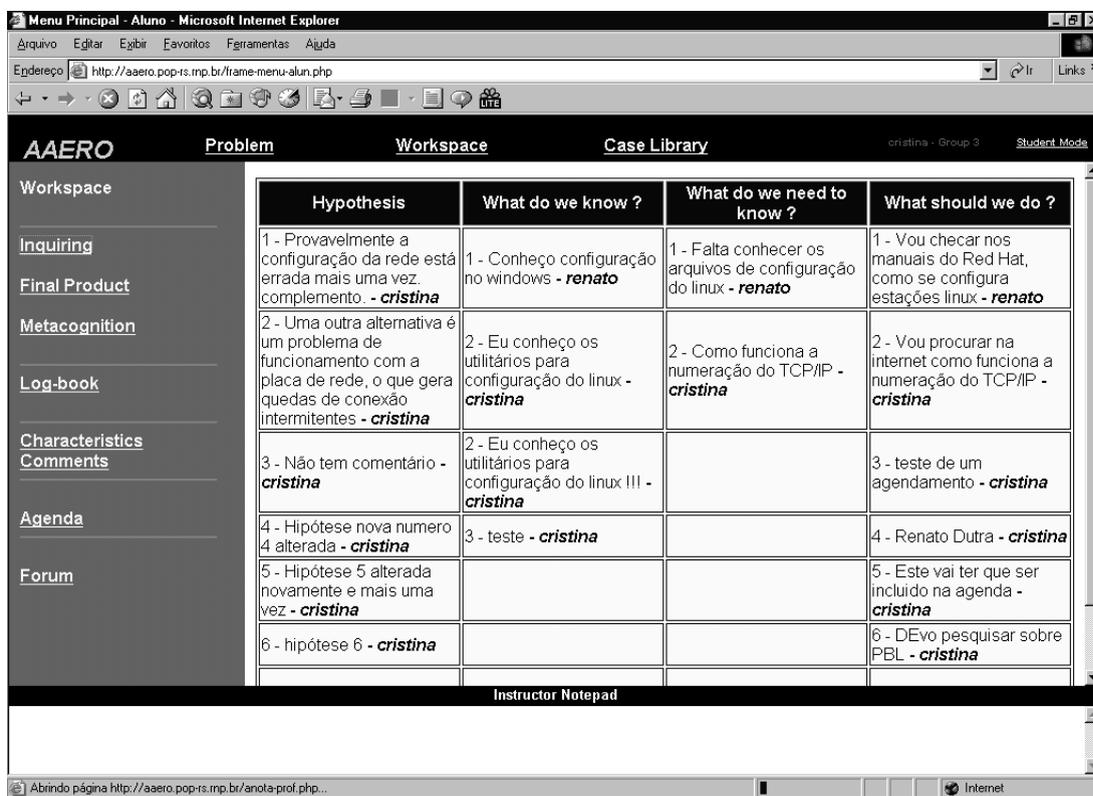


Figure 2. PBL Blackboard Screen

In the main menu, the student has access to the following options: "Problem", "Workspace" and "Case Library". In the "Problem" option, the students can access all information and characteristics of the problem that he is working on and, inspired by the CoMMIT software (Lautenbacher, 1997), the student can include specific comments for each characteristic. In the option "Workspace", the students find a tools menu that guides and organizes the learning activities according to PBL and they also find various features used in Computer-Supported Collaborative Learning (CSCL) environments. The PBL learning process is suggested through the items "Inquiring", "Final Product" and "Metacognition". The tools that aim at supporting collaborative learning also include the "Log-book", the "Agenda", the "Forum" and the "Characteristics Comments".

The item "Inquiring" organizes the steps of the inquiring process in the PBL Blackboard according to a derivation of the models proposed by Barrows (1985) and Stepien, Gallager, & Workman (1993), dividing the Blackboard into four columns: "Hypothesis", "What do we know?", "What do we need to know?" and "What should we do?". The "Hypothesis" column allows for the collaborative construction of some hypotheses where everybody can alter or complement the text, according to the software model Equitext (Rizzi, 2000). The students will always see their last hypothesis version in this column. The instructor, however, will have access to all recorded versions of the hypothesis. The columns "What do we know?" and "What do we need to know?" are not collaborative and, inspired by the software WebSmile (Guzdial et al., 1997), offer the students the possibility of creating a discussion in the "Forum" tool, which was integrated to the environment. The column "What should we do?" is the last one to be filled in by the students and it is also useful to distribute tasks among them, which are automatically included in their agendas. The student can also consult a specific case by typing the case number in the field "Case" and then look at it in the main window. After looking at the case, the student can consult similar ones through the item "Retrieve Similar Cases", located right under the case information in the main window. The search for similar cases can also be made directly from the left window by typing a case number in the field "Retrieve Similar Cases" to look at them in the main window. From there, the student can refine the search for similar cases as it is done within DUMBO.

4.1.1 Working through the problem

To start the collaborative and problem solving process the student must first choose which one of the problems he is going to work with, from a list shown right after the login. After that, the first step is to look at the problem information, which can be done through the option "Problem" in the main menu. The student will have access to all information regarding the problem (description, objective and references) [besides being able to] and can also consult information of each characteristic by selecting one from the list shown in the left window. At this stage, the student can also add comments and impressions about that particular characteristic that can be shared with other members of the group. By looking at the problem, the student can start the problem solving process, following the steps suggested by PBL through the "PBL Blackboard", which must be filled in column by column. This process is aided by the integration of the "PBL Blackboard" with a discussion Forum and an "Agenda" that are all available in the "Workspace". In addition the students have a "Log-book" which helps them with organization and where they can write down or share their learning evolution.

During the problem solving process, in order to help with the discussion of ideas, the students can access case libraries to seek help on how to solve the problem (Kolodner, 1996). This can be done through the option "Case Library", simulating a new case in the DUMBO System or looking at cases that have already been solved. In the simulation item in the left window the AAERO activates the DUMBO system using a mirror database, which is synchronized with the original DUMBO database. The student then has access to the DUMBO menu page, where he can add a new case, enter initial data of the assumed problem and answer a few specific questions so that DUMBO can search for similar cases in its library. The students may keep up with the context definition process, verifying similar cases and refining their research, exactly as it usually happens in DUMBO. This process may be interrupted and restated by direct access to the DUMBO problem Record through the record number.

4.2 Instructor Module

The objective of the instructor module is to offer resources so that he can develop new problems based on DUMBO cases and also accompany the students through their problem solving and learning process. The instructor's module therefore contains three options in its main menu: "Groups", "Accompanying" and "Problem Modeling".

In the "Groups" option, the instructor can create, alter and include members in a group. Groups and students are accompanied through the option "Accompanying". In this option, the instructor can verify how the groups are working by checking the students' records added in the Workspace items and he may also interact with the students through the forum or the Instructor Notepad, a feature that enables the instructor to register comments or questions for the students. The students in a fixed lower window will automatically see these. The Problems are modeled and created by researching and by picking a DUMBO case, through a

problem type or a keyword, which will be pasted onto the AAERO system, where the instructor will be able to alter and complement it. The instructor may exclude, alter or create characteristics from this copy, so that the case is transformed into a useful problem for the PBL approach.

4.3 Developing a problem and creating groups

The first step when applying PBL in class with the use of AAERO is to mold the problem. In order to do so, the instructor must use the option "Problem Modeling", immediately after the login which will show a form for direct DUMBO case research in the main window. Then the instructor may research through problem type (DUMBO divides the cases into eight main kinds) or through a keyword. This research will end up on a list of closed cases from which the instructor can choose which one will be the base for his/her problem. This case and all its characteristics will be pasted onto the AAERO Database and the instructor must then fill in the objectives of the problem learning, initial reference sources (URLs) and he must also attach an image that illustrates this problem. The instructor can also include new characteristics, alter the labels and the value of the existing characteristics and inform specific reference sources (URLs) for a particular characteristic. At the end of the process, the instructor must inform what will be shown as the statement of the Final Product (regular text) and what is the minimum amount of characters for it. When the process is over and the problem is recorded, the instructor will be able to add questions by editing the problem that will induce reasoning and stimulate metacognition.

Having reported all the problem data, the instructor can start putting the groups together to solve the problem. This process is done through the option "Groups" in the main menu. When selected, the option will show in the left window a list of all groups created and an option for the creation of a new group. The instructor will choose this option to create a new group and will inform the name of the group, the problem (through the list of problems created by the instructor), the subject of the course, the institution and the period within which the problem must be solved.

5. CONCLUSIONS AND FUTURE DIRECTIONS

This project demonstrated that the ideas of Kolodner et al. (1996) on the use of PBL with CBR could be perfectly applied when teaching Computer Networks. The use of these approaches allows for the training of professionals that are lifelong learners and who are able to work in teams. The development of this prototype also contributed to the evolution of the CINEMA TTS, developed by Madruga (1994) and DUMBO, developed by Melchior (1999).

At this time, the prototype is totally operational and it offers the necessary features for PBL application, organizing the learning process according to PBL and supporting collaborative learning. In future research we will analyze the ergonomics of the system, trying to identify improvements that can help the environment's practicality and navigation. We will also try to incorporate tools for synchronous collaboration. Interaction with the problem is another important topic for Constructivist Learning Environments (Jonassen & Murphy, 1999) and the use of Virtual Reality (VR) is suggested to simulate and interact with the problem. This can be achieved by converging this project with other VR projects currently ongoing at UFRGS. Another important characteristic discussed is the use of the AAERO system to other domains and the possibility of integrating AAERO with LDAP Servers database, allowing for better user control and integration.

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E-LEARNING OF RADIO COMMUNICATIONS

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ABSTRACT

Code Tutor is a Web-based intelligent tutoring system that facilitates learning of radio communications to the students of a telecommunications college. There exist a number of other Web-based intelligent tutoring systems, but their descriptions in the open literature seldom expose important architectural and design details for the sake of showing interesting aspects of cognitive modeling, discussing the systems' usability, and analyzing their learning effects. The paper presents explicitly Code Tutor's architecture, design, and implementation, as well as some details of both students' and teachers' sessions with the system. Code Tutor was built using modern intelligent and Web-related technologies, such as ontologies, Java-based expert system tools, Java servlets, Apache HTTP Server and JServ package, and XML. The system is actively used in practice, and experience shows that students are happy using it as a support for learning different topics in the domain of radio communications. The system is simple to use and update, and exhibits intelligence in organizing and presenting the learning material, assessing the students' knowledge, and giving them recommendations on further learning steps.

KEYWORDS

Web-based learning, intelligent tutoring systems, expert systems, Web-related technologies, ontology.

1. INTRODUCTION

Code Tutor is a small Web-based intelligent tutoring system (ITS) designed for fast students' briefing in the area of radio-communication. The learners are telecommunications college students. After they complete a course in radio-communication theory, they are supposed to exercise using expensive radio-station equipment. It is the teachers' responsibility to ensure that the equipment is always in a good condition and that it is used appropriately. There is little time for checking each student's capabilities for independent practical work when the course is over and before the exercises begin. Code Tutor is used instead.

The first version of Code Tutor has been actively used in the classroom since mid-2001. The teachers' opinion is that it is very useful, and the students favor this kind of learning. However, the first version has some limitations. Its expert module is implemented as a rule-based expert system (ES) using an ES shell that was too old, without support for network-based applications. Also, due to these weaknesses of the shell the entire system is limited to "closed-world" standalone applications, without connections and data interchange with the environment.

These facts have motivated us to build a new version, in which students communicate with the system through a standard Web browser. The entire system is implemented in Java, using many different current technologies: CLIPS tool (<http://www.ghg.net/clips/CLIPS.HTML>) was used for building ES knowledge base files (Code Tutor's domain knowledge), Java-based ES shell Jess was used to interpret these files (<http://herzberg.ca.sandia.gov/jess/>), JavaTM Servlet technology (<http://www.sun.com/products/servlet/>) was

used to implement the system's interactions with the students, Apache HTTP server (<http://www.apache.org/>) was used to store static HTML pages, Apache JServ (<http://java.apache.org/dist/>) was used to interpret the servlets, and XML technology (<http://www.w3.org/TR/2001/REC-XMLschema-1-20010502/>) was used to generate files that Code Tutor uses to provide recommendations to the students.

The paper first briefly overviews related work of other authors relevant for the design and development of the new version, providing the context within which Code Tutor is best understood. It continues by specifying the system's functionalities and shows its architecture. Then it discusses Code Tutor's design and implementation details thoroughly.

2. RELATED WORK

In designing the new version of Code Tutor as a Web-based ITS, our situation was much like the one in which authors of other ITS have been already: we needed to convert a standalone ITS to one that operates on the World Wide Web. There were a number of architectural paths from which we might have chosen. Hence we first studied the scope of Web-based ITS architectures. Extensive discussion on categorization of such architectures by Alpert et al. [Alpert et al., 1999], and Mitrovic and Hausler [Mitrovic and Hausler, 2000] was our starting point. They have found out that architectures of many Web-based ITS are either *centralized* (the application server performs all tutoring functions), or *replicated* (the entire tutor resides in a Java applet that needs to be downloaded and is executed on the student's machine), or *distributed* (tutoring functions are distributed between the client and the server). Each category has some advantages and some disadvantages, described elsewhere as well. For example, Johnson et al. discuss feasibility of client-side tutoring deployed in their pedagogical agent called Adele [Johnson et al., 1998].

We also studied architectures of a number of specific Web-based ITS, in order to find out about their characteristics and to relate them to our idea of Code Tutor as a Web-based ITS. The systems whose architectures we found most inspirational in designing Code Tutor include ActiveMath [Melis et al., 2001], VALIENT [Hall and Gordon, 1998], and ILESA [López et al., 1998].

3. CODE TUTOR'S OPERATION AND ARCHITECTURE

Code Tutor is a client-server learning environment designed as a Web classroom, Figure 1. Students and teachers work in a real or in a virtual classroom; in both cases, students learn individually and Web technology connects the server and the client sides.

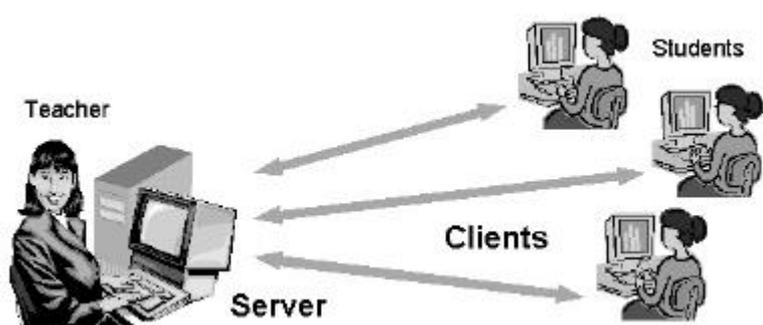


Figure 1. A Web classroom.

3.1 Working with Code Tutor

There are four modes of a student's interaction with Code Tutor: "Authentication" (logging in for a new session), "Learning" (selecting one of the chapters to learn from and reading the corresponding illustrated

lessons; some of the lesson pages are filled with text and graphics, and some of them also have audio clips of radio-emissions and/or spectral-analysis diagrams of radio signals), "Assessment" (answering multiple-choice questions the system asks after the learning of a lesson is completed, Figure 2), and "Validation" (the mode in which Code Tutor checks and updates the student model by estimating the user's knowledge about analyzing and receiving different types of radio-emissions).

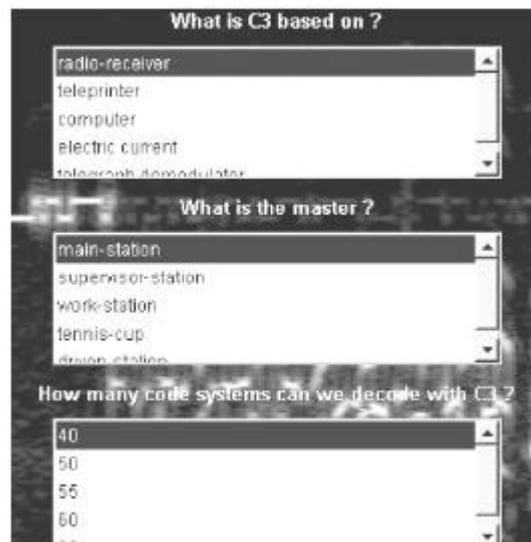


Figure 2. Answering Code Tutor's questions.

Each chapter is composed of several lessons. Currently, lesson is the elementary learning unit (i.e., lessons are not further divided in sections, because we wanted to keep Code Tutor's design simple). The lessons are short, distilled and composed of 3-5 pages.

In "Validation" mode, Code Tutor marks each answer given by the student and calculates the student's final score. If the user has at least one negative mark, the system returns him to the beginning of the relevant lesson. There are two options for a student who completes a lesson successfully. The first one is to choose another lesson, and the process is the same as described in the previous paragraphs. Code Tutor helps the student by recommending him what to learn next (see section 5). The second one is to repeat the same lesson and try to get a better score. In this case, the new score overwrites the previous one.

The teacher is on the server side. His tasks include authentication, starting the server, monitoring the students' sessions, editing the knowledge base and stopping the server. Some of the tasks are very different from those on the student side - for example, editing the knowledge base (see section 4), which is allowed only to the teacher. In this mode, the teacher adds, edits or deletes lessons. As the major effect of this operation, Code Tutor generates a script which updates its CLIPS knowledge base file (*.clp).

A specific server-side module, also accessible only by the teacher, is used for monitoring the students' sessions. It tracks the activities of each student logged onto the system and regularly updates a specific log file for each student. Each time the student logs onto the system, after the validation of his knowledge, and when he logs off the system, Code Tutor serializes all of his personal data, marks, scores, and other data relevant for the history of his learning activities into that flat-text log file (XML file). Also, each time the student completes some tests the results are added to this file. It is interpreted and displayed only by the teacher-side application. The teacher has "read only" authorities over the data in the log file and can see them in a specific form (window).

3.2 Code Tutor's architecture

The system architecture can be represented as in Figure 3. The following sections further describe some of its details. We opted for a centralized architecture, since Code Tutor had to support the idea of a Web classroom, with a centralized repository of student models and simultaneously support multiple students.

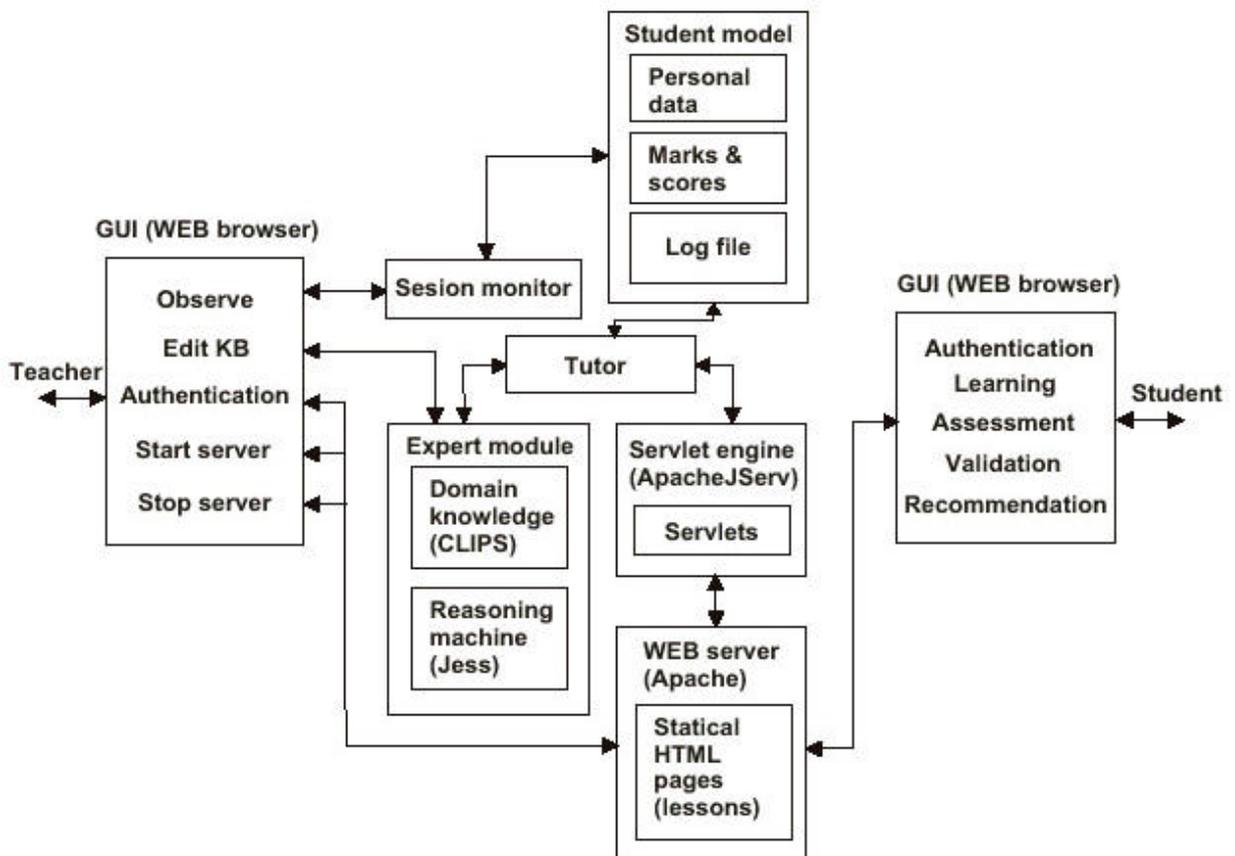


Figure 3. Code Tutor's overall architecture.

4. DESIGN AND IMPLEMENTATION

Code Tutor is essentially a rule-based system. Its expert module contains the knowledge base implemented in CLIPS and the Jess inference engine, run by the Tutor module, that interprets the knowledge base. The Tutor module also coordinates the student model updates.

4.1 Expert module

Code Tutor's knowledge is contained in *rules*, *chapters*, *lessons*, *sets of questions and answers (quandas or qandas)*, and *globals (global variables)*. The knowledge structure is represented by the ontology shown in Figure 4 (shown incomplete, for the sake of simplicity). The main class in the ontology is *KnowledgeBase*. It contains the other concepts of the Code Tutor's knowledge ontology. The instances of the *Chapter* class are related to the chapters the students can learn. *Lessons* are parts of a chapter. Each lesson has one or more associated *QuandaSets*. Each *QuandaSet* implements a multiple-choice question and includes the question string and a collection of *Answer* objects. An *Answer* object contains the answer string and the appropriate mark.

Global variables are used to store the addresses of the parts of the domain knowledge (*Chapter* instances) that the students learn. Another role of a global variable is to store the number of lessons in a chapter. *Global* is a class with only put and get methods, like a Java Bean. If the teacher adds a new *Lesson*, the corresponding global variable (which stores the number of *Lessons*) is incremented, and vice versa. If the teacher only edits an existing *Lesson*, this global variable doesn't change.

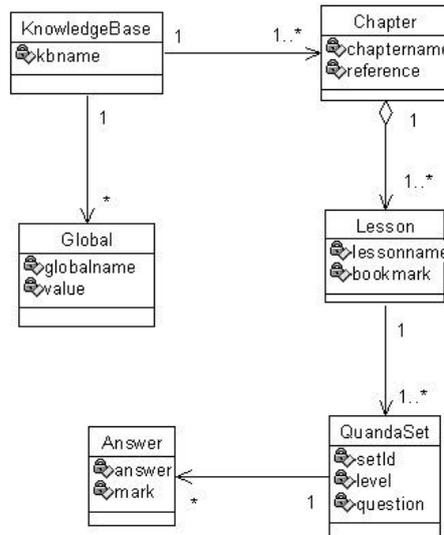


Figure 4. The ontology of Code Tutor's knowledge.

It follows from Figure 4 that Code Tutor's knowledge of radio communications is essentially represented in quandas, distributed by lessons and chapters. However, the Jess inference engine interprets *rules*, not quandas. The rules are automatically generated from quandas and are put in the *.clp file that Jess interprets. When the teacher creates or modifies the learning material, he either edits the contents of the lesson or he adds/removes/edits questions and answers as in Figure 5. The changes in quandas are reflected in the corresponding rules in the knowledge base automatically. This approach is teacher-friendly and requires no knowledge of programming or CLIPS scripting language.

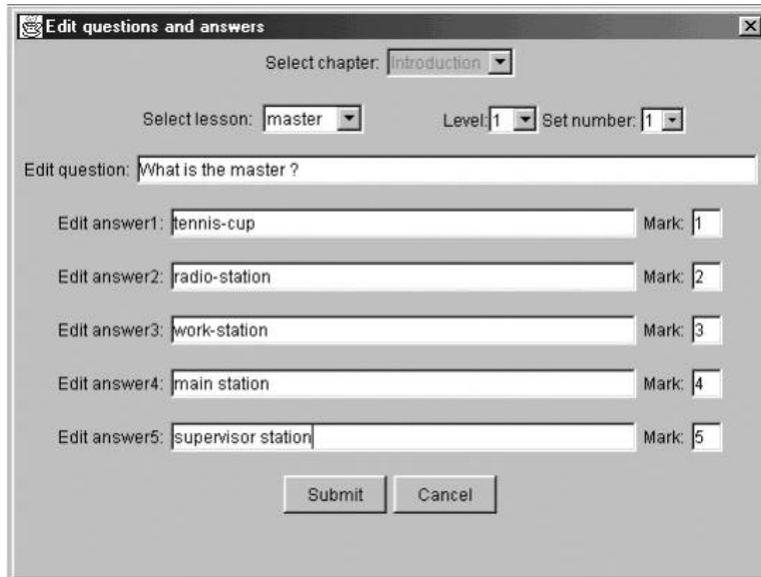


Figure 5. Edit-lesson dialog.

At the implementation level, Code Tutor's knowledge base is a collection of KB script files, one for each chapter. An example of a KB script file is shown in Figure 6 (CLIPS syntax). It contains instances of the concepts specified in the ontology and the rules generated automatically from quandas. The global variables are on top (grey). The chapters and lessons are below (white). Everything under the chapters is the rules (bottom grey area).

```

(defglobal ?*i* = 3)

(deftemplate Setup
  (slot setnum (type INTEGER))
  (slot level (type INTEGER) (default 1)))
(deftemplate Introduction
  (slot basics (type STRING))
  (slot master (type STRING))
  (slot numdec (type STRING))
  (slot obasics (type INTEGER))
  (slot omaster (type INTEGER))
  (slot onumdec (type INTEGER))
  (slot omarkintro (type FLOAT)))

(defrule start
=>
(bind ?*a* (assert (Setup(setnum(fetch SETNUM))(level(fetch LEVEL))))))
(set-reset-globals nil)
)

(defrule queriesandanswers1
?fact1 <- (Setup(setnum ?s)(level ?q))
(test (eq ?s 1))
(test (eq ?q 1))
=>
(store LESSONCOUNT ?*i*)
(store LESSON1 "basics")
(store QANDAL "What is C3 based on?/radio-receiver/teleprinter/computer/electric
current/FSK demodulator")
...
(defrule receiveanswer
=>
(bind ?*u* (assert (Introduction(basics (fetch ANSWER1))(master(fetch
ANSWER2))(numdec(fetch ANSWER3))))))
(set-reset-globals nil)
)

(defrule validate_basics51
?fact11 <- (Introduction(basics "computer")(obasics nil))
?fact12 <- (Setup(setnum ?s)(level ?q))
(test (eq ?s 1))
(test (eq ?q 1))
=>
(modify ?fact11(obasics 5))
(bind ?*u* ?fact11)
(set-reset-globals nil)
)
(defrule validate_basics41
?fact11 <- (Introduction(basics "FSK demodulator")(obasics nil))
?fact12 <- (Setup(setnum ?s)(level ?q))
(test (eq ?s 1))
(test (eq ?q 1))
=>
(modify ?fact11(obasics 4))
(bind ?*u* ?fact11)
(set-reset-globals nil)
)
...
(defrule validate
?fact1 <- (Introduction(obasics ?x)(omaster ?y)(onumdec ?z)(omarkintro ?f))
(test (neq ?x nil))
(test (neq ?y nil))
(test (neq ?z nil))
=>
(bind ?f(round(/ (+ ?x ?y ?z) ?*i*)))

(bind ?*u* ?fact1)
(set-reset-globals nil)
(store NUMMARKS (+ 1 ?*i*))
(store O1 ?x)
(store O2 ?y)
(store O3 ?z)
(store O4 ?f)
)

```

Figure 6. The structure of a KB script file.

4.2 Student model

Whenever the student (user) starts a new session, Code Tutor checks the student's authorities and creates a new object of the dedicated *User* class that contains the student's data. These are filled from the specific log

file that the system maintains for each student in each of his sessions (see Figure 3), and are later updated throughout the session. The *User* object aggregates the student's personal data, the selected lesson, the marks from the tests and the final score, Figure 7.



Figure 7. Important parts of the student model.

Currently, domain knowledge in Code Tutor is structured in two levels: the basic and the advanced level. A novice student has to learn the basic concepts of the radio-telecommunications first. If he passes the basic lesson test without negative marks, he can study the corresponding advanced-level lesson. The *level* field in the *Score* class reflects the level of the selected lesson. The *setid* field refers to the set of Code Tutor's test questions that the student has to answer during assessment (see the next section).

4.3 Tutor

Upon authentication, the student's session is controlled by the Tutor module. In the "Learning" mode, Tutor lets the student learn the chapters and lessons that he's ready to learn. Tutor estimates the student's readiness to learn a certain material from the student model. The system's interaction with the student in the "Assessment" mode is designed and implemented in rules, and is reflected in the KB script files. For this purpose, Code Tutor has five types of rules:

- the start rule (initiates the operation of the reasoning machine);
- the queries-and-answers rule (displays questions to the student);
- the receive-answer rule (collects the student's input when he is answering questions);
- the working rules (evaluate the student's answers); and
- the goal rule (calculates the student's final score).

Experience with Code Tutor has shown the students' tendency to remember the questions and wrong answers in order to pass the test in the next step. With this inadequate motivation (not to learn, but to get the positive mark), the student quickly completes reading the lesson that Tutor has returned him to, and immediately starts the test. He is certain that he will succeed this time. Hence one set of questions per lesson is not enough, and we have developed a number of question sets per lesson. This means that the student who gets at least one negative mark will be asked a new set of questions when repeating the same lesson. This forces the student to read and learn the lesson with attention.

The role of Tutor module is very important for students' motivation. Tutor's goal is to help the students understand the domain and acquire the knowledge they need. If the teacher is too rigorous, and he does not understand the students' needs, the motivation drops. Code Tutor solves this problem by repeating the test, and by giving recommendations to the student. Browsing freely through the lesson pages reassures the student that he can succeed. Also the multilevel learning gives the student a gradual learning satisfaction.

5. CONCLUSIONS

The present version of Code Tutor is developed using the latest technology. The major advantage of the new version of Code Tutor over the first one is its design flexibility. Big technological changes would not mean big changes in Code Tutor. The changes would only affect parts of the system. The object-oriented design contributes to the system extensibility.

One of the first steps in further development of Code Tutor is to make it capable of learning by itself. This means that the teacher should be able to easily mark up the lessons (to mark up the keywords and give the names to the chapters) and put them in the knowledge base (to put the lesson file(s) in a selected directory and insert the file reference into the system accordingly). After that, the system should be able to interlink the

teacher's input and generate the appropriate XML file(s). Also, the system should generate lesson templates and the appropriate forms based on the keywords. The marked-up facts in the lesson can be used to generate the rules. We discuss these ideas further in [Devedžic, 2002] and [Devedžic, 2003].

It should be stressed that, in order to use Code Tutor that way, the teacher should understand the domain and the basic principles of lesson marking, but is not required to understand details of the system design.

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PROVIDING ADVANCED TELECOMMUNICATION SERVICES IN RURAL AND PERIPHERAL AREAS: METHODOLOGICAL FRAMEWORK AND CASE STUDIES FOR PORTUGAL

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ABSTRACT

This paper discusses a methodological framework for techno-economic evaluation of providing advanced telecommunication services in rural and peripheral areas.

In the initial part of this paper all the necessary steps to produce a techno-economic evaluation of advanced telecommunication services are identified considering both demand and supply aspects. The application of the above methodology is applied afterwards to four rural areas in Portugal. Economic outputs concerning telecommunication project investments are presented, for several access and distribution technologies: ADSL (Asymmetric Digital Subscriber Line), VDSL (Very high speed Digital Subscriber Line) and LMDS (Local Multipoint Distribution Systems); these results are achieved with the support of a custom-designed techno-economic tool.

The results show that in some of the regions under consideration – Alentejo, Douro, Bairrada and Minho – market forces by themselves are not enough to the uptake of the advanced telecommunication services. For these to have a positive impact on the customer, some stimulation mechanism (in our study tariff subsidisation) is required, in order to counterbalance the low willingness to pay of these rural and peripheral clients.

KEYWORDS

Techno-economics, broadband, Information Society, subsidisation, rural areas, digital divide.

1. INTRODUCTION

Information and communication technologies have virtually penetrated all sectors of economic activity and are present in people and organizations daily life. The access and use of information is becoming more and more important, and it is now a decisive factor for personal fulfilment and institutional efficiency. In this sense, it is crucial to create the indispensable conditions to allow the access to this Information Society, even (or better, specially) in peripheral areas. In the point of view of the telecommunications operator, or of the regulatory entity, an essential aspect for the creation of these conditions is the correct evaluation of the costs and benefits associated with the different technologies that are possible to use for the offering of these services in these peripheral areas.

This document begins by the development of a methodological framework for the techno-economic evaluation of telecommunication services, as a function of the rural regions topology. This methodology has been initially developed on IST 2000-25172 TONIC project TechnO-ecoNomICs of IP optimised networks and services [1] and it was adapted for the specific conditions of Portuguese reality.

The most significant steps of the considered approach are the following:

1. Demographic and geographic characterisation of the areas under study. In this context, a special effort was done in the elaboration of geometric models that accommodate the territorial diversity of Portuguese regions in a flexible way.

3. CHARACTERISATION OF THE REGIONS UNDER STUDY

In this study four regions are considered, and these are representative of the socio-territorial patterns found on the Portuguese territory, namely Alentejo, Douro, Bairrada and Minho (Figure 2).

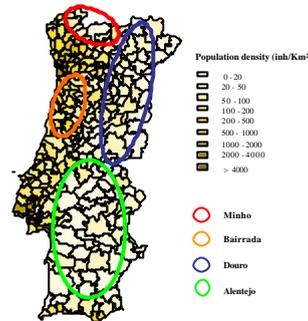


Figure 2. Regions under study

Table 1 presents the geographic and demographic characterisation of each of these zones, both globally and in terms of urbane agglomerates. As it is possible to see, these regions have very dissimilar characteristics, with population density ratios very different. These differences are the reason for having a separate definition for each region. NB: In Minho, since the population is distributed uniformly, the cluster area is defined by the access technology coverage and the distance between these nodes is zero.

Table 1. Geographical Indicators for Portuguese Rural Areas

Total Area	Alentejo	Douro	Bairrada	Minho
Population size	470000	670000	630000	670000
Area (km ²)	27000	22000	5500	4200
Population density (inh/km ²)	18	30	114	160
Clusters (average values)				
Area (km ²)	0.35	0.4	0.9	
Population density (inh/km ²)	7200	1820	2840	
Households density (hou/km ²)	3750	1240	1050	125
Distance between nodes (km)	10.5	4.4	2.7	0

3.1 Geographic Modelling

In order to represent the disposition of the communication infrastructures in the considered regions it is possible to use an abstract geometric model [3]. This model can be described in the following way:

- Each region is considered as an overlapping of a group of cities and small towns over the rest of the territory.
- The remaining area is represented, statistically, by a sample of nine residential nodes.
- Inside each sample, one of the nodes (possibly the central one) has the role of Local Access Point (LAP), to which all the other nodes are connected. This is depicted with the bold line (see Figure 3). The node that lodges the LAP is connected to the nearest Broadband Access Point (BAP). Different physical mediums can be used to support this BAP-LAP connection (fibre optics, radio links, etc.).

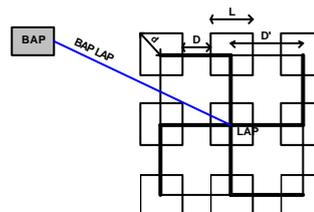


Figure 3. Geometric Model

The key attributes to a representative sample of a certain region are:

- The household density inside the residential nodes or, as an alternative, the number of households per node;
- The distance between the nodes boundaries – D – or, alternatively, the distance between the centre of the nodes – D’;
- The BAP_LAP length;
- The size of the nodes: the side (L) or half diagonal length – d’.

Table 2 shows the most important characteristics of the model for each of the four rural areas.

Table 2. Region Characterisation Parameters

		Rural Areas				Comments
		Alentejo	Douro	Bairrada	Minho	
Parameters	Household Density per Node	3750	1240	1050	125	In Households per Km ²
	Distance Between Nodes (D)	10.50	4.40	3.00	0	In Km
	Node Area (L ²)	0,35	0,40	0,90	64	In Km ²
	Number of Households in node	1313	496	945	8000	
	Bap_Lap Cable Length	40	15	10	10	In Km
	Half Diagonal Length (d')	0,30	0,32	0,47	5,66	In Km

Associating the typical network equipment and installation costs with this model makes it possible to estimate the total cost associated with a given technology.

4. NETWORK SOLUTIONS

The network technologies considered in this study for Portuguese rural areas are ADSL (Asymmetric Digital Subscriber Line), VDSL (Very high speed Digital Subscriber Line) and LMDS (Local Multipoint Distribution Systems), due to technological and market interest. To each of these technologies, the model explained in the previous section will be applied, making estimates to the cost of each part of the network. This way the total cost of implementation will be obtained to each one of the network solutions.

4.1 ADSL

ADSL [4] technology uses the already installed copper from telephony incumbent operators in the access network, in a new way that permits the support of high bit rates in the access to the data networks. ADSL can transfer data at high bit rates using an advanced digital modulation over the copper lines. This technology has the advantages of not needing a big restructuring in the infrastructure already in existence, and being easy to implement. Data signals are simply added to PSTN (Public Switched Telephone Network) or ISDN (Integrated Services Digital Network) using passive splitters in the client and in the local exchange. An ADSL system consists of four basic components:

- a DSLAM (Digital Subscriber Line Access Multiplexer), with ADSL and networks interface boards;
- a splitter in the local exchange;
- a splitter in the client premises;
- Client ADSL modems. ADSL modems are available with the 10BaseT Ethernet and/or 25.6 Mbps ATM interface.

ADSL can be implemented rather quickly and huge initial investments are not necessary to be made in the infrastructure. But ADSL has some limitations: maximum downstream bit rate is (theoretically) 8Mbit/s, but in practice is limited to 4-5Mbit/s with copper lengths up to 2Km and 2Mbit/s with lengths up to 3Km. This means that we cannot have a high quality TV channel and a fast Internet connection simultaneously. The usually offered service is the fast Internet access.

4.2 VDSL

VDSL [4] technology allows symmetric and asymmetric transmissions, being considered an evolution of ADSL technology on the consolidation and extension of the generalised broadband market. The major

difference to ADSL is that VDSL can offer higher bit rates but over shorter copper lengths. This restriction requires the installation of new local exchanges near the customer premises, in order to diminish the communication line lengths to the customer. These new local exchanges need an optical fibre feeder. In some of the peripheral zones under study, some areas are so small that VDSL may become a possible solution, without being necessary to add these intermediate local exchanges.

It is important to extol that the VDSL normalisation process is not yet finished. For this reason the availability of commercial systems is still limited [5].

4.3 LMDS

LMDS [4] is an asymmetric access technology via radio, commonly seen as a technology for new operators. With this technology new operators are granted to compete with the technologies usually offered by incumbent operators, such as xDSL and cable. LMDS is an interactive emerging technology of access via point-to-multipoint (asymmetric) radio links, implemented as a cellular system, able to offer services both for residential (TV, Internet access, POTS) and for business customers (leased lines, Internet access). Although using radio, LMDS is a fixed access technology, so terminal mobility is not included. The range of this type of systems is typically 2-5Km and the line of sight conditions must be established so that an acceptable system operation is achieved. In some cases a star or tree topology may be implemented using radio repeaters. Transmission rates of about 1-10Mbps for uplink and 10-50Mbps for downlink are typical values achieved by this system.

LMDS systems operate on both 26/28GHz and 40/42GHz radio frequencies. The lower range of spectrum is usually used in business solutions, replacing leased lines. The higher range is for residential customers, including TV. Many countries have defined licences for LMDS radio frequencies, but it has been very hard to allocate frequencies worldwide.

Nowadays there are many manufacturers with LMDS commercial products that are betting on the business market, but LMDS has also the potential to become a broadband access technology for the residential market, although at the present moment the cost of the equipment is still very high for this purpose.

5. TECHNO-ECONOMIC EVALUATION

Based on the data presented before, a techno-economic evaluation was performed for the quoted technologies, resorting to the geometric model of section 3. This evaluation involved some assumptions about the type of services, attending the Portuguese reality, in order to obtain an estimation of the economic indicators for each region. Please note that, in this section, to be synthetic, only the necessary tables and graphics to understand the obtained results will be shown, and not the complete set in which the conclusions are based.

5.1 Assumptions

- The duration of the project is 8 years (2002-2009);
- The Tax Rate and the Discount Rate are assumed to be 0% and 10%, respectively;
- Annual and connection tariffs have an erosion of 10% and 5%, respectively.
- Penetration rate varies from 2,5% in the first year to 30% in the last year.

5.1 Tariffs/Subsidisation

To offer these broadband telecommunication services in Southern European countries (such as Portugal), it is necessary to be very thoughtful, because these rural areas are usually very poor, and the population income might not allow them to pay for these advanced services.

This way, there is the need to calculate the amount of money a rural customer is willing to pay. This value will be called DIT (Disposable Income for Telecommunications).

Assuming that the average of the purchase power index is 100 for the Portuguese level, it is assumed 50.98, 40.23, 56.95 and 55.34 for Alentejo, Douro, Bairrada and Minho, respectively. The reckoned DIT for the national level is 720€, 900€ and 1100€ per year, for ADSL, VDSL and LMDS, respectively. Multiplying this value by the purchase power index of each area returns the result values presented in Table 3

Table 3. DIT on the different areas and different technologies

	Alentejo	Douro	Bairrada	Minho
Annual DIT for ADSL (€)	367	289	410	398
Annual DIT for VDSL (€)	489	386	546	498
Annual DIT for LMDS (€)	560	442	626	608

5.1.1 Service Classes, Tariffs and Penetration Rates

For the regions under study it is assumed that a small part of the possible clients are Business Customers. These need higher bit rates, so their tariffs will be higher (1920€, 2560€ and 2933€ for ADSL, VDSL and LMDS, respectively).

The residential class has a penetration rate varying between 2,5% in the first year and 27% in the last year of study; and the business class varies between 0,25% and 3%. The sum of the penetration rates (for both residential and business) equals 3% to 30%, as it was assumed in the preceding section.

With the objective of attracting economically the telecommunication operators, an IRR of 15% is guaranteed in all the analysed areas.

However, to reach this condition, a mechanism of subsidisation is necessary. The annual tariff for each of the residential services will have to be equal in all areas (it is necessary to have a National Tariff for residential customers). This tariff is assumed as being the Douro DIT (289€, 386€ and 442€ for ADSL, VDSL and LMDS, respectively), corresponding to the zone where this value is the lowest.

The subsidisation mechanism is defined as the difference between the tariff an household agglomerate is willing to pay and the tariffs an operator needs to receive (in order to achieve an IRR equal to 15%), plus the ISP (Internet Service Provider) tariff:

$$SUBS = OperatorTariff + ISPTariff - DIT$$

Table 4 presents the initial necessary subsidy, as a function of the region, for each of the different technologies. The tariff values for the operator and ISP were obtained with the application of the geometric model presented in section 3.

Table 4. Initial subsidy for the different areas

	DIT	Alentejo			Douro			Bairrada			Minho		
		Oper	ISP	Subs	Oper	ISP	Subs	Oper	ISP	Subs	Oper	ISP	Subs
ADSL	289	275	148	134	328	176	215	187	102	0	187	102	152
VDSL	386	415	223	252	545	293	452	250	136	0	350	188	0
LMDS	442	630	339	527	960	516	1034	510	274	342	287	155	0

Some conclusions can be drawn from this previous table:

- In Alentejo and Douro regions some subsidisation mechanisms are necessary for each of the technologies under study. In this case the operator will achieve an IRR equal to 15%.
- The previous point is also applied for LMDS in Bairrada and ADSL in Minho.
- In the other regions, with no subsidies we have an IRR above 15%, so it is not necessary to make use of this mechanism of subsidisation. In concrete, with ADSL in Bairrada and Minho an IRR equal to 27% and 50%, respectively, is achieved. VDSL in Bairrada has an IRR equal to 21%, and, finally, LMDS in Minho has 30% of IRR.

5.2 Economic Results

The subsidy value will vary with time, due to the costs and tariffs variation.

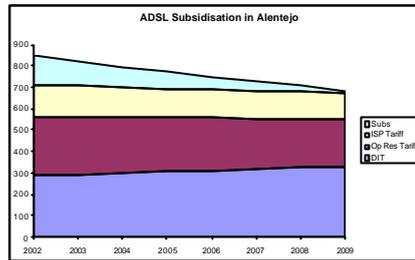


Figure 4 illustrates a typical graphic where subsidy is necessary, namely the Alentejo region and its variation with time.

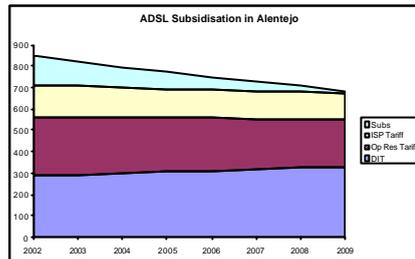


Figure 4. Subsidy mechanism for ADSL in Alentejo

Since DIT in Douro is lower, in this area the subsidy per habitation is bigger than in all the other areas. For ADSL in Bairrada a subsidy is not necessary because the DIT value is sufficient to guarantee an IRR equal to 15%.

For VDSL, it was noticed that as costs vary with time, the subsidy becomes unnecessary. In Bairrada and Minho it is not necessary subsidisation because the National Tariff that assures an IRR of 15% is lower than the DIT.

For LMDS, the required subsidy is bigger because LMDS is a much costly technology. In Minho subsidisation is not needed. This is due to the combination of the topology of the area with the reach of this technology (since Minho is an area with an uniform population density, the longer the radius of reach of the base station, the bigger is the number of potential clients).

The most relevant economic results for the economical evaluation of the project (IRR, NPV and Payback Period) are presented in the following table. These values were obtained without subsidisation, clearly demonstrating that only some case studies have an IRR over 15% - in these market forces by themselves are enough to the uptake of these services.

Table 5. ADSL Economic Results

	ADSL				VDSL				LMDS			
	Alentejo	Douro	Bairrada	Minho	Alentejo	Douro	Bairrada	Minho	Alentejo	Douro	Bairrada	Minho
NPV	314.740	-68.712	905.181	359.667	554.265	113.936	1.160.503	5.417.271	-332.916	-794.402	139.828	13.756.657
IRR	12.10%	9.00%	26.20%	14.10%	13.70%	11.80%	32.00%	58.40%	8.70%	4.00%	10.90%	36.20%
PayBack Period	7	-	5	7	7	7	5	4	-	-	-	5

As conclusion, observing the results presented before, the case studies where the IRR is lower than 15% must be marked out. In these it is necessary to have a mechanism of stimulation to the adherence on these advanced telecommunications services. When the IRR is bigger than 15%, there is no need to resort to the subsidisation mechanisms.

The obtained results also allow concluding that ADSL and VDSL are the technologies that require the lowest subsidisation. However, for the Portuguese Minho region, LMDS is a very particular example: even requiring a huge initial investment (as will be seen in the next section), the final IRR and NPV turn this project into a very interesting one.

5.2.1 Investments

Figure 6a) is a typical pie chart where it is possible to observe the investment partition per cost element. Once again the Alentejo region is analysed. So, for ADSL in Alentejo it is possible to see that there are two big investment slices: the bigger one for civil works, the other one for electronic equipment.

In Figure 6b) a comparison between the investments and revenues is presented, for each one of the four regions and for each technology during the study period. This picture also shows the investments and revenues cumulative values.

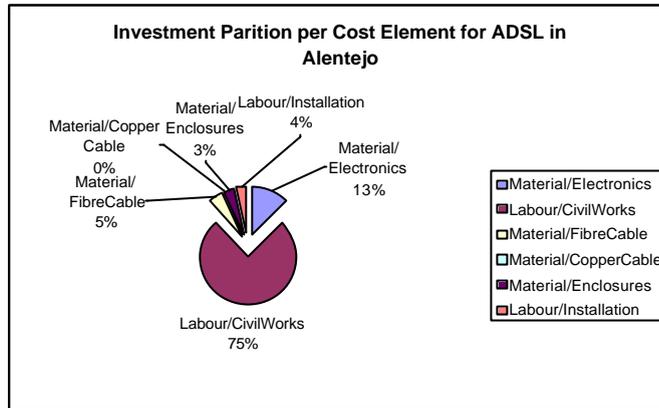


Figure 5 a) Investment partition per cost element

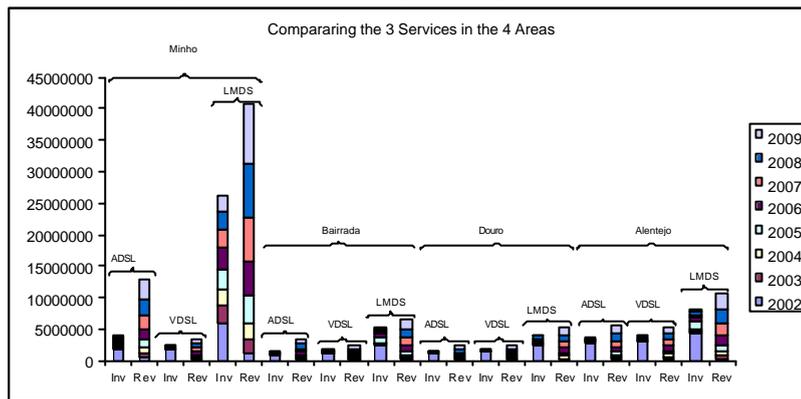


Figure 6 b) Investment and revenues comparison

As it can be observed in this figure the major investments are done at the initial year of the project in the three different technologies and areas, and are higher in LMDS for the different areas. During the project lifetime the investments logically decrease because the infrastructure is already in place.

For ADSL and VDSL high investments have to be made in civil works. For LMDS the great slice of investment is made in electronics (base stations and terminals). Depending on the considered region, these factors can turn the project to be unprofitable.

5.2.2 Sensitivity Analysis

Sensitivity analysis to several parameters variation is executed to illustrate the flexibility of the methodology used in this study.

In Figure 7 it is possible to observe how the economic output (IRR) varies with some inputs. The figure shows each value of economic output if an input varies 10%. As it can be observed, the first input (Initial Tariff for the Business customers) is the one that varies the economic outputs the most. It can also be seen that not all input are in direct proportion with the economic outputs.

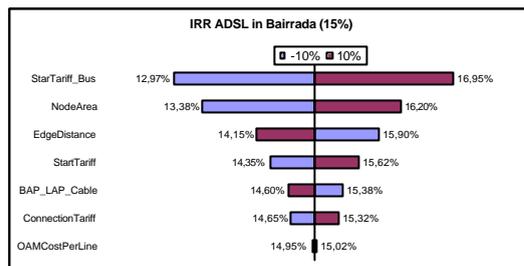


Figure 7. IRR Sensitivity

6. CONCLUSIONS

The access and use of information is becoming more and more important, and it is now a decisive factor for personal fulfilment and institutional efficiency. In this sense, it is crucial to create the indispensable conditions to allow the access to this Information Society, even (or better, specially) in peripheral areas. To offer these broadband telecommunication services in Southern European countries (such as Portugal), it is necessary to be very thoughtful, because these rural areas are usually very poor, and the population income might not allow them to pay for these advanced services.

The different areas in study – Alentejo, Douro, Bairrada and Minho – have very dissimilar characteristics: population densities and distribution patterns very different. As a consequence the economics of different technical solutions are drastically diverse, being a decisive factor for the suitability of one technology over another. Two examples (taken out from the case study results) confirm this assertion. The first one is LMDS in Minho. This technology is the one that presents the worst results for all regions, except Minho. In this area, due to its demographic characteristics (population is distributed uniformly) and the high coverage of LMDS (one base station can be shared by a huge number of customers), the economic results are very attractive. The second example is the generally better economic values of VDSL over ADSL. Since these rural regions can be modelled as a collection of relatively small clusters, VDSL can be installed directly in some cases (without new local exchanges need), and with its higher tariffs (due to the more advanced services offered, like TV) the economic results are normally better than ADSL.

In some of the four regions under consideration market forces by themselves are not enough to the uptake of the advanced telecommunication services. For these to have a positive impact on the customer, some stimulation mechanism (in our study tariff subsidisation) is required, in order to counterbalance the low willingness to pay of these rural and peripheral clients. This mechanism is also crucial for the telecom operators, due to their need of charge a certain tariff in order for their project to be profitable. If this market stimulus is not perpetrated operators will not invest because the customers do not have the capacity to pay for these services, and the digital divide will happen.

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DATA MINING OF SEQUENTIAL PATTERNS: AN APPLICATION TO THE NEXT BEST OFFER PROBLEM

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ABSTRACT

Several scientific and business domains require the discovery of hidden patterns in sequences of events. Common applications range from the classification of DNA sequences to the analysis of sequence of transactions in marketing environments. One method of mining sequential patterns is based on the derivation of association rules in sequences of events (Agrawal et al, 1995a). This approach is often based on extensions (Agrawal et al, 1995b) of the so-called *apriori* algorithm (Agrawal et al, 1993; Agrawal et al, 1994) for static sets. However, in its original formulation, the efficiency of the algorithm drops significantly when the number of simultaneous occurrences in the sequence is high. Moreover, conventional approaches to sequential pattern analysis based on this algorithm rely on the relative position of each event, but disregard the absolute time stamp of each event in the sequence. In this paper, we describe a variant of the *apriori* algorithm that is able to deal efficiently with large number of simultaneous occurrences. Moreover, we describe a method to estimate the time stamp of each candidate to the next occurrence in the sequence. We apply this algorithm to the so-called *best next offer* marketing problem: given the purchase history of a given customer, derive the most plausible next purchase and estimate the best moment to perform a marketing offer.

KEYWORDS

Data mining, knowledge discovery, association rules, time series analysis, linear regression, best next offer.

1. INTRODUCTION

In the last two decades there has been an increased interest on *datamining*, a common designation for any techniques devoted to find hidden information in large databases. Most of the accomplished work aims at detecting recurrent patterns in the data, namely detecting Association Rules. An association rule allows the derivation of assertions as: *If A occurs, then it is probable that B also occurs*. One popular application of association rules is the so-called *market basket analysis* in marketing applications: provided that a client has already purchased a given set of products, find one or more products that are usually *associated* with some of the items in the first set and for which the *probability* of joint purchase is high. As stated in Hand (1998), in *market basket analysis*, one studies conditional probabilities of purchasing certain goods, given that others are purchased.

This analysis can be very useful to e-Commerce. Knowing which items usually sell well together, one can place them close by in the catalogue page. This facilitates impulsive buying and leads the customer to order

also other items than the ones they were initially looking for. Many authors have developed specific algorithms to solve this problem. In Agrawal et al. (1993 and 1994) the well-known *apriori* algorithm for deriving association rules was presented for the first time .

In its original formulation, association rules deal only with static sets. This problem has later been generalized into the so-called sequencing problem, which aims at detecting sequential patterns in the data. In this new context one wishes to detect rules of the type: *If A occurred, then it is probable that B will occur within time T.*

This type of association rules can be used in marketing applications to solve the so-called *best next offer* problem: given the past purchase record of a given client, identify good candidates to the next product to be bought. This product can be used for a preferential marketing offer. Moreover, it would be desirable to have an estimate of the best moment in the customer's life to make the offer. This strategy aims to emphasise marketing strategies focused in the client, by opposition to conventional scoring approaches, focused in the product.

Many algorithms have been proposed to solve this problem. In Antunes et al. (2001) an exhaustive survey of the techniques for the mining of temporal sequences proposed to date is presented. One of the common approaches is the *apriori* algorithm (Agrawal, 1995a; Agrawal, 1995b), which addresses the problem by finding sequential association rules. Nevertheless, when dealing with large number of simultaneous occurrences, this method becomes slow. On the other hand, in its original formulation, it does not provide an estimate of the moment when the rule's consequent will occur.

In this paper we propose a variation of the *apriori* algorithm that uses an efficient method for dealing with simultaneous occurrences and provides a new method for computing the support of candidate sequences. Moreover, it is described a method for predicting the time of the rule's consequent using regression analysis. The paper is structured as follows. Section 2 introduces some definitions and the basic notation that will be used through the paper. The problem of detecting the most probable occurrence can be decomposed in two sub-problems that will be addressed in Sections 3, 4 and 5. The first problem consists in detecting the occurrence itself that is most likely to happen in the future. The second problem is concerned with the prediction of the actual moment of the future occurrence. The construction of association rules allows to answer the first question and is described in Section 3. In Section 4 we present a new method for treatment of simultaneous occurrences . The algorithm for prediction of the time stamp of the next event is described in Section 5. In Section 6 we present some experimental results of application the method to *the best next offer* problem. The paper ends with some conclusions in Section 7.

2. DEFINITIONS

Let D be a database that consists of records of occurrences related to entities. These records may concern purchases of items by the customers of a supermarket or ministration of medicines to the patients of an hospital or even the occurrences of failures in the equipment of a factory. Each record is, therefore, composed by the fields: *entity_id*, *mom_occurrence* and the occurrences.

Let x_i be the set of the occurrences present in the record i , that is, that occurred at time *mom_occurrence* and are related to *id_entity*. Any set of simultaneous occurrences will, from now on, be referred to as events. Then the sequence $s_k = \langle x_{1k} x_{2k} \dots x_{nk} \rangle$, which is simply an ordered list of the sets of occurrences related to the same entity ordered by the corresponding *mom_occurrence*, is called the entity's sequence.

A set of simultaneous occurrences will, for now on, be called an event. If the occurrences in the set did not occur necessarily at the same moment, then the set will be addressed simply as a set of occurrences. According to this, an entity's sequence is a sequence of events.

This representation of the entity's sequence only reveals the order by which the events happened, not quantifying the gap of time between them. To keep this information, there will be associated a tuple of moments to each of the entity's sequences identifying the moments of the events: $t_k = (m_{1k}, m_{2k}, \dots, m_{nk})$.

Consider the database represented in Table 1. Table 2 shows this database represented in terms of sequences and corresponding tuples of moments.

According to Agrawal et al (1995b), a sequence of events $\langle x_1 x_2 \dots x_n \rangle$ is contained in another sequence of events $\langle y_1 y_2 \dots y_m \rangle$ if there exist integers $i_1 < i_2 < \dots < i_n$ such that $x_1 \subseteq y_{i_1}, x_2 \subseteq y_{i_2}, \dots, x_n \subseteq y_{i_n}$.

Table 1. Records of the database ordered by *entity_id* and *mom_occurrence*

<i>entity_id</i>	<i>mom_occurrence</i>	<i>sets of occurrences (events)</i>
1	5 Jan 2001	{A, B}
1	7 Oct 2001	{C}
1	8 Feb 2002	{F}
2	6 Mar 2002	{A, C}
2	9 Sep 2002	{F}
3	10 May 2002	{C, E, F}
4	7 Apr 2001	{C}
4	8 Nov 2001	{E}
4	3 Mar 2002	{F}
5	8 Jun 2002	{A}
5	10 Aug 2002	{D, E}

Table 2. The same database represented in terms of its sequences

<i>entity_id</i>	<i>entity's sequence</i>	<i>corresponding tuple of moments</i>
1	< {A, B} {C} {F} >	(5 Jan 2001, 7 Oct 2001, 8 Feb 2002)
2	< {A, C} {F} >	(6 Mar 2002, 9 Sep 2002)
3	< {C, E, F} >	(10 May 2002)
4	< {C} {E} {F} >	(7 Apr 2001, 8 Nov 2001, 3 Mar 2002)
5	< {A} {D, E} >	(8 Jun 2002, 10 Aug 2002)

3. DESCRIPTION OF THE ALGORITHM

3.1 Simultaneous occurrences

In Agrawal et al (1995a) an algorithm that treats sets of simultaneous occurrences is presented. This algorithm performs the mapping of some of these sets in the entity's sequences. Then the records of the database are transformed accordingly. To perform the mapping, the algorithm makes several passes through the database searching for all the sets of simultaneous occurrences present in the entity's sequences. Along the search, it computes the supports of the sets, which is the fraction of entities whose sequence contains the set. If the support of a set is greater than the user-specified minimum support (*minsup*), this set is defined a *large itemset*. We shall call them large events, once an itemset is no more than a set of occurrences concerning simultaneous purchases of items, that is, an event. The mapping is performed on the large events and results in sequences of length 1: *1-sequences*.

After this step, starting with sequences of length 1, it generates sequences of length $k+1$ based on sequences of length k and uses the transformed entity's sequences to compute their support in the database. Then again it makes multiple passes through the database (now transformed).

When a database is very large and contains a great number of different sets of (simultaneous) occurrences, the number of large events to be mapped is expected to be also large and the number of candidate sets of higher length will grow exponentially.

The database in our study lies within this case. The number of different sets of simultaneous occurrences present in the entity's sequences is extremely high.

3.2 Finding large sequences in the database

The algorithm proposed herein starts by considering all the occurrences present in the database records. Then it generates sequences of occurrences using the apriori-generate function presented in Agrawal et al(1995b).

The support of these candidates is computed comparing them with the entity's sequences. Instead of considering sets of simultaneous occurrences as new sequences, it is reasonable to consider that when A and B occur simultaneously, this can be considered as a limit case of the two candidate sequences $\langle A B \rangle$ and $\langle B A \rangle$. In other words, an entity's sequence contains the event $\{A, B\}$, this entity can be considered to support both the candidate sequences of occurrences $\langle A B \rangle$ and $\langle B A \rangle$. Of course, care must be taken when computing the contribution of this event to the support of each candidate sequence: since this event occurs only once, it should not be fully computed in the support of both candidates. In the more general case of N simultaneous occurrences, one may proceed by generating all the possible combinations of the single occurrences and then compute their individual support with a modified weight. The main difference from the *apriori* algorithm lies within this computation and will be described in Section 4.

All the candidate sequences with support greater than the user-specified minimum support (*minsup*), called large sequences, are stored and used to generate candidate sequences of occurrences of higher length. The set of all the large sequences stored is then used to generate the association rules.

3.3 Generation of the Association Rules

Each large sequence found in the previous step will generate an association rule. First of all, let us define the general form of a sequence of occurrences. Let $A = \{a_i, i = 1, \dots, k\}$ be a set of k occurrences that may happen or, in other words, that are present in the database. Then the sequence $s = \langle a_1 a_2 \dots a_k \rangle$ is called a sequence of occurrences if there is a corresponding tuple of moments (m_1, m_2, \dots, m_k) such that $m_1 \leq m_2 \leq \dots \leq m_k$.

Given a large sequence represented by $s = \langle a_1 a_2 \dots a_k \rangle$, $k \geq 2$ there will be generated two new sequences: the antecedent of the rule: $s_a = \langle a_1 a_2 \dots a_{k-1} \rangle$ and the consequent of the rule: $s_c = \langle a_k \rangle$. The corresponding rule is composed by these two sequences: $R: s_a \Rightarrow s_c$. The sequence $s = \langle a_1 a_2 \dots a_k \rangle$ that generated the rule is called the generating sequence of the rule.

4. TREATMENT OF SIMULTANEOUS OCCURENCES

4.1 Sets of occurrences and sets of events

The sequence of occurrences $\langle a_1 a_2 \dots a_n \rangle$ is contained in the sequence of events $\langle x_1 x_2 \dots x_m \rangle$ if there are integers $i_1 = i_2 = \dots = i_n$ such that $a_1 \in x_{i_1}, a_2 \in x_{i_2}, \dots, a_n \in x_{i_n}$. An entity supports a sequence of occurrences s if s is contained in the entity's sequence.

Table 3. Some examples of sequences of occurrences supported by the entities of a database

<i>entity_id</i>	<i>entity's sequence</i>	<i>Examples of sequences of occurrences supported by the entity</i>		
1	$\langle \{A, B\} \{C\} \{F\} \rangle$	$\langle A B C F \rangle$	$\langle B A C F \rangle$	$\langle A C F \rangle$
2	$\langle \{A, C\} \{F\} \rangle$	$\langle A C F \rangle$	$\langle C A F \rangle$	$\langle A F \rangle$
3	$\langle \{C, E, F\} \rangle$	$\langle C E F \rangle$	$\langle E C F \rangle$	$\langle F C E \rangle$
		$\langle C F E \rangle$	$\langle E F C \rangle$	$\langle F E C \rangle$
4	$\langle \{C\} \{E\} \{F\} \rangle$	$\langle C E F \rangle$	$\langle C F \rangle$	$\langle E F \rangle$
5	$\langle \{A\} \{D, E\} \rangle$	$\langle A E D \rangle$	$\langle A D \rangle$	$\langle A E \rangle$

According to this definition, the sequences of occurrences in Table 3 are some of the (many) supported by the entities in the database of Table 2. The same sequence of occurrences can be supported by different entities: the sequence $\langle A C F \rangle$ is supported by the entities 1 and 2, while the sequence $\langle C E F \rangle$ is supported by entities 3 and 4.

But not all the entities of the database that support a sequence of occurrences do so in the same way. Besides supporting the sequence $\langle C E F \rangle$, entity 3 also supports five other sequences containing these

three occurrences (which are also present in Table 3). It is then necessary to distribute evenly the contribution of an entity to the computation of the support of the several sequences of occurrences that it supports .

4.2 Computing the support of a sequence of occurrences in the database

The support of a set of simultaneous occurrences is, as in Agrawal et al (1995b), the fraction of the total number of entities whose sequence of events contains it. To compute the support of a sequence of occurrences, we include a new factor: the individual contribution of each entity that supports it. This contribution is computed as follows: Given a sequence of occurrences: $s = \langle a_1 a_2 \dots a_m \rangle$ and an entity's sequence (of events) that contains it: $x_j = \langle x_{1j} x_{2j} \dots x_{nj} \rangle$, we have to:

- i) create the set $A = \{ a_1, a_2, \dots, a_m \}$ of the occurrences that are present in s ;
- ii) find the different sets x'_{kj} defined by:

$$x'_{kj} = \{ a_i : a_i \in x_{kj} \cap A, i = 1, \dots, m \}, k = 1, \dots, n;$$
- iii) find the number of elements in each of the sets $x'_{kj}, k = 1, \dots, n$, which will be called the cardinal of x'_{kj} (and will be represented by c_{kj});
- iv) compute the contribution of the entity j to the computation of the support of the sequence s :

$$weight_j(s) = \prod_{k=1}^n \frac{1}{c_{kj}!}$$

The support of a sequence of occurrences in a database is the weighted sum of the contributions of all the entities in the database that support it and is computed by,

$$support(s) = \frac{\sum_{j: \text{subject } j \text{ supports } s} weight_j(s)}{N} \times 100\% ,$$

where N is the number of entities present in the database.

Table 4. Computation of the support in a database of two different sequences of occurrences

sequence of occurrences	entities that support the sequence	corresponding entities' sequence	computation of the contribution of the entity to the support of the sequence				support of the sequence in the database
			k	x'_{kj}	c_{kj}	$weight_j(s)$	
< A C F >	j = 1	< {A, B} {C} {F} >	1	{ A }	1	1 / 1! × 1 / 1! × 1 / 1!	30 % ((1 + 1/2) / 5)
			2	{ C }	1		
			3	{ F }	1		
	j = 2	< {A, C} {F} >	1	{ A, C }	2	1 / 2! × 1 / 1!	
			2	{ F }	1		
< C E F >	j = 3	< {C, E, F} >	1	{ C, E, F }	3	1 / 3!	23,33 % ((1/6 + 1) / 5)
	j = 4	< {C} {E} {F} >	1	{ C }	1	1 / 1! × 1 / 1! × 1 / 1!	
			2	{ E }	1		
			3	{ F }	1		

Table 4 presents the computation of the support of the sequences < A C F > and < C E F > in the database of Table 2. Note that the contribution of entity 3 to the computation of the support of sequence < C E F >

equals $1 / 3!$ ($= 1 / 6$) which makes sense knowing that this entity's sequence will also contribute to the support of five more sequences.

5. PREDICTION OF THE MOMENT OF OCCURRENCE

Once the occurrence that is most likely to happen (a_k) for an individual entity has been detected, it is necessary to predict the most likely moment in time for that occurrence to take place. Let us consider the general form of the specific association rule that generated this result: $\langle a_1 a_2 \dots a_{k-1} \rangle \Rightarrow \langle a_k \rangle$. We know the moments of occurrence of the $k-1$ occurrences that compose the antecedent of the rule, which are a subset of the elements in the tuple of moments related to the entity and will be denoted by $(m_1, m_2, \dots, m_{k-1})$. The goal is to predict the moment in time when the occurrence in the consequent of the rule will happen, which was previously represented by m_k .

Considering the general form of the linear regression model, $m_k = b_0 + \sum_{j=1}^{k-1} b_j \times m_j + e$, where:

- m_k is the moment of occurrence of the event a_k (rule's consequent);
- $\{b_i : i = 1, \dots, k\}$ are the coefficients of the regression model;
- $\{m_j : j = 1, \dots, k-1\}$ are the moments of occurrence of the events in $\{a_j : j = 1, \dots, k-1\}$ (rule's antecedent);
- e is the error term of the regression model, the problem of predicting the value of m_k can be solved in two steps: modeling and prediction.

To perform the modeling, we have to select from the database all the entity's sequences that contain the generating sequence of the rule. Let N be the number of entities in the database whose sequence of occurrences satisfy this condition. Each one of these entity's sequence will produce a vector of records $\mathbf{x}_i = (1, m_{i1}, m_{i2}, \dots, m_{i,k-1})$ and a value $y_i = m_{ik}$, for $i = 1, \dots, N$, where m_{ij} represents the moment of occurrence of the event a_j related to the entity i . Building the matrix $\mathbf{X}_{(N \times k)} = [\mathbf{x}_i]_{i=1, \dots, N}$ and the vector $\mathbf{Y}_{(N \times 1)} = [y_i]_{i=1, \dots, N}$, the former equation can be written in the matrix form: $\mathbf{Y} = \mathbf{X} \mathbf{B}$, where \mathbf{B} is the $(k \times 1)$ vector of regression coefficients.

The prediction consists in finding \hat{m}_k , the estimate of the moment of occurrence of a_k ,

$\hat{m}_k = \hat{b}_0 + \sum_{j=1}^{k-1} \hat{b}_j \times m_j$, where:

- $\{m_j : j = 1, \dots, k-1\}$ are the known moments of the occurrences in $\{a_j : j = 1, \dots, k-1\}$ and
- $\{\hat{b}_j : j = 1, \dots, k-1\}$ are the computed estimates of the coefficients of the regression model.

6. EXPERIMENTAL RESULTS

The proposed algorithm was applied to a real database of customer transactions of a large company. The whole database contained the records of about 25,000 customers and a total of about 90,000 transactions. The time interval between the transactions of each client range from some months to some decades.

In order to assess the algorithm, the customers in the database were divided in two independent sets for training and testing. The training set, used for derivation of association rules and corresponding regression models, comprises 80% of randomly selected customers. The remaining 20% were used as a test set to assess the generalization performance of the derived association rules and regression models. During the test phase, the last event in each test sequence was used as a target for evaluation of association rules and time prediction.

Since the test problem concerns customer transactions, in the remainder of this Section, we shall call *customer's sequence* to an entity's sequence, *bought item* to a single occurrence and *purchase* to a set of simultaneous occurrences (event).

The association rules were derived from the customer's sequences in the training set. To evaluate the performance of the used method, we applied the resulting association rules to the customers in the test set. Firstly, we searched, for each of the customers, the rules that fit his sequence of purchases. We consider that

an association rule fits a customer's sequence if its antecedent sequence is contained in the customer's sequence and consequent sequence is not, that is, if the items present in the antecedent of the rule were bought by the customer, but the item that results from the rule was not. For some of the customers, there were found several rules that fit his sequence of purchases, but for others there were not found any. Each of the rules that fit a certain customer's sequence indicates an item that is likely to be bought by the customer. We compared, for each customer of the test set for which there is, at least, one rule that fits, the several items indicated by the rules with the real item that the customer bought. In Table 5 is presented the results of this analysis.

Table 5. Analysis of the association rules

<i>number of costumers in the test set</i>	<i>nr of costumers for which there is, at least, one rule that fits</i>	<i>Number of costumers for which there is, at least, one rule that indicates the real result</i>
4906	4795	330

Independently from the previous analysis, we constructed a regression model based on every association rule derived, the way described in Section 5. We present an analysis of the association rules in Table 6 and in Table 7 is presented an analysis of the models constructed upon them. After that we used the transformed entity's sequences in the test set to evaluate the performance of the prediction method. For each model, we found every entity whose sequence is contained in the antecedent sequence of the corresponding rule. In this pass we also evaluated if the last event in the entity's original sequence contained the occurrence in the consequent of the rule. If not, we dropped the entity. Then, for each of these entities, we computed the estimate of the moment of the last occurrence (the occurrence in the consequent of the rule) and compared it with its real value to evaluate the committed error. The error values are expressed in terms of years, since the moments of item purchases were set to be the costumers' ages at the times of purchase. The set of the errors committed in each prediction were chosen to be the statistical measure of effectiveness of the predicting method. In Table 8 we present a study of the effectiveness of the regression models constructed. The histogram in Figure 1 shows how these errors are distributed. Most of them (around 82 %) are below two years while only 4,61% of the errors are above four years.

Table 6. Evaluation of the association rules

<i>number of costumers in the training set</i>	<i>number of association rules (AR) found</i>	<i>supports of the AR</i>		<i>number of occurrences in the antecedent of the rule</i>	
		<i>minimum</i>	<i>maximum</i>	<i>minimum</i>	<i>maximum</i>
4906	6222	0.01%	2.5%	1	9

Table 7. Evaluation of the regression models

<i>Modeling</i>				<i>Prediction</i>	
<i>number of regression models constructed</i>	<i>number of regression models used for prediction</i>	<i>R_squared (models used for prediction)</i>		<i>number of entities used for prediction</i>	
		<i>mean</i>	<i>standard deviation</i>	<i>mean</i>	<i>standard deviation</i>
1207	405	95,729	8,838	3	3,6

Table 8. Descriptive statistics of the errors of prediction

<i>N</i>	<i>Minimum</i>	<i>1st Quartile</i>	<i>Median</i>	<i>3rd Quartile</i>	<i>Maximum</i>	<i>Average</i>	<i>Standard Deviation</i>	<i>Mode</i>
1243	0	0,230	0,643	1,456	73,036	1,5352	3,764	0,000

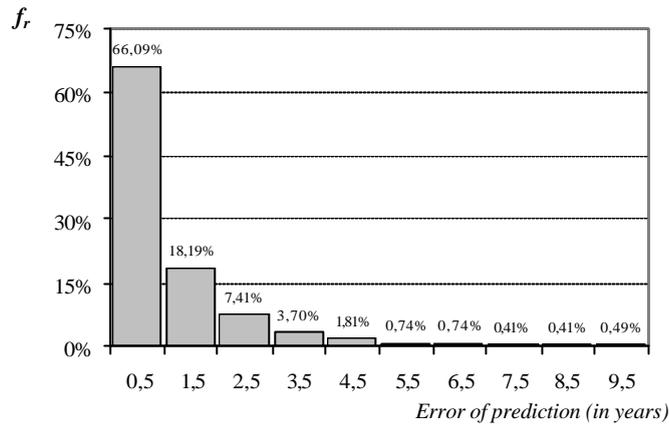


Figure 1. Histogram of the errors of prediction

7. CONCLUSIONS

We described a new approach for mining sequential patterns in sequences of events. The algorithm presented herein provides an efficient way to deal with large number of simultaneous events and produces a reasonable estimate of the time stamp of the next item in the sequence. The algorithm was applied to the so-called *best next offer* marketing problem, using a real database of marketing transactions. It was shown, using an independent test database of known transactions, that the proposed algorithm is able to provide reasonable candidates to the next item in the sequence and reasonable estimates of its associated time stamp. Future work will include the test of the algorithm in different application scenarios and the study of methods for improving the accuracy of time stamp prediction, using either generalized regression techniques or non-linear regression models based on neural networks.

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UNCERTAINTY MODELING IN EXPERT SYSTEMS FOR FINANCIAL RELIABILITY EVALUATION¹

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ABSTRACT

In this paper we described an expert system for financial reliability evaluation of companies, from the perspective of the improvements we have made over time in the management of uncertainty and imprecision inherent to data relevant for the problem solution. The first version of this expert system was a “crisp” one - it was based on the decision making model that utilized a hierarchical aggregation structure, where the financial reliability estimation was positioned on the top of a hierarchy and the leaves represented the attributes that had impact on the evaluation. The later version of the expert system takes advantage from the inclusion of fuzzy set theory into the financial reliability assessment. The fuzzy expert system is based on fuzzified decision model in which the subjective estimations of experts are expressed as linguistic terms, by fuzzy sets. The rationale behind this model is described by production rules. For the aggregation of the assessments we use the combination of the LOWA operator, the fuzzy linguistic quantifier “most” and the classical “min-max” operator, while the *center-of-gravity* method is used as a defuzzification method, as we require the “best compromise” among the evaluated degrees of financial reliability. The results and experiences of the transformation of the “crisp” system into a fuzzy application are presented in this paper.

KEYWORDS

fuzzy expert systems, LOWA operators, linguistic quantifiers

1. INTRODUCTION

The ongoing business situation with a steady growth in the number of business transactions, increased company insolvencies and bankruptcies imposed the need for creating an automated decision support system in order to obtain more accurate financial reliability evaluation (FRE) of companies that participate in business. This task is within the qualitative area, as the information required for decision making (e.g. structure of income and costs, financial position, financial strength, etc.) cannot be set out in a precise numerical way, but tend to be presented to a lesser or a greater degree. An attempt to collect and evaluate all the necessary information indicates that a decision making process takes place in a fuzzy environment and arises the interest in the application of the theory of fuzzy sets.

In the 70-ties were the achievements of fuzzy logic for the first time included into decision making field, enabling the modification of strict models that demonstrate clarity and precision in mathematical sense and utilization to the aspiration of other kind. Prof. H.-J. Zimmermann had worked extensively ([1],[2],...) on the application of fuzzy set theory in the strategic management domain. The results of his work had shown that the incorporation of fuzzy logic into problem solutions where the domain knowledge is mainly indicative and qualitative by nature, in a form of assessments and almost always fragmentary, incomplete and fuzzy, could

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lead to more successful decisions. An interesting article [3] highlighted the possibility of the utilization of proceeding of fuzzy control systems to non-technical expert systems. Furthermore, in [4] the authors demonstrated the generality, flexibility and main properties of the fuzzy multiple attribute decision support tool. Some problems from financial area, such as: checking the credit solvency of small business firms, creditworthiness evaluations, detecting fraudulent financial reporting, etc. have been solved in late 90's by fuzzy logic based systems ([5],[6],[7]).

Based on the relevant existing research, we have firstly developed a "crisp" expert system (ES) for financial reliability evaluation of companies. It was based on the decision making model that utilized a hierarchical aggregation structure, where the financial reliability estimation was positioned on the top of a hierarchy and the leaves represented the attributes that had impact on the evaluation. The degree of the financial reliability of a company was hierarchically aggregated upon experts' ranking and subjective evaluations of the fulfillment of relevant criteria. In the next paragraph we described the architecture and functionality of this ES that was developed and implemented in the Yugoslav "Kulska banka A.D." bank, in order to provide consistent FRE of bank customers.

The "crisp" system could not model accurately the "softness" of human decision process. Consequently, we have made improvements in the management of uncertainty and imprecision inherent to data relevant for the problem solution. It resulted in the transformation of "crisp" ES into a fuzzy application. In the third paragraph we presented a fuzzy system for FRE, as an improvement of the previous "crisp" system and as a practical answer to the research question: in which way can the fuzzy set theory contribute to better decision-making.

2. DESCRIPTION OF THE IMPLEMENTED "CRISP" EXPERT SYSTEM

The financial reliability of companies depends on many diversified factors that have to be analyzed from different aspects in order to be evaluated. Firstly, the values of relevant factors have to be assessed, secondly, information contained in the relationships of relevant factors have to be derived (the so-called vertical dimension) and the last, but not least important task is to analyze the financial reliability determinants over time (the horizontal dimension). Therefore, the FRE is not an easy task. Furthermore, FRE is a task that should be accomplished most seriously, with a high responsibility and the decisions have to be objective and consistent. For this reason we decided to automate the decision making process of FRE.

2.1 Development of the expert system for financial reliability evaluation

The goal of the project was to develop an ES that will support the decision-maker to evaluate the financial reliability of companies that participate in business, on the high level of expertise. In the domain theory there are many methodologies proposed for the FRE. Consequently, the first step in the project realization was to select (or formulate) the most adequate methodology in consultation with the domain experts. The methodology we have adopted² for FRE uses as inputs the following relevant factors:

- | | |
|--|---------------------------------------|
| I Structure of income & costs | income |
| I1 Business income / total income | I6 Regular income / total income |
| I2 Financial income / total income | I7 Regular expenses / total expenses |
| I3 Business expenses / total expenses | II Thrift / economy |
| I4 Financial expenses / total expenses | II1 Regular income / regular expenses |
| I5 Foreign sales income / business | II2 Total income / total expenses |

² The methodology adopted for the financial reliability evaluation is proposed by eminent Yugoslav institutions and authorities: (1) the Yugoslav National bank, "Accounting Practice" No 8/1998, pp.20-23; (2) Vunjak N.: "Financial Management", Faculty of Economics, Subotica, Yugoslavia, 1995; (3) Rodic J.: "The Theory and Analysis of Annual Reports", Ekonomika, Belgrade, Yugoslavia, 1991; (4) Pejic L., Radovanovic R., Stanisic M.: "The Assessment of Company's Worthiness", Business Review, Belgrade, Yugoslavia, 1991.

- II3 Business income / business expenses
- III Financial result and profitability
 - III1 Profit rate
 - III2 Net profit / total income
 - III3 Net loss / total income
 - III4 Net loss / total assets
 - III5 Coverage of interest expenses by profit
- IV Financial position
 - IV1 Capital share in total liabilities
 - IV2 Owned capital / total capital
 - IV3 Profit / interest
- IV4 Fixed assets / owned capital
- V Financial strength
 - V1 Capital share in total liabilities
 - V2 Financial balance (“ACID test”)
 - V3 Capital structure
 - V4 Real value of owned capital
 - V5 Profit rate
- VI Other (cash flow, leverage,...)
 - VII Amortization /total expenses
 - VI2 Cash flow
 - VI3 Business leverage
 - VI4 Financial leverage

The design of the system is based on assessment hierarchy that represents all the relevant factors involved in a FRE (fig. 1.). Every factor in this hierarchy is assigned a weight, which depends on the branch of the industry and the goal of the FRE. The evaluation on the higher hierarchical level is derived upon the assessments of criteria from the lower hierarchical level, combined with the weights related in this unvarying hierarchy. The weights (between 0 – not important and 10 – most important) are determined by experts in advance, and set during the design phase, but can be modified by the user during the consultation phase in order to reflect more accurately his/hers subjective view³ of the problem and to provide the what-if analysis⁴. Whenever an ES is run for the achieving a FRE of a company, the user would assign values for the relevant factors (by accepting the default ones or by supplying his/hers own ones). Consequently the system would determine the financial reliability by assessing the relevant factors, the weights of the factors and the actual values inputted from the Regional business association (“Privredna komora”) database of balance sheets of companies. The access to the database was enabled using the C program written for this purpose.

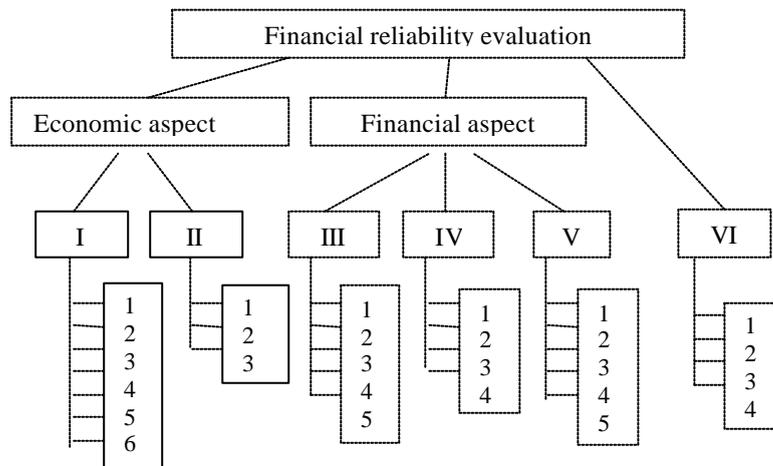


Figure 1. Hierarchy of factors influencing the FRE

This ES has been developed using conventional knowledge based system technologies, with “crisp” logic and is implemented in Exsys Professional shell. Below are listed some representative rules from the knowledge base:

- If Structure of income and costs is good then FRE: $-Confidence=[\%c1]+20*[\text{importance I}]$
- If Financial result and profitability is unfavorable then FRE: $-Confidence=[\%c1]-10*[\text{importance III}]$
- If $[I1]>0.97$ then $[I \text{ GROUP}]$ is given the value $[I \text{ GROUP}]+1$
- If $[I1]\leq 0.97$ and $[I1]>0.95$ then $[I \text{ GROUP}]$ is given the value $[I \text{ GROUP}]+0$
- ...

³ For each consultation with the system the user is asked to adjust the default weights in accordance with his/hers subjective judgment of factors’ importance by moving the scroller on a scroll bars.

⁴ By varying the default importance weights, the user can gain insight into the possible shifts in financial reliability in turbulent business environment.

If [I GROUP] >0 and [I GROUP] <7 then Structure of income and costs is favorable

If [I GROUP] >=7 then Structure of income and costs is good

The output of the system is of the form: *The financial reliability is value (CI= n)*, where *value* \in {extremely bad, bad, good, extremely good} and *n* is the sum of the achieved points, calculated by the underlying evaluation algorithm, $n \in [-500, 500]$. The financial reliability is *extremely bad* if $n < -250$, *bad* if $n \geq -250$ and $n < 0$, *good* if $n \geq 0$ and $n < 250$ and *extremely good* if $n \geq 250$. Along with a statement on company's FRE, a system shows in a thermometer manner the individual assessments of all 6 groups of factors that influence the final assessment and this way visualizes the corporate portfolio.

2.2 Drawbacks of the “crisp” expert system

The task of FRE is based on wide variety of information and knowledge, mainly indicative and qualitative by nature, in a form of assessments and almost always fragmentary, incomplete and fuzzy. In other words, the task is within the qualitative area, as the information required for the evaluation (e.g. structure of income and costs, financial position, financial strength, etc.) cannot be set out in a precise numerical way. This arises the interest in the inclusion of the theory of fuzzy sets in the ES for FRE.

Consequently, the main drawback of the “crisp” ES for FRE is that it could not model accurately the “softness” of human decision process. As can be seen from the production rules, sharp thresholds are used in inference process instead of imprecise elements, the so-called linguistic terms applicable to linguistic variables that are part of natural languages. This does not always reflect the experience and the knowledge of human experts and therefore leads to automatically derived decisions that deviate from experts' decisions.

Suppose that the input data of a company is assessed, in a “crisp” ES, in the following way:

[I] = -7 \Rightarrow Structure of income & costs is extremely unfavorable.

[II] = 1 \Rightarrow Thrift / economy is neutral.

[III] = -11 \Rightarrow Financial result and profitability is extremely unfavorable.

[IV] = -5 \Rightarrow Financial position is extremely unfavorable.

[V] = 6 \Rightarrow Financial strength is good.

[VI] = 7 \Rightarrow Other (cash flow, leverage, ...) is average.

In this case the financial reliability is evaluated as *bad*.

The minor changes in calculated points (for. e.g. [III]=2 and [V]=7) result in the change of the output into *extremely bad*. The above simple example shows how minor changes in input assessments can influence the output of the “crisp” system.

The fuzzy ES described in the following section of this paper overcome this shortcoming because its reasoning process is based on linguistic terms that approximately categorize the companies that participate in business with respect to certain properties, the linguistic variables (for e.g. the variable *Structure of income & costs* is described as *extremely unfavorable*, *unfavorable*, *favorable*, and *very favorable* to the certain degree, i.e. membership value).

3. DESCRIPTION OF THE IMPLEMENTED FUZZY EXPERT SYSTEM

During the exploitation of the “crisp” ES for FRE, it became apparent that experts do not work with sharp thresholds and that their decision making rational can not be modeled adequately in traditional logic. As fuzzy techniques have advantages in areas where vague judgment of humans has to be acquired and processed automatically, ([2], [5], [6],...), we decided to transform the system into a fuzzy application.

3.1 Rebuilding the expert system for financial reliability evaluation as a fuzzy system

The FRE hierarchy with corresponding weightings from the “crisp” system was transformed into a fuzzy representation following the E. Cox's fuzzy design methodology steps. In the development of this system we have used the DataEngine, an advanced fuzzy system development environment. The same experts that have

been involved in the development of the “crisp” version of ES cooperated in the development of the fuzzy version of the system.

Step 1.: Decomposition of the system in components of input-process-output

The decomposition of the system had already been done during the development of the “crisp” version. For the purpose of fuzzyfication of decision-making process, we slightly modified the previous decomposition by adding two new factors: the economic aspect of the FRE (denoted by E) and the financial aspect of the FRE (denoted by F) as shown in fig. 2. Also a weight (ω_i) can be attached to each branch in this structure to emphasize the influence of some factors on the decisions made compared to other factors.

Step 2.: Determining the inputs and outputs

There is one output from the system, the evaluation of financial reliability. The economic and financial aspects represent two intermediate variables, the outputs from the observed system components. They are introduced for editing purposes only. The inputs are the same as into the “crisp” ES, divided into 6 disjunctive groups as stated earlier and they directly influence the assessment of the related group.

Step 3.: Analyzing the domain of each variable

In this step, the domain experts were expected to answer to the question how do they assess the relevant factors and to enable the representation as linguistic variables.

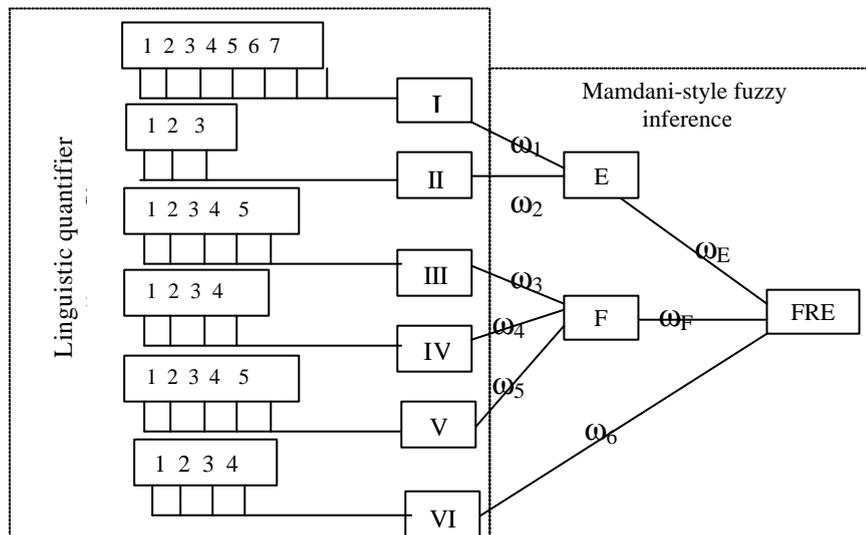


Figure 2. Structure of the fuzzy system for FRE

Step 4.: Define the fuzzy sets

When assessing the input factors or the intermediate variables, decision-makers consistently use linguistic terms for expressing levels of goodness. In order to keep the fuzzy model of the decision making process as simple as the demanded correctness allows, the number of linguistic terms for the input variables of our system was reduced to 3, as shown in Table 1. In further discussion, these linguistic terms will be referred as *b* for the lower extreme, *m* for the medium one and *g* for the upper extreme.

Table 1. Linguistic terms used in fuzzy ES for FRE

<i>Structure of income & costs</i>	<i>Thrifty / economy</i>	<i>Financial result and profitability</i>
Unfavorable	Unfavorable	Unfavorable
Favorable	Neutral	Neutral
Very favorable	Good	Good
<i>Financial position</i>	<i>Financial strength</i>	<i>Other (cash flow, leverage,...)</i>
Bad	Small	Unfavorable
Acceptable	Medium	Favorable
Good	Large	Very favorable

Upon the information the domain experts have provided, the membership functions for inputs and outputs were defined, similarly as it is shown on fig. 3. for the factor *Business income/total income*, represented as linguistic variable II.

II Business income/total income (sharp thresholds)

$0 \leq II < 0.90$	Unfavorable
$0.90 \leq II < 0.95$	Favorable
$0.95 \leq II$	Very favorable

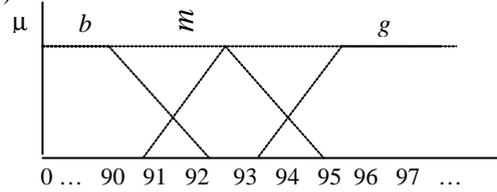


Figure 3. Valuation of parameter business income/total income modeled by experts

The financial reliability of a company can be evaluated as: bad (b), not so bad - almost medium (b^+m^-), medium (m), above medium - not so good (m^+g^-), good (g) and very good (g^+). The corresponding membership functions can be seen in fig. 4. The economic and financial aspects (variables *E* and *F*) can be described as bad (b), medium (m) and good (g).

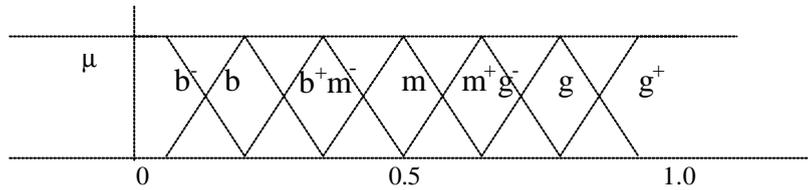


Figure 4. Evaluation of financial reliability

Step 5.: Define the rules

For each branch of the structure from fig. 2, fuzzy rules have been formulated on their terms. The rules that are used in the evaluation of the economic and financial aspect of the FRE task are shown in tables 2 and 3 respectively. Each row represents one rule of the form:

IF GROUP I = *x* AND GROUP II = *y* THEN *E* = *z* (DoS = *w*)
 or IF GROUP III = *x* AND GROUP IV = *y* AND GROUP V = *z*
 followed by *F*=*u* (DoS=*w*), $w \in [0,1]$, where $x,y,z,u \in \{b,m,g\}$ and DoS is the degree of support experts can attach to each rule in the rulebase.

Table 2. Evaluation of the economic aspect

I	II	$E (\omega_E > \omega_F)$	$E (\omega_E \leq \omega_F)$	I	II	$E (\omega_E > \omega_F)$	$E (\omega_E \leq \omega_F)$	I	II	$E (\omega_E > \omega_F)$	$E (\omega_E \leq \omega_F)$
b	b	b	B	m	b	m	b	g	b	m	m
b	m	b	M	m	m	m	m	g	m	g	m
b	g	m	M	m	g	m	g	g	g	g	g

Table 3. Evaluation of the financial aspect

III	IV	V	F	III	IV	V	F	III	IV	V	F
b	b	b	b	m	b	b	b	g	b	b	b
b	b	m	b	m	b	m	m	g	b	m	m
b	b	g	b	m	b	g	m	g	b	g	m
b	m	b	b	m	m	b	m	g	m	b	m
b	m	m	m	m	m	m	m	g	m	m	m
b	m	g	m	m	m	g	m	g	m	g	g
b	g	b	b	m	g	b	m	g	g	b	m
b	g	m	m	m	g	m	m	g	g	m	g
b	g	g	m	m	g	g	g	g	g	g	g

Table 4 contains those rules that evaluate the financial reliability, as the final output of the system. Somewhat different are the rules that are used to assess the six groups of factors, due to the large number of

input combinations of values (for e.g., there would be 3^7 rules for the assessment of the I group of factors named *Structure of income and costs*). Thus, to obtain a label representing the level of the overall group, we find adequate either the utilization of the LOWA operator, with the “most of” linguistic quantifier, or the application of *max* operator on the input values and the proportional linguistic quantifier “most of” for the assessment of six groups of factors.

Table 4. Financial reliability evaluation

E	F	VI	FRE	E	F	VI	FRE	E	F	VI	FRE
b	b	B	b ⁻	m	b	b	b	g	b	b	b ⁺ m ⁻
b	b	M	b	m	b	m	b ⁺ m ⁻	g	b	m	m
b	b	G	b ⁺ m ⁻	m	b	g	m	g	b	g	m ⁺ g ⁻
b	m	B	b	m	m	b	b ⁺ m ⁻	g	m	b	m
b	m	M	b ⁺ m ⁻	m	m	m	m	g	m	m	m ⁺ g ⁻
b	m	G	m	m	m	g	m ⁺ g ⁻	g	m	g	g
b	g	B	b ⁺ m ⁻	m	g	b	m	g	g	b	m ⁺ g ⁻
b	g	M	m	m	g	m	m ⁺ g ⁻	g	g	m	g
b	g	G	m ⁺ g ⁻	m	g	g	g	g	g	g	g ⁺

In the aggregation with LOWA operator F using fuzzy linguistic quantifiers, the weights represent the concept of fuzzy majority. Thus in the fuzzy decision model we could firstly apply the F operator to determine the linguistic value b, m or g of each input variable: $F(b, m, g) = [\omega_1, \omega_2, \omega_3]B^T$, where $B = \tau(\{b, m, g\})$, with τ being a permutation over the set of labels. Secondly, we could apply the F operator to determine the linguistic value b, m or g of each group variable (I to VI): $F(v_1, v_2, \dots, v_n) = [\omega_1, \omega_2, \dots, \omega_n]B^T$, where $B = \tau(\{v_1, v_2, \dots, v_n\})$

The formula Yager proposed for the computation of the weights ω_i as described in [8], can be applied in our case:

$$v_i = Q(i/n) - Q((i-1)/n), i = 1, \dots, n$$

$$Q(x) = \begin{cases} 0 & x < 0.3 \\ \frac{x-0.3}{0.5} & 0.3 \leq x \leq 0.8 \\ 1 & x > 0.8 \end{cases} \quad x \in [0,1]$$

Despite the appropriateness of the LOWA operator, we applied the second approach, because the DataEngine development tool does not support the LOWA operator utilization.

Application of *max* operator to the membership values of input variables in fuzzy sets b, m and g (fig. 3) attaches one unique label to each input variable. The direct application of proportional linguistic quantifier “most of” to the exact number of derived b, m or g labels, results in membership values μ_g, μ_m and μ_b (fig. 5.) These values reflect to what extent does each group of relevant factors belong to the set of lower extreme (b), intermediate value (m) or upper extreme (g). In this case, a new rule block has to be formulated, with a following semantics:

IF “most of” input values in a group (I to VI) are assessed as *good* / *m(edium)* / *b(ad)*
 THEN the whole group is described by the linguistic term *g(ood)* / *m(edium)* / *b(ad)*

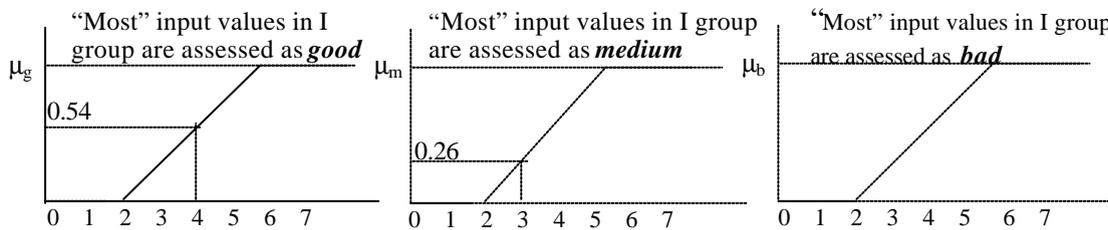


Figure 5. The “most of” quantifier applied to the number of assessed input values

Step 6: Define the defuzzification method of each output variable

After the Mamdani-style inference by *min-max* operator in rule blocks shown in tables 3 and 4, the evaluation of financial reliability is derived in a fuzzy form. Finally, the FRE is defuzzified to a scale, which connects to the weight-value system of “crisp” ES. The *center-of-gravity* method is used as a defuzzification method, because the fact that we required the “best compromise” among the estimated degrees of financial reliability.

Step 7: Validating and tuning by simulation

The fuzzy approach to FRE have to be validated by comparing the real system output to the output given by domain experts during the knowledge elicitation from cases. The changes made in: (a) shapes of membership functions, (b) the defuzzification method, (c) aggregation operators and/or (d) DoS of rules can led to different output results.

4. CONCLUDING REMARKS

The correctness of the presumption that a representation with membership functions and related rules corresponds to the experts decision making model to a higher extent than the hierarchical aggregation model is well known from the literature, but even though one should not take the utilization of fuzzy set theory as a panacea that will enable the development of an error free ES. At the same time, the elicitation of membership functions is usually troublesome and thus does not shorten the time needed for the development of the system. Consequently, the elicitation process should be performed with great care, and be supported by a structured method and should be done by an experienced knowledge engineer.

In order to draw definite conclusions about the usage of fuzzy decision model in the ES for FRE, serious further investigation should be undertaken to get answer to the question is it beneficial to supplement the satisfactory, already functioning “crisp” ES with a fuzzy one. Serious evaluations based on real practical experience and comparison of deduced fuzzy expert system’s outputs with human experts judgment should be the aim of further research efforts.

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FACTORS AFFECTING THE HOME ADOPTION OF ICT BY NON-ADOPTERS IN CENTRAL QUEENSLAND, AUSTRALIA

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ABSTRACT

The use of Internet technologies at the societal level is being seen as a fundamental driver for economic, social and cultural sustainability in both developed and developing situations. Experience to date suggests that despite the provision of expensive infrastructural access, adoption of Information Communication Technologies (ICT) for local community benefit has been relatively slow. In contextualising this issue for wider application in other situations, particularly in developing countries, this paper examines the level of non-adoption of the Internet from their home in Central Queensland, Australia, when access has been easily available for more than five years. In a population where home adoption of the Internet is 44%, this research found that there were wide variations in reasons for non-adoption across the socio-economic parameters. The findings from this research support the proposition of discontinuous adoption based on psychographic profiles. The implication is that higher adoption of ICT in homes which is intrinsically linked to the demand for IT products and services requires targeted programs to address the concerns of different societal subsets.

KEYWORDS

Internet adoption, ICT adoption, community informatics, Central Queensland

1. INTRODUCTION

Community access to modern Information Communication Technologies (ICT) as a basic component of economic, social and cultural sustainability has become a topic of increasing interest to governments and international agencies representing the interests of developed and developing nation states over recent years (WSIS¹, GCNP², Castells, 1996). In recognising the potential disadvantages from reduced access to ICT, particularly in regional and rural areas, government agencies in many developed countries have implemented large funding programs to provide Internet access to areas outside city and metropolitan areas. However, the uptake of ICT has often been well below expectations and brings into question the value of the provision of ICT infrastructure in isolation. Whilst business, education and government agencies are often amongst the first to adopt ICT for internal efficiencies, it is use at the community level which is now being posited as providing a large component of the potential social, economic and cultural benefits (Castells, 1996).

The ability of ICT to shift economic activity and service provision into larger metropolitan areas within, or even outside, nation states is now quite visible. What is now known as (electronically enabled) Community Networking has been promoted and tested at the community level by social enthusiasts as a

¹ WSIS – World Summit on the Information Society. <http://www.wsis.itu.int>

² GCNP - Global Communities Networks Partnership. <http://globalcn.org>

means of strengthening local solutions to social, cultural and economic sustainability efforts. This has mostly been undertaken in locations which demonstrate a lack of interest or opposition by business, government agencies and funding agencies. This issue is fundamental to the inclusion of the civil society along with business and nation states in the development of the agenda for the first World Summit on the Information Society (WSIS) being conducted under the banner of the United Nations in 2003.

Like governments in other developed countries, the Australian government is committed to ensuring that its citizens benefit from the information age. It promotes a view that the information economy is a vital key in the growth of regional Australia needed to build more viable regional communities, with better investment and employment opportunities (The National Office for the Information Economy [NOIE] 2002).

However, the adoption of the ICT in the communities of regional Central Queensland (CQ) is much lower than that at national level in Australia (Taylor 2002). Thus, identifying the inhibitors to the ICT adoption is imperative for government policy and service delivery. Taylor et al. (2002) have reported the associations between demographic and socio economic factors and home Internet connectivity in regional CQ.

This paper aims to identify the financial, physical and psychological barriers in adopting ICT in CQ, a region situated on the coast in the north-eastern part of Australia straddling the Tropic of Capricorn covering some 250,000 square kilometres and has a population of approximately 300,000.

2. METHODOLOGY

2.1 Data collection.

The 2001 CQSS³ (Central Queensland Social Survey) was administrated through the CATI (Computer-assisted Telephone Interviewing) system at the Population Research Laboratory within the Centre for Social Science Research at Central Queensland University (Mummery and Schofield 2001).

The CATI program allows the sample to reflect the socio economic profiles of the region by identifying the proportion of socio economic subsets required. In all valid 1200 interviews were collected with 400 being from Rockhampton and the remainder collected from within a 350 km radius of Rockhampton.

One of the purposes of this survey was to identify the reasons for some people not having computer (and subsequently not accessing the Internet) at home. Eleven reasons for non-adoption and the nine socio-economic factors were synthesised from a range of reasons identified from the literature (ABS 2000, Hellwig 2000; Rickert, 2000; NUA; PEW). This paper focuses on analysing reasons for not having computer/Internet at home in general, and associations of these reasons with each of the socio-economic parameters in the Central Queensland Region (CQR) of Australia.

2.2 Data analysis

Chi-square tests were used to examine the statistical differences between two and three categories within a variable (factor), and associations between pairs of variables (Kinnear and Gray 1997). The level for significant difference was set at $p=0.05$, but when $0.1 < P < 0.5$, the associations between two variables were considered. Multivariate analyses with Post Hoc Tests were used to obtain indicative percentage differences between the categories of variables in association with the prescribed reasons for non-adoption.

Binary Logistic Regression with categorical covariates was used to identify the factors for not having a computer at home. Odds Ratios (OR) (Knoke and Bohrnstedt 1994) were used to measure the weight of associations of each factor with each of the reasons. An OR value of 1.00 was used to indicate that two variables are unrelated; an $OR > 1.00$, indicates the positive covariation of the variables; an $OR < 1.00$, it indicates the negative or inverse covariation. The first category of each factor was used as a reference ($OR = 1.00$) to detect the association of category variation with each of the reasons.

³ Funding to undertake this data collection and analysis was provided by Telstra Research Laboratories, Australia

3. RESULTS

3.1 General findings for non adoption of computers at home in CQ

The survey results indicated that 39% of the residents in CQR did not own a home computer. Table 1 outlines the respondent's reaction to the 11 reasons offered to them to explain their non-adoption. 'Not useful' was the most prominent reason (55.8%) given for non-adoption of computers at home. This was followed by 'reducing community values' (49.5%) and 'would use a public access point' (52.2%).

Table 1. Reasons for not having a computer at home across population surveyed in CQ

Attitudes	Agree		Disagree		Total		Binomial tests
Factors	Count	%	Count	%	Count	%	P (2-tailed)
Cost	109	35.9	195	64.1	304	100	<0.0001
Difficult to use	125	35.1	231	64.9	356	100	<0.0001
Not useful	259	55.8	205	44.2	464	100	0.014
Not comfortable with the technology	206	45.7	245	54.3	451	100	0.074
Friends not using	74	15.7	396	84.3	470	100	<0.0001
Makes society less fair	95	22.2	333	77.8	428	100	<0.0001
Reduces community values	208	49.5	212	50.5	420	100	0.884
Not safe for family	114	27.7	297	72.3	411	100	<0.0001
Invades privacy	154	36.1	273	63.9	427	100	<0.0001
Lack of keyboard skills	179	38.2	289	61.8	468	100	<0.0001
Would use a public access point	246	52.2	225	47.8	471	100	0.357

3.2 The effect of socio-economic factors on non-adoption of computers at home.

Location

People living in different areas may have different reasons for not having a computer at home (Hellwig, 2000). This analysis found that a higher percentage of people living in the rural areas believed that the use of computer/Internet at home was "not safe for their family" when compared to people in Rockhampton (Table 2). This difference may indicate that people living in rural areas were more conservative adopters of ICT. However, the increase in feelings of insecurity by people in rural areas may also be associated with their reduced tertiary education levels when compared with those living in cities (data not presented).

Table 2. Geographic location associated with the attitude towards not using computer at home

Location	Rockhampton	Reminder of the region	Total (%)	P	Total N
Not safe for family	20.7	31.2	27.7	0.027	411

Gender

More male no-adopters (41.5%) than females (35.2%) indicated that a lack of keyboard skills prevented them from using a computer at home. No other gender differences were detected for non-adoption.

Table 3. The effect of gender on lack of keyboard skills for non-adoption of computers at home

Gender	Male	Female	Total (%)	P	Total N
Lack of keyboard skills	41.5	35.2	38.2	0.097	468

Age

A greater proportion of older people (>40) agree that 'difficult to use' prevents them from using a computer at home when compared to the younger cohorts (<40). More than 70% of the non-adopting senior cohort (>55) indicated that a 'computer was not useful', compared to less than 50% of their younger cohorts. As a result, over 50% the non-adopters surveyed felt a computer was 'not useful' at home. Also, more than 50% of non-adopters in senior age cohort (>55) indicated that they were 'not comfortable' with the use of a computer at home. This compares with 6.7% of non-adopters in the youngest cohort (18-24).

More than 27% of non-adopters in senior group (>55) indicated that their decision for non-adoption was influenced by friends, whereas none of non-users in the youngest cohort (18-24) indicated that their decision was influenced by friends. Over 50% of non-users in older groups (>40) indicated that computer usage may 'reduce community values', whereas fewer than 40% of younger counterparts (<40) had this opinion.

None of the youngest non-adopter cohort (18-24) thought that 'safety for the family' was a issue for not using a computer at home, whereas more than 20% of those in the older groups (>25) did. Almost 40% of non-adopters in the older groups (>40) thought that both 'invasion of privacy' and 'lack of keyboard skills' affected their decision not to adopt, compared to fewer than 30% of those in younger groups (<40).

Finally, non-adopters at home may use computer elsewhere. Over 70% of those in younger cohorts (<40) would use public access points, when compared to approximately 50% of those in middle age cohorts (40-55) and approximately 40% of those in the senior age cohort (>55).

The reasons for non-adoption of computers at home within each age group, shown in Table 4, show that the main reasons for non-adoption in the younger age cohorts (<40) were 'would use public access point', followed by the 'not useful'. The main reasons given by the mid age cohort (40-55) for non-adoption was that they felt computers at home may 'reduce community values' or they 'would use public access point', followed by the view that a computer was 'not useful'. The main reasons for non-adoption at home given by the senior age cohort (>55) was the view that a computer was 'not useful', followed by the belief that computers would 'reduce community values'.

Table 4. The effect of age on reasons for not using computer at home (%)

Age group	18-24	25-39	40-55	>55	Total	P	Total N
Difficult to use	22.2 b *	27.9 b	38.5 a	38.5 a	35.1	0.063	356
Not useful	47.1 b	38.8 b	49.4 b	72.7 a	55.8	<0.0001	464
Not comfortable with the technology	6.7 c	35.2 b	46.6 ab	54.8 a	45.7	<0.0001	451
Friends not using	0.0 b	6.5 b	11.2 b	27.1 a	15.7	<0.0001	470
Reduces community values	23.5 b	37.5 b	51.3 a	58.7 a	49.5	0.002	420
Not safe for family	0.0 b	25.8 a	29.6 a	30.3 a	27.7	0.058	411
Invades privacy	5.3 b	24.7 b	39.1 a	44.0 a	36.1	<0.0001	427
Lack of keyboard skills	21.1 b	29.0 b	42.6 a	41.6 a	38.2	0.037	468
Would use a public access point	78.9 a	69.8 a	51.2 b	39.5 c	52.2	<0.0001	471

* percentages denoted with different characters indicate significant differences a p<0.05

Education levels

Table 5 shows that people with primary education level had more negative attitudes towards to having a computer at home, either physically, or psychologically, when compared to those with higher education levels. In order, these were expressed as 'not useful', 'reduces community values', 'not comfortable with the technology' 'difficult to use' and 'lack of keyboard skills'.

The main reasons for non-adoption for people with the secondary education were either 'not useful' or 'would use public access point'. Those with tertiary education levels indicated that non-adoption at home was due to either 'would use public access point', or a belief that computers 'reduce community values'.

The level of education, especially at the primary education level, associated with non-adoption may also be interrelated with age. Further analysis revealed that within the primary education level, 24.7% of the people surveyed were in 40-55 age group, 75.3% of those were over 55, and no none were younger than 40.

Table 5. The effect of education on non-adoption of computers at home (%)

Education levels	Primary	Secondary	TAFE	Uni	Total	P	Total N
Difficult to use	58.1 a *	35.2 b	29.3 b	23.9 b	34.7	0.014	354
Not useful	76.0 a	56.4 b	48.0 bc	39.6 c	55.4	0.002	460
Not comfortable with the technology	65.9 a	46.5 b	36.1 b	34.0 b	45.3	0.005	448
Friends not using	41.3 a	14.9 b	9.9 b	4.0 b	15.5	<0.0001	466
Reduces community values	73.8 a	44.4 b	50.7 b	52.5 b	49.2	0.005	417
Not safe for family	47.5 a	23.3 b	33.8 ab	22.9 b	27.5	0.007	408
Invades privacy	53.8 a	32.0 b	35.5 ab	40.8 ab	35.7	0.054	423
Lack of keyboard skills	59.6 a	42.3 b	32.5 b	7.8 c	38.6	<0.0001	464
Would use a public access point	39.1 b	52.4 ab	53.7 ab	65.2 a	52.6	0.097	468

* percentages denoted with different characters indicate significant differences a $p < 0.05$

Marital status

People who 'used-to-be married' had significantly higher non-adoption for all reasons listed except for 'would use a public access point' when compared with those who were 'never married' (Table 6). The major reasons for not having a computer at home in the 'used-to-be married' group were the impact of 'friends not using', and believing that computers were 'not safe for family'.

Table 6. Marital status associated with some reasons for not having a computer at home (%)

Marital status	Never married	Used-to-be married	Married	Total	P	Total N
Not comfortable with the technology	34.8 b *	54.7 a	44.5 ab	45.4	0.031	449
Friends not using	9.9 b	22.7 a	14.3 b	15.6	0.042	467
Reduces community values	35.8 b	58.3 a	50.0 a	49.6	0.018	417
Not safe for family	24.2 b	36.8 a	25.1 b	27.7	0.075	408
Invades privacy	23.2 b	45.5 a	36.3 a	36.3	0.013	424
Would use a public access point	64.9 a	38.3 b	54.1 a	52.2	0.001	467

* percentages denoted with different characters indicate significant differences a $p < 0.05$

Children at home

The dominant reasons for non-adoption by people without children at home were that computer/Internet was considered 'not useful' or that it 'reduced community values' (Table 7). The main reason given by people with at least one child at home for non-adoption at home was that they 'would use a public access point'.

Combined family income per week

It can be seen from Table 8 that except for 'would use a public access point', people with family incomes lower than \$AUD400/wk had a higher proportion of reasons for not having a computer at home when compared to their higher income counterparts. In addition to 'usefulness', 'not comfortable with technology', and 'reduces community values', the 'cost' was also a factor for the lower income non-adoption. The main reason given for non-adoption by those with a combined family income of more than \$AUD400 per week was that they 'would use a public access point'.

Table 7. Effect of children at home on reasons for not having a computer at home (%)

Children at home	No children	At least one child	Total	P	Total N
Difficult to use	38.2	29.6	34.9	0.063	355
Not useful	64.0	39.4	55.7	<0.0001	463
Not comfortable with the technology	48.3	40.3	45.6	0.063	450
Friends not using	19.1	8.4	15.6	0.003	469
Makes society less fair	25.4	16.2	22.2	0.030	428
Reduces community values	54.5	39.9	49.5	0.004	420
Invades privacy	39.4	29.9	36.2	0.052	426
Keyboard skills	44.8	25.5	38.3	<0.0001	467
Would use public access point	46.7	63.9	52.3	<0.0001	470

Table 8. The effect of combined family income on non-adoption of computers at home (%)

Combined household income pw	<\$AUD 400	>\$AUD 400	Total	P	Total N
Costly	40.0	30.0	35.9	0.090	304
Not useful	62.9	46.6	55.7	<0.0001	463
Not conformable with technology	52.0	37.6	45.6	0.002	450
Friends not using	19.4	10.7	15.6	0.010	469
Reduces community values	53.2	44.9	49.5	0.091	420
Invades privacy	40.3	31.1	36.2	0.049	426
Would use a public access point	44.0	62.4	52.3	<0.0001	470

Employment status

Unemployed people tended to have lower levels of home adoption of computers. The dominant reasons was 'not useful', while 'cost', 'difficult to use', 'not being comfortable with the technology' and peer pressure from 'friends not using' were also significantly influenced by employment status.

Table 9. The effect of employment status on reasons for not having a computer at home (%)

Employment status	Fully employed	Semi-employed	Unemployed	Total	P	Total N
Costly	24.3 b *	38.8 ab	41.9 a	35.9	0.016	304
Difficult to use	24.5 b	35.0 ab	41.1 a	35.1	0.017	356
Not useful	44.1 b	42.1 b	65.5 a	55.8	<0.0001	464
Not comfortable with the technology	31.3 b	45.1 ab	53.2 a	45.7	<0.0001	451
Friends not using	9.0 b	10.3 b	20.8 a	15.7	0.003	470

* percentages denoted with different characters indicate significant differences a $p < 0.05$

Summary of the effects of all factors.

Table 1 indicates that the major reason cited by non-adopters for not having a computer at home was that the technology was considered 'not useful' across all population surveyed. This effect was affected by 'age', 'education level', 'children at home', 'combined family income' and 'employment status'.

The results of non-adoption have been summarised in Table 10 using odds ratios.

Compared to the younger age groups, higher proportions of senior people (>55) had conservative attitudes towards having a computer at home in terms of perceptions of usefulness, being comfortable to use the technology, the impact of friends not using the technology, being safe for the family and invading privacy. Higher proportions of older people had negative attitudes towards to having a computer at home due to perceptions of 'not being comfortable with using the technology', 'peer pressure', and 'privacy invasion'. Generally, people with higher education levels had lower levels of negative attitudes towards having a computer at home. This was particularly evident for perceptions of computers as being 'difficult to use', 'not comfortable with the technology', 'friends not using', and 'lack of keyboard skills'. People with at least one child at home were more positive towards computer/Internet use at home when compared to those without children at home. This was evident in the lower proportions of cited reasons ('not useful', 'makes the society less fair', 'reduces community values' and 'lack of keyboard skills') for non-adoption of computers at home, and in the higher interest in using public access points.

It was found that people with lower income did not necessarily consider 'cost' as the main factor for not having a computer at home. People with lower incomes tend to have relatively lower education levels which in itself impacts on the reasons for not adoption. Analysis of the data indicated that 72.6% people with family income lower than \$AUD400/wk only received the primary education, whereas 65.3% people with higher income had received university education. Thus those with higher income levels are more likely to be able to use computer/Internet in their work places to satisfy many of their home based needs. Unemployed and semi-employed people considered that 'cost', or 'not useful for the family' as the main reasons for not having a computer a home when compared to those who are fully employed.

Table 10 Logistic regression between demographic and socio economic factors and reasons for not having a computer at home (data were odds ratios with the first category of each factor as a reference)

Parameters	Usage codes	Cost	Difficult to use	Not useful	Not comfortable with the technology	Friends not using	Makes society less fair	Reduces community values	Not safe for family	Invades privacy	Keyboard skills	Would use a public access point
Locations	Rockhampton	1							1			
	Reminder of	1.63							1.83			
Gender	Male											1
	Female											0.70
Age	18-24			1	1	na			na	1		
	25-39			0.72*	8.2	1			1	4.85		
	40-55			0.95*	11.2	1.33			1	9.52		
	>55			1.76	11.9	4.0			1.50	11.50		
Education levels	Primary		1		1	1		1	1		1	
	Secondary		0.40		0.55	0.37		0.36	0.32		0.59	
	TAFE		0.28		0.41	0.30		0.54	0.56		0.40	
	Uni		0.23		0.33	0.09		0.54	0.31		0.07	
Marital status	Never							1	1			1
	Used-to-be							2.59	1.55			0.33
	Married							2.09	0.81			0.50
Children at home	No child			1			1				1	1
	At least one			0.63			0.54	0.56			0.45	1.70
Dwelling ownership	Rent	1										1
	Own	0.44										0.59
Combined family	<400				1							1
	>400				0.59							2.07
Employment status	Fully	1		1								
	Semi-	2.21		1.04								
	Unemployed	2.45		1.85								

*indicated no significant difference with the reference category

4. CONCLUSIONS

This study found that whilst some general reasons for non-adoption emerged across the respondents (principally ‘not useful’, ‘use public access’ and ‘reduces community values’), there were wide variations across the socio-economic parameters. Hence the research supports the proposition of a discontinuous adoption cycle based on psychographic profiles as proposed by Moore (1991).

In particular, our research has found that people residing in rural areas, those who rent properties, or those who are unemployed consider ‘cost’ was a factor for non-adoption when compared to their respective counterparts. Those with a lower level of formal education cited ‘difficulty of use’ as major reason for non-adoption. Furthermore, this group and age cohorts older than 25 years or with lower family incomes were ‘not comfortable with the technology’. Also this group and those older than 55 years were more subject to negative influences about the Internet by their friends than their contemporaries. Those with no children at home, a low level of education, married or used-to-be-married are more likely to believe Internet may ‘reduce community values’. Older people residing in rural areas, with a low level of formal education or who used-to-be married believe that Internet is ‘not safe for families’.

People with a low level of formal education cited ‘lack of keyboard skills’ as an impediment to adoption of the Internet at home. This research also found that amongst the non-adopters, those who were single, have at least one child at home, rent properties, or have higher family income favour public access points to gain Internet access. On average, over 50% of non-computer-users at home use public access points. This was particularly evident amongst singles (or younger age groups), those who own properties, those with at least one child at home, or those who have higher income (>AU\$400/wk) level, (or university education level), where the proportion of using public access points is over 65%.

This research suggests the need for well planned, targeted and integrated support programs should accompany the rollout of ICT infrastructure, if high levels of ICT use for local community benefit are to be

obtained. Higher levels on home use of ICT are quite clearly linked to the demand for ICT products and services. Whilst the roll out of ICT infrastructure is often promoted as providing regional, rural and remote situations with the benefits associated with the information age, current experience suggests this access clearly has the potential to bleed regional economies as purchasing, decision making and power shift to centers with larger economies of scale either within or outside of nation state boundaries. The challenge is to concurrently build demand and supply in regional areas in ways that strengthen regional communities as well as providing the benefits that access to such technologies in a globalising world provide.

Our findings also have implications for maximising the benefits of project funding in developing countries as they address how best to meet the challenges of the digital divide.

This research highlights the need for more detailed research in home adoption of ICT. In particular, the issues of correlations across age and other socio-economic parameters needs further examination, the impacts of marital status, the interrelationships between socio-economic parameters and public access as well as longitudinal implications require further examination.

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ATTRIBUTE SELECTION FOR CLASSIFICATION

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ABSTRACT

The selection of attributes used to construct a classification model is crucial in machine learning, in particular with instance similarity methods. We present a new algorithm to select and rank attributes based on weighing features according to their ability to help class prediction. The algorithm uses the same structure that holds training records for classification. Attribute values and their classes are projected into a one-dimensional space, to account for various degrees of the relationship between them. With the user deciding on the degree of this relation, any of several potential solutions can be used as criterion to determine attribute relevance. This low complexity algorithm increases classification predictive accuracy and also helps to reduce the feature dimension problem.

KEYWORDS

Data Mining, classification, attribute selection, relevant attributes, exclusive attributes

1. INTRODUCTION

Two well-known problems arise when building classifiers which use decision tree structures and instance-based methods. First, the input order of attributes determines heavily the predicting skills of the algorithm. Choosing the wrong order of attributes (or features) could move apart in the hyperspace, values that otherwise would be closer. Secondly, some attributes contribute more than others in building the prediction hypothesis [Aha, 1994]; attributes considered *irrelevant* increase the computational cost and can mislead distance metrics calculations [Indyk, 2000]. This is particularly true for nearest neighbour algorithms, which find the class of unknown instances using the geometric concept of proximity or similarity built around the notion of distance between points in an *n-dimensional* space. As the position of any instance is defined by the value of its attributes, if these are not relevant, then the basic assumption is violated. Based on these, attributes are classified as *relevant* or *irrelevant*, in terms of their degree of contribution to the classification model [Kohavi et al., 1997; Lebowitz, 1985]¹. Feature selection is used for this reason, and is defined as the process of identifying and removing as much irrelevant and redundant information as possible with the goal of improving classification accuracy. Because we use a tree structure to hold instances, our method requires first setting in the input order, attributes with larger discriminatory power with respect to classes, as done in some rule induction algorithms [Quinlan, 1986; Cover et al., 1997].

The complexity of feature selection algorithms depends on the number and quality of its attributes. Searching relevant attributes cannot be exhaustive in many cases. The dimension of datasets is exponential in the number of attributes. Hence, verifying every possible combination of attributes is, in many cases, out of the question [Lesh et al., 1998]. Because of this, we developed a low computational algorithm with the following goals: a) Establish a criterion to determine *relevant* attributes. b) Rank attributes at preprocessing time based on this relevance and c) Reduce the number of attributes. The overall goal is to diminish the

¹ These authors still identify *redundant* attributes, a situation which we do not address here.

algorithm's complexity as well as to increase or at least preserve its predictive skills. Our results show a steady improvement of our classification algorithm when ordered features are used with this simple method.

2. DEFINITIONS

2.1 Basic definitions

Notation $\{r \hat{\mathbf{I}} R, c \hat{\mathbf{I}} L / \forall \exp(r) \bullet \exp1(r)\}$ stand for the set of values of $\exp1$ when r and c take values in R and L , and \exp is true. If $\exp1(r) = r$ then the expression is reduced to $\{r \hat{\mathbf{I}} R / \forall \exp(r)\}$.

Let's assume the existence of a data set R composed of a finite set of N records r of type:

$$r = \langle v_1, v_2, \dots, v_i, \dots, v_n, c \rangle, v_i \hat{\mathbf{I}} T_i, c \hat{\mathbf{I}} L \text{ and } v_i(r) = v_i. \quad (1)$$

Each record is formed by the Cartesian product of a finite sequential set of attributes A_i , belonging to set S having v_i values $\in T_i$. Each record is associated with one of m classes c_1, c_2, \dots, c_m , belonging to set L . Each attribute's domain is partitioned into a finite number of user-defined intervals within domain T_i . These intervals are represented by integers with values from 1 to s_i . We assume the existence of function $ordi_i()$, which converts an attribute value into the corresponding interval value:

$$p_i = ordi(v_i), v_i \in T_i. \quad (2)$$

Using function $ordi_i$ in (2), every attribute value $v_i \in T_i$ is converted into a pattern element with value p_i . Every p_i value will fit into one of s_i partitions belonging to attribute A_i . Together, all p_i elements form a vector called pattern p containing n element values. We call P the set of all patterns p obtained from R .

$$p = \langle p_1, p_2, \dots, p_i, \dots, p_n \rangle, \forall p \in P, \forall p_i \in (1..s_i) \text{ where } p_i = ord_i(v_i(r)). \quad (3)$$

Notice that the number of partitions s_i is not the same for all attributes².

We define functions $pat(r)$ and $label(r)$ such that:

$$pat(r) = p \text{ and } label(r) = c \text{ if } r = \langle v, c \rangle, v = \langle v_1, v_2, \dots, v_n \rangle. \quad (4)$$

In every pattern p from (3) we find n sub-patterns q_i , which correspond to its prefix:

$$q_i = \langle p_1, p_2, \dots, p_i \rangle, i = (1..n). \text{ So } p = \langle q_i, u \rangle \text{ where } u \text{ is the suffix portion.} \quad (5)$$

We define function $freq(p)$, which returns the number of records exhibiting pattern p :

$$freq(p) = \# \{r \hat{\mathbf{I}} R / pat(r) = p\}. \quad (6)$$

Function $freq$ can be equally applied to a sub-pattern q_i :

$$freq(q_i) = \# \{r \hat{\mathbf{I}} R / pat(r) = \langle q_i, u \rangle\}. \quad (7)$$

We define function $freq(k)$, which is applied to the k^{th} interval from attribute A_i , giving the total number of records in k . A variation of this function includes restricting the number of objects belonging to class c .

² This is due to changes in the number of partitions for selected attributes as we show later in section 6.

$$\begin{aligned} freq(A_i, k) &= \#\{r \in R \mid ord_i(v_i(r)) = k\} \\ freq(A_i, k, c) &= \#\{r \in R \mid ord_i(v_i(r)) = k \wedge label(r) = c\} \end{aligned} \quad (8)$$

Assuming that partition granularity is such that allows all patterns to have a given label, we define function $labels(p)$, which return the set of labels associated with the subset of records with pattern p .

$$labels(p) = \{r \hat{I} R, c \hat{I} L \mid pat(r) = p \wedge label(r) = c \bullet c\} . \quad (9)$$

The number of class labels attached to a given pattern p is:

$$nlabels(p) = \# labels(p) . \quad (10)$$

Using the Equation in (10) we define the *strength of a pattern* as:

$$strength(p) = \#\{i \hat{I} (1..n) \mid nlabels(p_i) = 1\} \quad (11)$$

2.2 Other definitions

Definition 1. Attribute A_i is said to be *semi-exclusive for partition k* , iff function $semk()$ is true. Function $semk()$ is defined as:

$$semk(A_i, k, \varphi) = \exists c \hat{I} L \bullet ((freq(A_i, k, c) / freq(A_i, k)) \geq \varphi) \quad (12)$$

Parameter \mathbf{j} is a user-defined value representing the fraction of records in interval k with class c . The special case when $\mathbf{j} = 1$, is referred to as an *exclusive interval*, meaning that all A_i values in this interval belongs to the same class. Attributes exhibiting this type of value are also described in the literature as *primary* [Turney, 1996], [Kohavi et al., 1997].

Definition 2. The *degree of exclusiveness of a pattern* corresponds to the fraction of p_i elements within pattern p conforming to the *exclusive values property*. It is calculated with the following function:

$$Semp(p, \varphi) = \#\{i \hat{I} (1..n) \mid semk(A_i, p_i, \varphi)\} / n . \quad (13)$$

Definition 3. The *degree of relevance of attribute i* denoted with \mathbf{d}_i , is the ratio between the total number of records in semi-exclusive partitions and N . Large values of d mean a more *relevant* attribute.

$$\mathbf{d}_i = \#\{r \hat{I} R, k \hat{I} (1..s_i) \mid semk(A_i, k, \varphi \wedge ord_i(v_i(r)) = k \bullet r\} / N . \quad (14)$$

The opposite represents *irrelevant* attributes.

Definition 4. The *shape of a pattern* is defined as:

$$shape(p) = (p_2 - p_1, \dots, (p_n - p_{n-1})) \quad (15)$$

And the distance between two patterns is:

$$d(p, p') = \sum_i |p_i - p'_i| \quad (16)$$

Using equations from Definition 4 we can define the following:

Definition 5. The shape similarity function between shapes is defined as:

$$sf(p^1, p^2) = d(\text{shape}(p^1), \text{shape}(p^2)) \tag{17}$$

In Figure 1 we show semi-exclusive intervals and the calculation of d for two attributes, A_1 and A_2 . An asterisk means more than one class for a given partition; i.e. $nlabels(p_i) > 1$.

s_i	0	1	2	3	4	5	6	7	8	9	total
freq	77	32	62	49	79	20	12	23	11	43	408
class	*	*	*	*	*	*	*	*	4	4	54

d
54/408=0.132

s_i	0	1	2	3	4	5	6	7	8	9	total
freq	227	23	35	17	17	14	12	13	5	45	408
class	*	2	*	*	4	4	*	4	*	4	112

d
112/408=0.274

Figure 1. Attribute projection in one-dimensional space for attributes A_1 and A_2 .

3. OVERVIEW OF THE CLASSIFICATION ALGORITHM

We have previously developed a classification algorithm for supervised learning based on instances and the nearest neighbour paradigm in [Serendero et al., 2001]. Classification is done extracting two nearest patterns p^+ and p^- with respect to a query pattern p^x . The extraction of p^+ is done first in a recursive way. Any sub-pattern q_i is of the form $q_i = \langle q_{i-1}, k \rangle$. Starting with $i = 1$, assuming an empty sub-pattern $q_0^+ = \langle \rangle$ and knowing element q_{i-1} , the problem consist in finding the next sub-pattern by calculating some value for k^+ , which satisfies the following property:

$$\forall k \in K(q_{i-1}) \bullet (|k^+ - k^x| \leq |k - k^x|) . \tag{18}$$

The set $K(q)$ is defined by:

$$K(q) = \{ k \mid \langle q, k \rangle \in P \} \tag{19}$$

Hence, k^+ is the closest element to k^x among the elements in $K(q_{i-1})$. If two values of k^+ verifies Equation (18), then we chose the one where $freq(q_i^+)$ is a maximum. The algorithm searches next for pattern p^- . The search mechanism is the same as for p^+ , but with set $K(q)$ using this time pattern p^+ previously calculated:

$$K(q) = \{ k \mid \langle q, k \rangle \in P \wedge ((nlabels(\langle q, k \rangle) > 1) \vee ((labels(\langle q, k \rangle) \cap labels(q_i^+)) = \emptyset)) \} \tag{20}$$

The new pattern should have its class distinct from the p^+ class.

A final step consists in applying function $merit()$ to both selected patterns. The pattern with the largest $merit(p)$ is the winner. This function represents an aggregation of several criteria, and is defined as:

$$merit(p) = \sum_i w_i \cdot a_i(p) \tag{21}$$

Every criterion in a_i has weight w_i . These criteria a_i ($i = 1..6$), numbered in no particular order are:

- The *degree of exclusiveness* of a pattern, calculated as $a_1(p) = semp(p)$ from (13).
- The *strength of a pattern*, calculated from Equation (11). So $a_2(p) = strength(p)$.

- The *similarity shape* from Definition 5 and Equation (17) applied to a pattern against p^x to calculate the most similar shape: $\mathbf{a}_3(p) = sf(p^x, p)$.
- A number related to the *distance* to p^x , calculated as $\mathbf{a}_4(p) = d(p^x, p)$ from Equation (16).
- The *frequency* of a pattern, where a larger frequency is a better option, other conditions being equal. Function frequency is calculated as $\mathbf{a}_5(p) = freq(p)$ using function in (6).
- Let be mc the *majority class*, the class with the largest frequency then $\mathbf{a}_6(p)$ equals 1 if $label(p) = mc$ and 0 otherwise.

Weights are obtained preprocessing the training dataset. The weight of each criterion corresponds to its degree of accuracy correctly classifying patterns. Each criterion is tested individually by setting all other weights to zero. The goal is to optimise T , the *degree of accuracy* of each criterion. It is calculated as:

$$T = N^{\circ} \text{ of records correctly classified} / N; \text{ and being the error } \varepsilon = 1 - T \tag{22}$$

The application of function *merit* () at running time, allows selecting the best pattern. Its class is assigned to p^x . A more detailed explanation of this process is left for a next article.

In the algorithm implementation all training patterns are stored into a *trie* [Fredkin, 1960], including frequencies and class information at the sub-pattern level. These structures have proven to be very fast on search problems [Bergman, 1994;Merret et al., 1996; Alber et al., 2001], which is one of the main problems in the near neighbour paradigm. The large storage required by tries is partially solved keeping the file on disk. Also, several known compress tools are available for tries such as *Patricia trees* [Gonnet et al., 1991], *X-tree* [Berchtold et al., 1996] and *Burst tries* [Heinz et al., 2002].

4. ATTRIBUTE SELECTION

4.1 Determining most *relevant* attributes

In general, our method ranks attributes by their capacity of predicting classes without taking directly into consideration other attributes from the original sequence. We postulate that this capacity increases, when an attribute exhibits a larger *degree of relevance* as stated in Definition 3. For instance, attribute A_i is *relevant* if some \mathbf{a} percentage of its instances with value v_j is associated with class c_l . In this sense, we soften the Boolean definition found in [Kohavi et al., 1997]. Our objective is *to find the most discriminative attributes from the point of view of usefulness to the predictor, with the purpose of improving its prediction accuracy* [Guyon, 2001]. This heuristic criterion has been used successfully before [Liu et al., 2000].

A sub-pattern q of size i can be a common prefix for distinct labels, i.e. when $nlabels(q_i) > 1$, representing areas of larger entropy with respect to classes in the data hyperspace, not allowing any conclusion on class membership. Inversely, sub-patterns where $nlabels(q_i) = 1$, represent homogeneous regions, where smaller values for i (shorter sub-patterns) represent larger areas. If a new instance to be classified falls into one of these areas, its chances of correct classification increase. Most of its neighbours will share the same label. For this reason, we are interested in looking at the entire data space from the viewpoint of attributes with larger number of examples where classes are “*visible*” directly from them, thus avoiding endless combination of possibilities as done in traditional methods [Kohavi et al., 1997; Miller, 1990; Brodley et al., 1995]. We consider these attributes more *relevant* than others. Now, the shortest sub-pattern contains only one element $q_1 = \langle p_1, c \rangle$, usually associated with several classes. We want to find which attributes perform better than others in this situation. To do this, all values of an attribute are projected into a one-dimensional space previously partitioned into equal interval widths. In the trie structure used for implementation this corresponds to build the tree with a single level. This resembles the 1R classification system [Holte, 1993] although in this system the ranking of features is based directly on error rates. In our case we are interested in the total number of sub-patterns q_1 , found in *semi-exclusive intervals* (from Definition 1), for a given attribute A_i and \mathbf{j} values. Attributes showing more individual patterns in these intervals are also more *relevant* (Definition 4). Based on this, relevance can be set as a measure of attribute comparison as explained next.

4.2 Ranking Attributes by their relevance

Ranking attributes is done knowing which attributes are comparatively more *relevant* than others. To do this we compute each *attribute's relevance* from (14), and rank them in decreasing order according with the value of d , as the example shown in Fig. 1 for A_1 where $d = 0.132$. This ranking gives as result list β , which represents all attributes ordered by their degree of relevance:

$$\beta = \langle d_1, d_2, \dots, d_i, \dots, d_n \rangle, |d_i| \geq |d_{i+1}| \quad i \in (1..n). \tag{23}$$

Attributes where $d_i = 0$, are orderly pushed to the list's end. The list represents the input order of attributes used by the classification algorithm. As shown in Section 5 doing this improves the predictive accuracy of the classification algorithm.

4.3 Reducing the number of attributes by their degree of relevance

Reducing the number of irrelevant attributes drastically reduces the running time of a learning algorithm and yields a more general concept, easier to understand by the domain expert. This reduction can be achieved using the concept of *attribute exclusiveness* as defined in Section 3. This is done by eliminating from list β in (23) all attributes where d is small or zero. This reduction, though, cannot be done without a cost. The trade-off is done at the expense of losing some predictive accuracy. With this constrain in mind, our goal is to find a minimum subset of attributes S' such that when the classification algorithm is applied accepting some error e , we can obtain a new predictive accuracy T' as $S' \subset S$, that satisfies $T' \leq T + e$. The new set S' obtained from list β in (24) includes only *relevant* attributes discarding all others. The classification algorithm rebuilds the tree using the new sequence in S' . At running time, and using some user-user-defined error over the existing prediction value T from (22), a new T' value is obtained. Error e is a function of cost and quality [Brodley, 1995]. If Equation (24) is satisfied and $(T' - T) \leq e$, then S' is adopted as the new set of attributes. Otherwise, the threshold value of f should be reduced and list β rebuilt. As a result this will increase the number of attributes in subset S' and hopefully will also increase prediction accuracy T' diminishing the value of e .

5. RESULTS

We have tested these techniques on seven datasets from the UCI repository [Murphy et al., 1994]. All records with unknown attribute values were eliminated. Ten-fold cross validation was used. Accuracy results were averaged.

Table 1. New Attribute Order using $f = 0.75$

N°	Number Attrib.	Dataset	N. ° Records		New Attribute Order Number represents original ordinal number (Bold face = attribute is <i>relevant</i>)	Relevant Attributes (%)
			Training	Test		
1	24	Hypothyroid	1598	1063	18,23,21,1,20,22,7,5,13,24 , 19,17,16,15,14, 12,11,10,9,8,6,4,3	41.7
2	24	Dermatology	218	140	20,22,27,29,6,12,8,25,33,34,24,15,10,31,26, 30,14,23,7,32,28,21,19,18,17,16,13,11,9,5,4, 3,2,1	57.6
3	33	Adult	28468	15060	3,9,14,2,4,5,7,8,13,6,1,10,11,12	71.4
4	13	Diabetes	462	306	5,6,2,7,4,8,3,1	75.0
5	12	Forest covert	15120	565892	1,10,5,6,4,12,8,7,9,3,11,2	83.3
6	12	Pendigits	7494	3498	6,12,3,7,11,4,2,15,5,14,16,8,1,10,9,13	87.5
7	16	Cancer-W.	407	273	7,2,1,8,3,9,4,6,5	100.0

The average decrease in error rate after ordering attributes of 4.3% in Table 2 is similar to results reported for different datasets in a previous article where this technique was applied [Serendero et al., 2001]. This

confirms that the gain in predictive accuracy is significant and steady when applied to different data domains. It also confirms the need for attribute ordering when tree structures and instance-based methods are

Table 2. Variation in predictive error rate after ordering and reduction in the number of attributes

N°	Datasets	Classification: Predictive Error Rate (%)			Variation (%) due to:	
		Original (A)	Ordered (B)	Reduced(C)	Order (B-A)	Reduction (C-B)
1	Forest covert	28.2	20.5	23.9	-7.7	+3.4
2	Dermatology	10.2	4.5	6.5	-5.7	+2.0
3	Diabetes	27.8	22.2	22.5	-5.6	+0.3
4	Pendigits	9.3	5.3	2.0	-4.0	-3.3
5	Cancer -W.	5.5	2.2	1.8	-3.3	+0.4
6	Adult	18.9	16.0	10.6	-2.9	-5.4
7	Hypothyroid	1.6	0.7	1.1	-0.9	-0.4
Average					-4.3	

used, as is our case. Although not conclusive due to experiment size, variation in error rates after attribute reduction (C-B) seems to be related to the intensity of attribute “*pruning*” (Table 1). As expected, a large reduction in the number of attributes results in greater error rates. In 43% of cases reducing the number of attributes increases predictive accuracy, meaning that the ranking method works well. Attributes at the list’s end are indeed irrelevant for predictive purposes. Accuracy in the remaining datasets shows a small loss not greater than 3.3% if compared with a 56% average reduction on the number of attributes, and hence, in problem complexity. In the face of large datasets with high dimensions where traditional feature reduction methods represent very high computational costs, this method can be a fair solution.

Our feature selection methods integrated into the classification algorithm helps to produce competitive results as shows its comparison with Quinlan’s landmark tool C4.5 (also known as See5) in Table 3. In general, our classifier shows better performance than C4.5 for datasets with smaller number of classes and worse when the opposite is true. This is explained by the fact that in order to speed up the search process, our algorithm only looks for two close patterns accounting for only two classes.

Table 3. Comparing classification accuracy against the popular C4.5

N°	Dataset	Error in accuracy (%)	
		C4.5	Ours
1	Adult(Census 94,USA)	14.6	10.6 ± 1.2
2	Forest cover	29.1	20.5 ± 2.5
3	Cancer-W	5.8	2.2 ± 0.2
4	Hypothyroid	0.7	0.7 ± 0.3
5	Dermatology	3.9	4.5 ± 0.3
6	Pima Indian Diabetes	26.8	22.2 ± 1.4
7	Pendigits	3.4	2.0 ± 0.5

Source for C4.5 results: [Chou et al., 2000; Li et al., 2000; Murphy et al., 1994; Chawla, et al., 2001].

6. DISCUSSION

In this article we present a simple and low-cost feature selection method, useful for algorithms using decision trees and instance-based methods in supervised learning. Results show on average a decrease of over 4% in classification predictive error when attributes are ranked by their degree of relevance. This result is consistent with previous results obtained on different datasets and offers a simple solution to ranking features.

Accuracy increases even further in 43% of cases after attribute reduction. This not only confirms the correctness of this simple method for ranking attributes, but also the fact that it works as a good filter indication on the predictive skills of attributes. In the remaining 57% of cases a loss in prediction not greater than 3.3% did represent eliminating an average of 56% of attributes for all datasets considered. This is very important to help reducing algorithm complexity in high dimensional datasets and therefore the comprehension of the domain expert in data relations.

Future work includes modifying slightly the algorithm to extract as many patterns as classes exist in a dataset with the goal of increasing predictive accuracy in datasets with more than two classes. This should not significantly increase search time if we consider the excellence of tries with respect to search performance.

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COMPOSING HETEROGENOUS ACCESS POLICIES BETWEEN ORGANIZATIONS

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ABSTRACT:

One crucial aspect of information technology for e-Society is security, where authorization is one of the three important factors, besides availability and integrity. During the past years Role-Based Access Control (RBAC) has been proven a sound method of modeling the authorization within an organization. Recently we introduced a novel distributed concept RBAC which is based on distributed generation and administration of access rules through distributed *authorization spheres*. In this approach called *Modular Authorization*, we were able to provide techniques for a decentralized definition of access policies, which are inherited along the organizational structure.

But in an e-Society exchange of information and therefore access to information is not limited to a single organization. In this paper we present an extended version of the Modular Authorization which allows to define access policies across the boundaries of an organization, thus taking into account both distributed and heterogeneous authorization structures.

KEYWORDS

Role-Based Access Control, Authorization, Composition

1. INTRODUCTION

In large organizations a huge number of access rules and constraints are needed for securing the access to sensitive data. This poses serious practical problems for consistency checking of rule sets as much as for checking access requests against large lists of company-wide access requirements. Formal approaches to access control (authorization) offer an inherent potential for automated verification and evaluation procedures.

While practical efficiency is already a key issue under homogeneity assumptions these questions have so far only been studied to a small extent. As the major contribution of this paper, we will present a general approach for distributed authorization that features novel compositional techniques supporting efficient generation, analysis, evaluation procedures specifying data access policies for heterogeneous structures of cooperation within, and between, large organizations. We termed our formal model **Extended Modular Authorization**. It is based on Role-Based Access Control (RBAC). An in-depth overview to role-base access control was given in [Samarati and de Capitani di Vimercati, 2001; Sandhu et al., 2000].

The idea of Role-Based Access Control (RBAC) was developed during the last decade. Its key concept is the following: access rights to an object, called privileges, are connected to a role, not to a single user. A user is assigned one or more roles, and gets access privileges through these roles. If a user changes his job position he is assigned a new role and others may be discarded, but the role itself is unchanged. Our formal method was developed in a first step for handling distributed authorization under distributed control, in a hierarchically organized company [Wedde and Lischka, 2001]. Here distributed authorization control was studied for the first time. In [Wedde and Lischka, 2003] we presented an approach to specify a cooperative administration of an RBAC system.

The problem of composing independent role-based access policies has been studied to a small extent so far. On the one hand the properties of the composed authorization rule were to be formally and automatically derived from the properties of the originating authorization spheres, and from the semantics of the composition operator. Along these lines, an algebra of security policies has been defined by P. Bonatti et. al [Bonatti et al., 2000], and a method of composing different policies has been presented. While

algorithmically attractive this yields a centralized implementation which may soon turn out infeasible for cooperating companies. On the other hand, while Bonatti's algebraic formulas can be expressed in our formal RBAC language - thus putting the algebraic compositional concept in one-to-one correspondence to our incremental method - we keep track of the control area (authorization sphere) under which an access rule is governed. Thus, in case of decision conflicts or inconsistencies we are able to both restrict the search area and resolution procedure of such problems to the involved control areas (modularly).

A role graph based approach was presented in [Nyanchama and Osborn, 1999; Osborn, 2000], which allows to merge access policies from different organizations. However, in this way the approach does not reflect synergetic effects and methods as arising from negotiations between companies (clearinghouse activities to accommodate the possibly divergent interests). Besides, there is a need to homogenize roles and graph structures which is not practical, let alone flexible, under changes of security requirements. In essence, the graph structure represents a centralized control approach. In contrast our model is both decentralized and flexible. In [Cuppens et al., 1998] the problems of merging several security policies are addressed yet these policies are defined in a homogeneous framework of roles and their structures, different from practical needs.

In the next section we present a scenario which will further demonstrate the potentials of our approach. In section 3 we describe the key issues of Modular Authorization. The definition of our authorization language is extended in section 4 in order to include tools for cooperative arrangements between companies. In section 5 we show how a cooperation between two organizations can be modeled with these rules. Conclusions are drawn in section 6, and an outlook on our future work is given.

2. SCENARIO

Cooperating organizations (companies, government agencies) exchange data frequently. This is particularly so in case of a joint task force between two companies (which is joined by employees from both partners, typically on a temporary bases while the task force is established on a medium range). A good example may be a consulting company which is on a mid-range contract to collaborate with the software department of a large corporation, in defining, pursuing, and completing a large software project. Even if the task force is residing at the location of one partner data access is necessary to data located at the other site, during the software development process. This involves quite a few complications, beyond the access control problems in one organization.

In this subsection we briefly describe an application scenario of a cooperation between two organizations. We are dealing with a cooperation ("Fu-Company") which hired an IT-Consulting Company ("Consult") to support their development department in a particular project. In this scenario we will focus on the role functionality of these organizations, due to the page limitations.

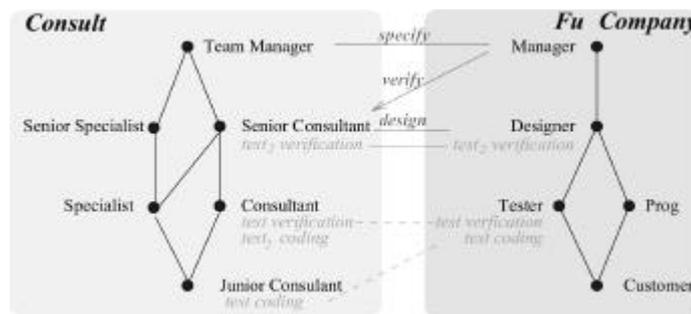


Figure 1. role hierarchies of two cooperating organizations and relations between roles

The role hierarchies of the two cooperating organizations are shown in figure 1. We assume that the cooperation is not limited to the exchange of some data files between the organizations. Instead the staff involved in the cooperation should access the data according to their assigned roles in that cooperation. Each organization assigns roles to their staff according to its role hierarchy. The following example illustrates that a one-to-one relationship between the roles is not always suitable for a cooperation.

In the software-department of the “Fu-Company” a dedicated role “Tester” is responsible for testing and the verification of the test is done by a different user which is assigned the role “Tester” as well. On the other hand in the consulting company it is the job of “Junior Consultant” to code all the tests. The verification is done by the “Consultant”. If a “Consultant” is developing tests, these will be verified by a “Senior Consultant” in the same company.

We recognize a direct relation between “Junior Consultant” and “Tester” w.r.t. test coding, as well as between “Consultant” and “Tester” w.r.t. test verification. We may decide to extend the role “Designer” within this cooperation, in such a way that a user assigned that role, may also verify the tests of a “Consultant”. We assume that the work-flow in the cooperation of “Consult” and “Fu-Company” may be as follows:

- “Manager” of “Fu-Company”, in cooperation with “Team-Manager” of “Consult”, is responsible for the **specification** of the software. The specification is released for the analysis when it is signed by “Manager”.
- It is the job of “Team Manager” and “Senior Consultant”, in cooperation with “Designer”, to do the **analysis** of the software project.
- The **design** is generally modeled by “Senior Consultant” and “Designer”, while some design jobs are delegated to “Consultant” and “Specialist”. (The role “Specialist” is always applied to an area of expertise, we do not want to model this by a set of roles e.g. “Specialist for Cryptography” or “Specialist for Network Programming”. Instead an expert of cryptology is a user which is assigned the role specialist in unit “Cryptography”.) While the time-consuming detailed design jobs are done by the former, the later is responsible for the design of complex and/or critical parts of the project.
- In this cooperation fragment no user is assigned the role “Senior Consultant” in this project group, due to cost reduction. Thus no access rights granted to the role “Senior Consultants” could be exercised by the “Team Manager” through that role.
- The design has to be presented to the “Manager” for signature. At that point no more modification is allowed. (If the inspection was successful all roles which are responsible for the coding may access the documents.)
- If the “Manager” refuses the design, he may alter the specification.
- If he modifies the specification, all roles which are responsible for the analysis and the design may alter the corresponding objects.

These role descriptions will be formalized by authorization rules presented in section 5.

3. MODULAR AUTHORIZATION

Access monitoring may be quite inefficient and infeasible for large organizations (and hence a large set of access rules). For overcoming this we will now introduce distributed access control through distributed authorization spheres which are partially autonomous in setting new rules while at the same time higher-level access rules are “inherited”. Thus access control is a local operation, and the control structures can be flexibly adapted to changing needs.

Considering the scenario in section 2, a manager has mostly the same function in every project team. The specific behavioral patterns and access rights for this role can therefore be partially inherited by superordinated roles within an authorization spheres. The special needs in a subordinate project team would be taken care of by adding special authorization rules.

3.1 Roles and Units

As in other models [Sandhu et al., 2000] that are based on role-based access control (RBAC) “a *role* is a job function or job title within the organization with some associated semantics regarding the authority and responsibility conferred on a member of the role”. In our approach we additionally define a structure called *unit* to model organizational entities such as departments or project groups. In [Wedde and Lischka, 2001] we called the same structure *group*. Due to confusion with other research such as in e.g. [Osborn and Guo, 2000]

we changed the name here into *unit*. In [Osborn and Guo, 2000] groups are sets of users and a group can be assigned a roles. In that the role is assigned to all users which are member of the group. As a user may play different roles in different units, we want to specify access rights, or limitations, for a particular user w.r.t. his or her membership in a unit. Consequently, every access right will be specified to apply to a pair ($\langle role \rangle$, $\langle unit \rangle$) and users are assigned a role in a unit. Thus a user “Bob” assigned to “Manager” in unit *A* and “Designer” in unit *B*, may not use the access privileges of a “Manager” in unit *B*.

We consider a *unit* as a set of subjects and objects to pursue (possibly very complex) tasks. A hierarchical order is defined over all roles. This allows us to derive access rights according to this hierarchy (e.g. a superior role has all the access rights of the subordinated role w.r.t. this hierarchy) There is also a hierarchical order defined for all units which represent of an organization.

3.2 Authorization Sphere

One key aspect of our modular authorization language is a decentralized definition of the access policies through local **authorization teams**. The access policy of a local authorization team, expressed through a set of rules, is valid for a well-defined set of units. We call this set the **authorization sphere** of an authorization team. An authorization team consists of all users who may modify the set of rules of this authorization sphere. *An authorization sphere is a special unit*. Every unit is subordinate to an authorization sphere, and *authorization spheres do not overlap*.

In our model the authorization is partially done in a **modular** fashion, through the different authorization teams. At the same time we have an **inheritance principle** built in, which is based on hierarchical relationships between authorization spheres. The key issues of this principle are:

- Rules which are defined by an authorization team of a unit under the corresponding authorization sphere for accessing and manipulating objects are valid for the unit, as well as for subordinate units. (This includes subordinated authorization spheres.)
- If two inheritance streams are merged into a subordinate authorization sphere **conflicts** may arise within in the corresponding units (For details see [Wedde and Lischka, 2001]). A conflict resolution is required. For this purpose every unit which is subordinated to two ore more superordinate authorization spheres will be modeled to a special authorization team, for modeling the resolutions.

For further details on how enforcement, overruling and extension of rules are handled we refer the reader to [Wedde and Lischka, 2001].

3.3 Formal Definition

The following entities are used to specify the modular authorization language. \mathcal{U} is the set of all units defined in the system. The units are partially ordered into $(\mathcal{U}, <)$ representing the organizational hierarchy. All authorization spheres comprise the set \mathcal{AS} which is a subset of \mathcal{U} , as authorization spheres are special units. The authorization sphere of a unit is expressed through a function *sphereof*: $\mathcal{U} \rightarrow \mathcal{AS}$. In the sequel we refer to the partial order “<” defined for units through the organizational hierarchy.

$$sphereof(u) = \begin{cases} u, & u \in \mathcal{AS} \\ as, & as \in \mathcal{AS} \wedge as > u \\ \bigwedge as' \in \mathcal{AS}: as > as' > u \end{cases}$$

\mathcal{R} is the set of all roles defined in the system, which have an system/organization wide unique name. The roles are also partially ordered into $(\mathcal{R}, <)$. There are further sets comprising all subjects (\mathcal{S}), all objects (\mathcal{O}), type of objects (\mathcal{T}) and all access methods (\mathcal{AC}) defined in the system.

3.4 Feature Predicates

Feature Predicates characterize the variables used in all access predicates. This covers subjects, objects and authorization spheres. In this way feature predicates are particularly used to model the scope of access policies. Units contain objects and users who are assigned roles in that unit.

Definition 1 (unit membership) *The binary predicate **unit** (e, u) holds iff entity $e \in \{ST \cup OT\}$ is a member of unit $u \in UT$. ST is a subject term specifying a concrete subject or a variable denoting a subject. In a similar manner, OT is denoting a concrete object or a variable. UT is a unit term, denoting either a concrete unit or a variable.*

In case of $u, u' \in \mathcal{U}$ where u' is subordinated to $u (u' < u)$, if $s \in \mathcal{S}$ has a role in u and s may (temporarily) belong to u' the role would have to be assigned to the user. (not necessarily the one he held in u). If no role is assigned to user s in u' , then $unit(s, u')$ will not hold. Units may be related to other units, this is expressed by the following predicate.

Definition 2 (unit relation) *The binary predicate **unitin**(u_1, u_2) holds iff $u_1, u_2 \in UT$ and $u_1 < u_2$ according to the unit hierarchy or of u_1 and u_2 are identical.*

As authorization spheres are interpreted as a set of units from \mathcal{U} this predicate may also be used to describe a hierarchical relationship between two authorization spheres.

Similar predicates are defined to specify roles and their assignment. A feature predicate describing the role-assignment has the form **role**(s, g, r) and holds if subject s is assigned role r in unit u . A relation between roles is expressed by a predicate of the form **rolein**(r_2, r_1) which holds iff role r_2 is a subordinate role or r_1 according to the role hierarchy specified.

There are more feature predicates entirely presented in [10] describing the ownership, signature on objects, types, attributes of objects which can not be presented in this paper, due to the lack of space. The set \mathcal{F} contains all feature predicates defined in the system.

3.5 Access Predicates

The actual access policies are modeled through rules which are expressed by access predicates. As shown in table 1 these access predicates are defined in a layered fashion, as each layer may contain predicates of the previous one. as denotes the authorization sphere which specifies the rule that a subject s is given or denied (depending on $\langle sign \rangle$) access with method a on object o .

Table 1. access predicates

cando ($as, s, o, \langle sign \rangle a$)	$\leftarrow L_1 \& \dots \& L_n$	$L_i \in$	\mathcal{F}
dercando ($as, s, o, \langle sign \rangle a$)	$\leftarrow L_1 \& \dots \& L_n$	$L_i \in$	$\mathcal{F} \cup cando$
descide ($as, s_a, s, o, \langle sign \rangle a$)	$\leftarrow L_1 \& \dots \& L_n$	$L_i \in$	$\mathcal{F} \cup cando \cup dercando$
do ($as, s, o, \langle sign \rangle a$)	$\leftarrow L_1 \& \dots \& L_n$	$L_i \in$	$\mathcal{F} \cup cando \cup dercando \cup decide$
grant ($as, s, o, \langle sign \rangle a$)	$\leftarrow L_1 \& \dots \& L_n$	$L_i \in$	$\mathcal{F} \cup cando \cup dercando \cup decide \cup do \cup$ $grant(as', s, o, \langle a \rangle); as' < as$

The basic rule (**cando**) is used to enable or deny access under the condition stated in the body of the rule. A basic rule may give a role write access to a specific type of objects.

Derivation rules (**dercando**) are used to link a file access to other access rights of type *cando* or feature predicates. As mentioned above giving the same rights to a superior role (according to the role hierarchy) is one concept. In our approach we may limit this kind of inheritance to some types of objects or the rights are only handed on users who are assigned a superior role in the same unit. We may also derive a read privilege if the same role is already allowed to write a specific object.

Deduction rules (**do**) describes how, in a specified authorization sphere, new rules can be deducted based on the validity of specific access predicates. In some cases it might be necessary to define exceptions from derived rules, e.g. a role may write to mailbox file but is not allowed to read it, even if a general derivation rule defines otherwise.

The environments of our system may be highly dynamic, therefore we may define *decision* rules (**decide**) which initiates the authorization sphere where the access request occurs to check with a user whether the access is granted or not.

Conflicting rules originating from different higher ranking authorization spheres will be handled according to grant rules (**grant**). In order to resolve these conflicts rules of any authorization sphere as well

as grant rules from any subordinated authorization sphere may be considered. (This limitation guarantees a cycle-free definition of the rules.)

A more detailed motivation for the layered structure has been given in [Wedde and Lischka, 2001]. From a practical viewpoint validity checks for access requests can be more efficiently completed in a layered structure of the described type, as compared to a complete search through the list of access predicates.

In the next section we present the extensions to our modular authorization language which are necessary to meet the requirements of such a kind of cooperation between two organizations. In section 5 we will show how the given examples can be formalized.

4. EXTENDING MODULAR AUTHORIZATION

As the example in figure 1 shows, for cooperation between organizations two new problems surface: one is the heterogeneity of the roles and their hierarchical structures in the partner organizations, the other one is the problem to model collaborative requirements between such role structures that cannot be expected to be congruent in all aspects. In this section we will outline a homogeneous extended modular approach to support this additional design task.

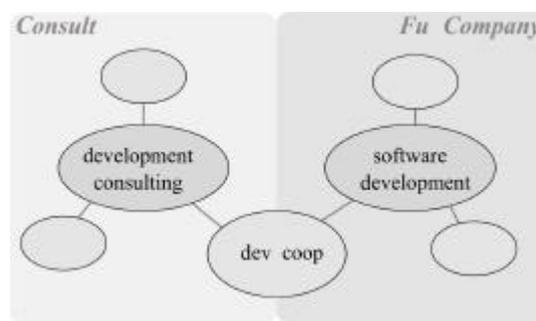


Figure 2. cooperating authorization sphere

As usual in practice a working group or task force is established for the cooperation between the two organizations described in section 2, which specifies the details of the cooperation. In our modular authorization system this is modelled by a common authorization sphere which has two ancestors, one in each organization. According to the hierarchical order of the authorization spheres all rules of “Consult” and “Fu-Company”, which have been formalized to express the work-flow in units of these organizations, are inherited by the subordinated spheres (see 3.2). We have shown in [Wedde and Lischka, 2001] that conflicts may arise if two inheritance streams are merged and have discussed some resolution strategies.

While merging the inheritance streams of two organizations we have to deal with doubled declaration of roles, units, etc. But double declared roles, e.g. a “CEO” of an American stock cooperation and a British private limited company, may mean different roles. We keep the names yet add the information about the organization, to solve this problem. (As Modular Authorization was designed for heterogeneous distributed systems, all of the declarations mentioned above, are checked at each node. Thus the declarations and rules are digitally signed by the authorization team responsible in the organization. (As Modular Authorization was designed for heterogeneous distributed systems, all of the declarations mentioned above, are checked at each node. Thus the declarations and rules are digitally signed by the authorization team responsible in the organization. (The digital signature is generated by a shared signature scheme [Shoup, 2000]. The signature key of the authorization team is certified by the ancestor team. A detailed description of mutual extension of roles and declaration is topic of a future paper.) As an additional result it is possible to identify the organization during the evaluation of access requests and operate only on the declarations, partially orders and rules of the respective organization.)

In order to formalize two declarations as equivalent, or to refer explicitly to predicates of other organizations, respectively we introduce three additional feature predicates. For the definition we also define the set ORG : It contains all organizations known in the system, $\mathcal{V}ORG$ is the set of name variables denoting

elements of ORG . Organization-terms ORT are defined as $ORT = \mathcal{V}ORG \cup ORG$ specifying either a concrete organization or a variable denoting an organization. We use the notation $org, org' \in ORT$. In a similar manner, \mathcal{RT} is specifying a role-term and \mathcal{TT} terms of object-types.

The organization which declares a certain role is described by the following feature predicate:

Definition 3 (role affiliation) *The binary predicate $roleof(r, org)$ holds iff $r \in \mathcal{RT}$ and $org \in ORT$ and r is a role defined in organization org .*

Similar the organization which declared a specific type of objects is described.

Definition 4 (type affiliation) *The binary predicate $typeof(t, org)$ holds iff $t \in \mathcal{TT}$ and $org \in ORT$ and t is a type defined in organization org .*

The organization of a unit, but also the organization sphere, can be described through the following feature predicate:

Definition 5 (unit affiliation) *The binary predicate $unitof(u, org)$ holds iff $u \in \mathcal{UT}$ and $org \in ORT$ and u is a unit of organization org .*

In the example given in section 2a common authorization sphere “dev-coop” is created between the two organizations “Consult” and “Fu-company” as shown in figure 2. Within this common authorization sphere the evaluation of the rules of the predicate $unitof(dev-coop, Consult)$ and $unitof(dev-coop, Fu-Company)$ should be valid, as this authorization sphere does not belong to any organization in particular. With these extensions we may formalize the access rules for the scenario given in section 2.

5. COOPERATION OF ORGANIZATIONS

In our scenario we assume that “Tester” and “Junior Consultant” to have the same read and write access rights for all objects that are associated with testing. The scope of these objects can be characterized through feature predicates [Wedde and Lischka, 2001], and we will denote the set of these predicates by $F_{o-Test}^{Consult}$. In formal terms to formulate the rule that a “Tester” has access rights a to objects to which “Junior Consultant” has access rights a , are as follows:

$$grant(dev-coop, s, o, +a) \leftarrow do(as, s', o, +a) \ \& \ unitof(as, Consult) \ \& \ role(s, u, Tester) \ \& \\ role(s', u, JuniorConsultant) \ \& \ unitin(u, dev-coop) \ \& \ F_{o-Test}^{Consult}$$

If a “consultant” has the right to sign an object of a specific unit, this right is also granted to the “Tester”.

$$grant(dev-coop, s, o, +s) \leftarrow do(as, s', o, +s) \ \& \ unitof(as, Consult) \ \& \ role(s, u, Tester) \ \& \ role(s', u, Consultant) \\ \ \& \ unitin(u, dev-coop) \ \& \ F_{o-Test}^{Consult}$$

Correspondingly we formalize the access rules allowing “Consultant” or “Junior Consultant” to access object for which “Tester” has access rights a , in the same manner.

In the scenario we assumed that no user is assigned to role “Senior Specialist” in the authorization sphere “dev-coop”, therefore all access rights of “Team-Manager” which were derived from the rights of that rule should be disabled. This is formalized by the following rule.

$$grant(dev-coop, s, o, -a) \leftarrow role(s, u, Manager) \ \& \ unitin(u, dev-coop) \ \& \ unitof(as, Consult) \ \& \\ dercando(as, s', o, +a) \ \& \ role(s', u', SeniorConsultant)$$

In our scenario in section 2 we described several stages and steps in a software development process, in particular dependencies and transactions. We model the latter ones through access rules as in the following characteristic examples:

Both a “Manager” and a “Team-Manager” may write objects of type “project specification” as long as this object has no signature from a “Manager”.

$$cando(dev-coop, s, o, +w) \leftarrow role(s, u, Manager) \ \& \ unitin(u, dev-coop) \ \& \ typeof(o, proj-spec) \ \& \\ \neg signature(o, s') \ \& \ role(s', u, Manager) \\ cando(dev-coop, s, o, +w) \leftarrow role(s, u, Team-Manager) \ \& \ unitin(u, dev-coop) \ \& \ typeof(o, proj-spec) \ \& \\ \neg signature(o, s') \ \& \ role(s', u, Manager)$$

When the project specification is completed, the specific objects are signed by a “Manager”.

$$cando(dev-coop, s, o, +s) \leftarrow role(s, u, Manager) \ \& \ unitin(u, dev-coop) \ \& \ typeof(o, proj-spec)$$

(As there is a valid signature at that object, none of the two rules above will be valid, thus a “Manager” or a “Team-Manager” may not write on that object.)

“Senior Consultant” releases a project design by signing off on it. “Manager” may accept the design and add his signature. If he does not accept it, he may modify the project specification (a kind of constructive denial).

$$cando(dev-coop,s,o,+w) \leftarrow role(s,u,Manager) \& \text{unitin}(u,dev-coop) \& \text{unit}(o,u) \& \text{typeof}(o,proj-spec) \& \text{signature}(o',s') \& \text{unit}(o',u) \& \text{typeof}(o',proj-design)$$

After adding his comments the specification may also be modified by a “Team-Manager”, as the former signature of the “Manager” is no longer valid. The specification will be signed again to start the next round of analysis and design process. The rules which model these procedures would be formalized correspondingly. Due to page limitations we give this hint only.

6. CONCLUSION AND FUTURE WORK

In this paper we dealt with large sets of complex access requirements and presented a method of modeling access control mechanism by means of access rule composition. We meant to demonstrate that through a formal extension of the role model in the Modular Authorization approach [Wedde and Lischka, 2001] we succeed in covering all relevant aspects of collaborative interaction between organizations that exhibit heterogeneous role patterns and inheritance structures as well as cooperation rules between the organizations involved. We covered structural and functional heterogeneity like between corporations from different business areas.

Due to page limitations we were only able to demonstrate our findings in a case study cycle. However, while we have certainly completed more systematic research in this subject field we have started further work, particularly in respect to conflict detection and resolution techniques. This will be subject to discussions in upcoming publications.

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E-LEARNING SYSTEM MULTIPES

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ABSTRACT

In this paper we would like to introduce the e-learning system MultiPeS that is being developed at the Department of Cybernetics, Faculty of Electrical Engineering, Czech Technical University in Prague. This system is used as educational support tool for students in full-time study and as teaching material for students of life-long learning and in distant form. In addition to multimedia tools, the elearning system MultiPeS contains a number of modules that significantly contribute to easier acquisition of information, creating relations among pieces of information and their successive remembering and refreshing. Courses developed in MultiPeS environment can be run both in on-line and off-line mode.

KEYWORDS

Information and communication technologies, e-learning, HTML course, multimedia

1. INTRODUCTION

Invention of writing was a cultural event that appeared simultaneously in China and in Golden Halfmoon of eastern Mediterranean area approximately 5000 years ago. It was the first attempt to save and exchange information between different locations and in time. It happened 200 000 years after speech appeared. We think that the most important invention that influenced information and communication system of our planet in the past was the invention of letter-print by Johann Gutenberg in 1447. Gutenberg's letter-print changed the world immediately, fast and drastically. It improved and unified writing, eased reading, which enabled fast production and distribution of information. New technology enabled that new information and theories were shared not only locally but also on long distances. New letter-print system invented by Gutenberg was cheaper, faster and individually focused and scored a success in the society. In its concept it is very simple, based on elementary moving types that can be placed in line and form words, sentences, meaning and record ideas.

Parallel with changes we are nowadays witnessing in connection with the development of new information and communication technologies is striking to the eye. Internet has become a new information and communication network of this century. It is cheap, fast, individually focused information medium and scores a success in the society. At present 380 million people around the world use the Internet and every day this number increases by 170 000 new subscribers. More than 10 million people use the Internet every day. Exchange of knowledge and information in the world network is for sure revolution for our knowledge and culture and it may represent another Gutenberg's revolution. At present each employee must manage during his/her active life twice or three times larger volume of knowledge than he/she got during his/her study. Thus he/she arrives at life-long learning. Elearning is a special tool suitable for this type of education. In its concept it is a simple tool based on separate bytes that "placed" in line form meaning, imagination, sound – the multimedia.

In this paper we would like to explain the motivation for the development of our own e-learning system, its architecture, and functions of individual modules.

2. ADVANTAGES CONNECTED WITH APPLICATION OF E-LEARNING SYSTEMS

At present when information is moving force of the world nobody doubts about necessity of continuous education. Systematic education of employees and self-education using the form of training, seminars, or individual study is common constituent part of life of every individual. To prepare young people for a new world means that we must develop new ways of teaching and learning. The way we learn changes radically: from purely lecture based education to interactive style. E-learning is a modern form of distant education that utilizes the most up-to-date information technologies in the form of electronic distributed education. Its main advantages are versatile flexibility and saving. Multimedia course combines text explanation with animations, video sequences, audio recordings, graphics, schemas and testing objects.

Classical education assumes that all or most of the students perceive and understand with the same speed, that oral explanation of the lecturer is convenient for all students and that all want to study the same topic at the same time. Elearning system removes all these shortcomings. Student can study the course as long he/she wishes, defines way of passing the course, going back to some topics, selects from several variants of explanation. He/she runs the course when needed that means that he/she wants to study and will concentrate on the topic. By means of a number of questions, and tests, he/she is interactively involved in educational process, which significantly increases effectivity of the process and remembering and understanding of the topic.

At classical education it is very difficult to measure what information students have kept from a course after a certain time interval. Course quality strongly depends on the teacher's quality and can be variable in time. Often the course cannot be evaluated before the students finish the course. Thus sometimes it is found out then only that a certain course does not correspond to original requirements. E-learning with the aid of testing objects and control systems effectively measures each course. It enables to set up objectively required goals (e.g. after finishing the course student must answer correctly 95 out of 100 questions concerning the topic) and to measure them in a simple way. E-learning supplies immediately information about individual students: what is their score in certain parts, how much time they spend in certain parts of the course, how they respond questions. E-learning statistically evaluates success rate of individual courses and in this way it identifies courses that should be modified or re-structured. E-learning lays emphasis on the way of passing information to students. At present it is not satisfactory to acquire right information at right time but it is necessary to understand the information fully and to see relations in the given context. Precisely this the e-learning offers.

The aim of e-learning is not to replace classical education in all areas. However it is a suitable supplement even for such areas where classical style is due to the direct contact between students and teachers regarded for irreplaceable. For example, it is possible to "pre-train" students electronically. Then they arrive to lessons with a teacher with a lot of information and questions. The teacher can focus on interesting or difficult parts of the topic, which leads to significant extension and enrichment of the course. In addition to that, the teacher is not excluded from the process of educating students. E-learning brings a number of communication tools from e-mail to videoconferences that enable teachers to contact individually each student. Based on the information from the electronic course, the teacher has precise information what the student's score in certain parts is, how much time he/she spends in certain parts of the course, how he/she responds questions. Thanks to the communication tools the teacher can communicate with a certain student more intensively than in classical lessons.

3. E-LEARNING SYSTEM MULTIPLES

Nowadays there exist a number of commercially available e-learning systems. We analyzed their functions, advantages and disadvantages. After this analysis we decided to develop our own e-learning tool. One of the main reasons was the price of commercial systems. Although each of the companies that offer the e-learning systems has different business policy (one company offers an e-learning system as a compact system, another company offers a system as a set of modules that can be purchased separately), the basic price of a functional system is at least several thousands of US dollars (hundreds of thousands of Czech crowns). The price does not depend only on the type of the commercial product but also on the number of used modules (e.g. testing

module, module for automatic message sending) and the number of students that use this tool for their study (number of user licences). Each upgrade of the system is paid as well. The expenses for staff training are quite high, too. The price of one-day training is usually more than 500 US dollar for one person. (All prices are based on information available on the Internet.) The staff must be trained for maintenance of the system functionality and for development of e-learning courses as well. Other reasons for development of our own system were very diverse quality level of available systems, (un)availability of individual functions of the system, and frequently not very intuitive menus and commands of the system. In addition, most of the commercial systems do not allow off-line operation and thus study of e-learning courses which means higher costs for students working from their homes. Besides that these systems do not usually allow greater modification of the course using scripts that a skilled teacher can develop.

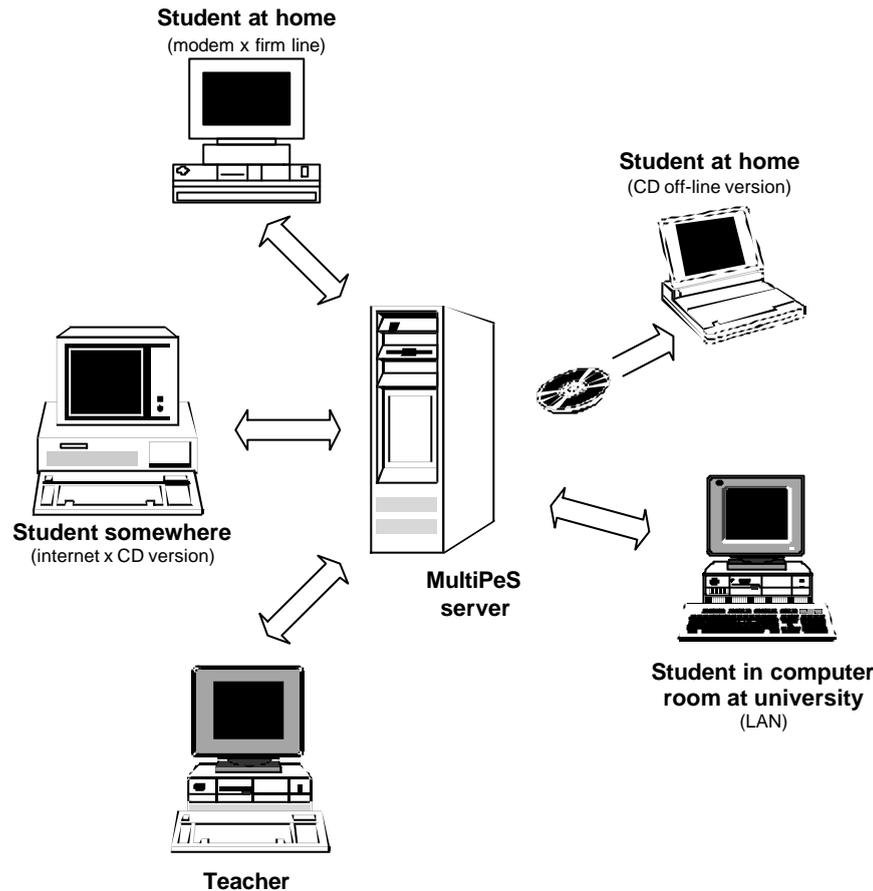


Figure 1. Possibilities of study using MultiPeS e-learning system

Based on the above-mentioned analysis and described advantages of use of e-learning, we have decided at the Department of Cybernetics to develop an e-learning system **MultiPeS (Multi media Pedagogical System)** that could help us continuously increase quality of teaching and include the latest research results. The developing environment is programmed in Microsoft Visual C++ 6.0 programming language under Microsoft Windows operating system. It is designed as an open modular system, which enables its simple further extension. Students access courses placed on an educational server using a PC at any place and anytime through an internet explorer (MS Internet Explorer or Netscape Navigator). Another advantage of the e-learning system MultiPeS is that it works both in on-line mode (the educational course is placed on web pages of the educational institution, access from computer laboratories, home study with modem or firm connection to internet), and in off-line mode (student can get the course on a CD-ROM), that is more suitable for home study since it can save financial means. Students can choose the variant they prefer. However it is obvious that some features of the MultiPeS e-learning system are available only in on-line mode (e.g. e-mail communication of the student with the lecturer, or other students).

3.1 Project Design

First step in preparation of an e-learning course in MultiPeS system is creation of a new project. The project is a group of all course parts (texts, figures, tests, sound tracks, or video sequences). The file containing the project has suffix *.prj and its structure is shown in figure 2.

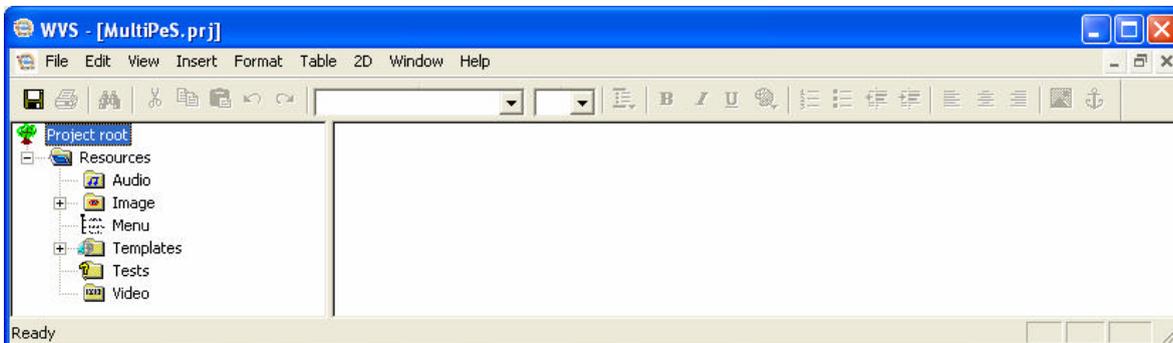


Figure 2. Structure of a new project

3.2 Menu

For simple orientation in learning text, two types of menu – normal and tree – are incorporated into the MultiPeS e-learning system. The teacher that creates a course can not only select Menu type (see figure 3) but also construct Menu and attach various icon types to individual parts of the Menu. Menu constructed in this way is shown in middle part of figure 4.

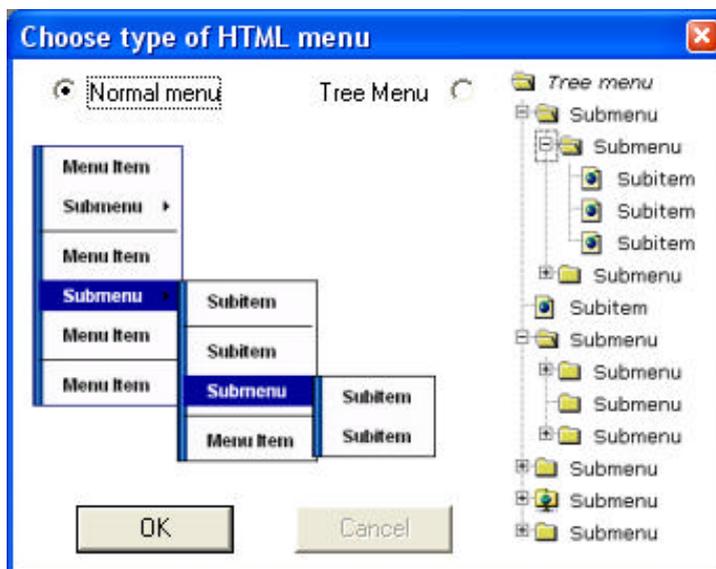


Figure 3. Choice of different Menu types

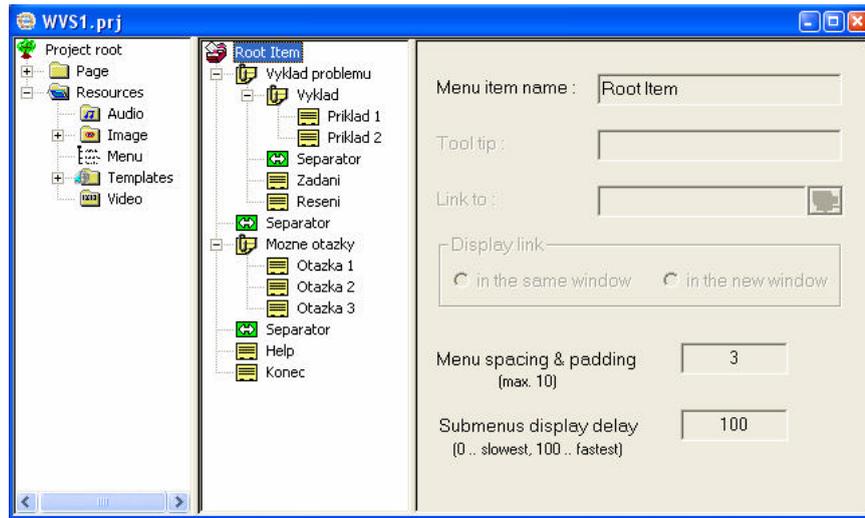


Figure 4. Menu Creation

3.3 Learning Page

General structure of learning page of the MultiPeS e-learning system is shown in figure 5. The page is divided into three parts:

- menu – for simple orientation among individual learning pages
- syllabus – references in large text (learning text exceeds one page)
- text

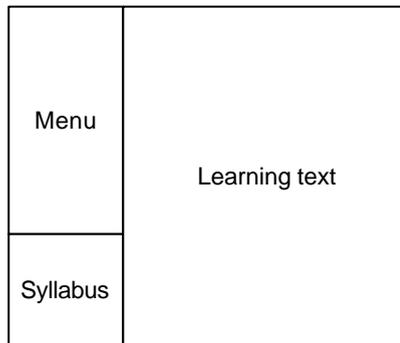


Figure 5. Structure of learning page

In the project, there are predefined templates for creation of learning texts for the user. Similarly as with multimedia elements, it is possible to insert into the project new user templates or to generate templates directly in the project. When developing a new learning page, the user is asked about the page template he/she wants to use for the new page. After that the template’s preview opens in right half of the screen.

In built-in editor there are following elements for development of learning pages available:

- text insertion and modification
- text structuring (bullets, numbering)
- tables
- references (in text, to another page)
- multimedia elements (figures, animations, sound tracks, video sequences)
- page background
- insertion of scripts for extension of functionality of the learning page

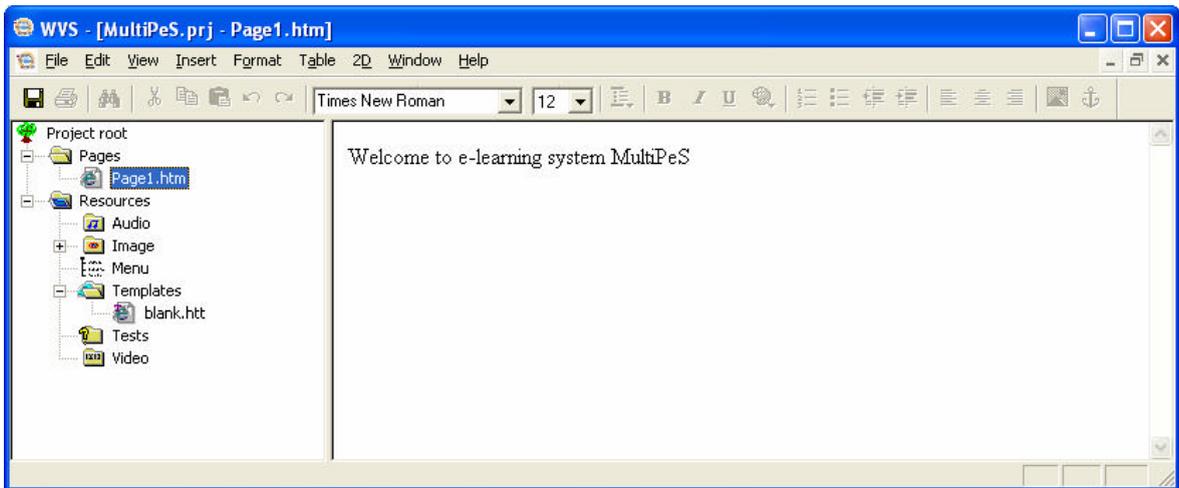


Figure 6. Creation of learning pages

3.4 Testing Elements of the e-Learning System

An indisputable part of this educational technology is the feedback and check of acquired knowledge of participants. For that form of exercises and test variants is used. Their importance has been mentioned above. When preparing testing exercises the teacher can use following elements:

- mark-off field
- switch
- text field
- push-button
- window / hiding text

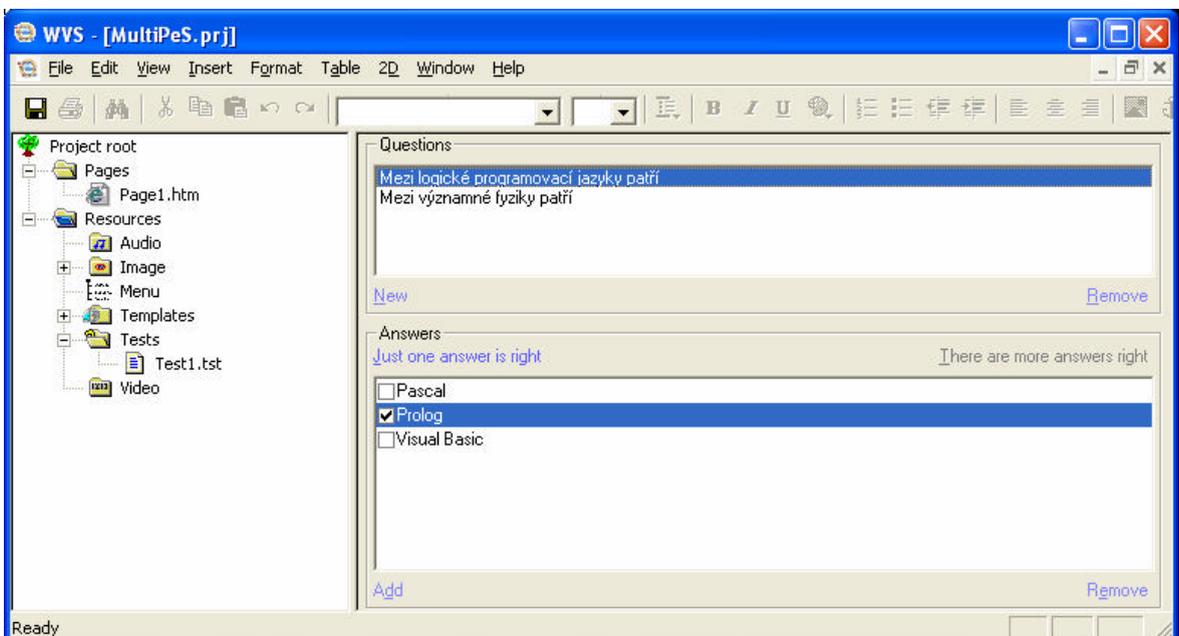


Figure 7. Generation of testing exercises

3.5 Modules Enlarging Capabilities of the e-Learning System MultiPeS

E-learning system MultiPeS contains following modules that extend its capabilities:

- module with user profile – it plans for the student and generates his/her personal study plan
- module for discussion forum – communication among students and between a student and teacher
- module with feedback – this module serves for control of equipment measuring biological signals (e.g. blood pressure), then it saves the measured signals for further processing, including recorded messages from the e-learning system; this module is created for didactic and scientific studies.

3.6 Development of a Complete e-Learning Course

Final step in developing an e-learning course is marking the introductory learning page and after pressing a single button the course is exported in HTML format. It is possible to export the course in the format suitable for study using PDA (Personal Digital Assistant) or in a format suitable for printing as well.

4. CONCLUSION

We offer students and their teachers new environment with novel educational capabilities – hypertext textbook with links to related topics, educational video sequences, solved and unsolved examples, instructions, interactive tests with automatic evaluation and tools for development of supportive materials (e.g. glossary, key words, summaries of individual chapters). Since the MultiPeS system is developed as an open system new functionalities may be added on request. A developed course can be easily extended or modified according to changes in curricula and technology development. This point is important especially for engineering courses where the development is fast and it is necessary to introduce new pieces of knowledge in education immediately. The user interface has standard layout. The orientation in menus and learning pages is very simple. The generated tests can be used in two ways, namely by students during study for verification of their own knowledge and by teachers for examination of students. The system is available for academic staff of the CTU free of charge.

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BUILDING A MEDICAL DIGITAL LIBRARY BASED ON DYNAMIC COLLECTION MANAGEMENT

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ABSTRACT

We present our efforts towards the development of a digital library environment built to support medical research in the Medical School of Athens University and emphasise the issues considered and the proposed solutions. Access to medical images produced by Medical School laboratories is facilitated. A different collection is supported for the material produced by each laboratory to fulfil specific user requirements. One of the main requirements during system development was automated collection definition and implementation. We introduced the term *dynamic collection management* to denote the support of automated collection definition and management within an integrated Digital Library environment. The way this feature affects performance was also examined. Athens Medical School Digital Library is built according to a multi-tiered client-server model and is based on IBM Content Manager platform. The experience obtained while using the prototype version of the system is also presented.

KEYWORDS

Digital Library Architecture, Dynamic Collection Management, Metadata, Medical Application

1. INTRODUCTION

Digital Library Systems facilitate the management of large collections of digital material and resources providing advanced accessing capabilities (Fuhr, 2001). Medical applications may benefit from this kind of technology, since they require handling of large amount of data, such as medical images or videos. Since digital library systems are usually web-based, different levels of service regarding image/video quality must be supported. In this paper, we present the Digital Library System built to support the collections of digital research material produced by the laboratories of the Medical School of Athens University, called Athens Medical School. The system facilitates access through the Web to medical research material – mainly medical images - to researchers and students for educational and research purposes. The Digital Library for Athens Medical School was developed by the Libraries Computer Centre in cooperation with the Department of Informatics and Telecommunications.

Typical Medical Image Archive systems, as those presented in (Suh, 2002) and (Bristol, 2000), facilitate access to medical material based on web-based multi-tiered architectures. All the material added in the system is part of a single collection. No specialised research characteristics are taken into account and all images are described by a core metadata set. Both system architectures are focused on ensuring performance, rather than providing detail description mechanisms and advanced searching capabilities. The digital library of Athens Medical School must support a number of collections, each one fulfilling the requirements of a specific laboratory regarding digital material structure and metadata modelling. Furthermore, the number of collections supported is not predefined. Thus, while designing the Digital Library architecture, the

organisation and administration of dynamically created collections was explored. Through the Digital Library Management System, the administrator should be able to define new collections (in terms of the digital object structure and corresponding metadata model) and modify the characteristics of existing ones. We introduced the term *dynamic collection management* to denote the support of automated collection definition and management within an integrated Digital Library environment. Dynamic collection management was a strong implementation requirement.

Two additional characteristics were also explored: (a) In the medical archive systems previously discussed, the medical material is gathered and processed by a specialised unit before added in the system. The Digital Library environment built for Athens Medical School supports a more complex workflow, since the research material is added directly by the researcher, while he/she also participates in metadata creation. Furthermore, this material may be updated after being published. (b) The system should provide multiple language support (at least Greek and English) in both data storing/cataloguing and user interface levels. This feature affects the efficient system performance especially during collection search.

The rest of the paper is organised as follows: In section 2, we present Digital Library provided functionality focusing on dynamic collection management support. Data and metadata representation issues are addressed in section 3. Experience obtained from the employment of the system is discussed in section 4. Conclusions reside in section 5.

2. PROVIDED FUNCTIONALITY

Athens Medical School (AMS) is one of the largest medical research institutions in Greece. Hundreds medical images/videos are produced by its laboratories on a daily basis. Laboratory staff is responsible for choosing the ones that should be added in the Athens Medical School Digital Library (AMS DL). The selection process is based on educational and research criteria. Although most of them are parts of patient medical files, they are characterised only by content-based properties that are meaningful in medical research. Images are produced by microscopes, phasmatographs and other medical equipment as digital objects and are mainly stored in TIFF format. Whenever an image is selected for addition in a digital collection, it is sent to the Central Library of Health Sciences. The cataloguers must fill the metadata fields, process the image and add it in AMS DL. Since the metadata characterising each image are strongly related with the specific medical area, cataloguers were unable to fill them. Thus, this is partially done by the laboratory scientific staff. The system provides workflow support to facilitate cooperation between researchers and cataloguers in the Central Library of Health Science. The workflow supports the following stages:

- Stage 1: Medical Object creation and characterisation (performed by the researcher)
- Stage 2: Medical Image processing that includes image watermarking and reproduction in different formats (performed by the cataloguer)
- Stage 3: Medical Object cataloguing and addition in the DL (performed by the cataloguer)
- Stage 4: Medical Object review (performed by the researcher, if needed)

Each medical object entering the workflow is characterised by a state, as indicated in figure 1. Only objects characterised as *Published* are actually available for viewing.

Furthermore, while most material properties, such as producer, description and format, are common, domain-specific properties must also be supported (Darmoni, 2001). Since laboratory requirements significantly differ, it was decided to develop a different collection for each laboratory. Each collection is characterised by general metadata information, common in all collections, and domain specific metadata, useful for researchers in the specific domain. Since the number of collections needed is not static and predefined, we have identified two requirements: a. the need to easily create new collections and b. the need to extend or modify *collection description* (e.g. the digital object structure and metadata information characterising objects included in each collection). The term *dynamic collection management* denotes the support of automated collection definition and management within AMS DL. Each image/video is accompanied by a description and notes indicating its significance. Since this information is produced by the

researcher, it is important to enable full text search capabilities within description and notes, treated as parts of the digital object.

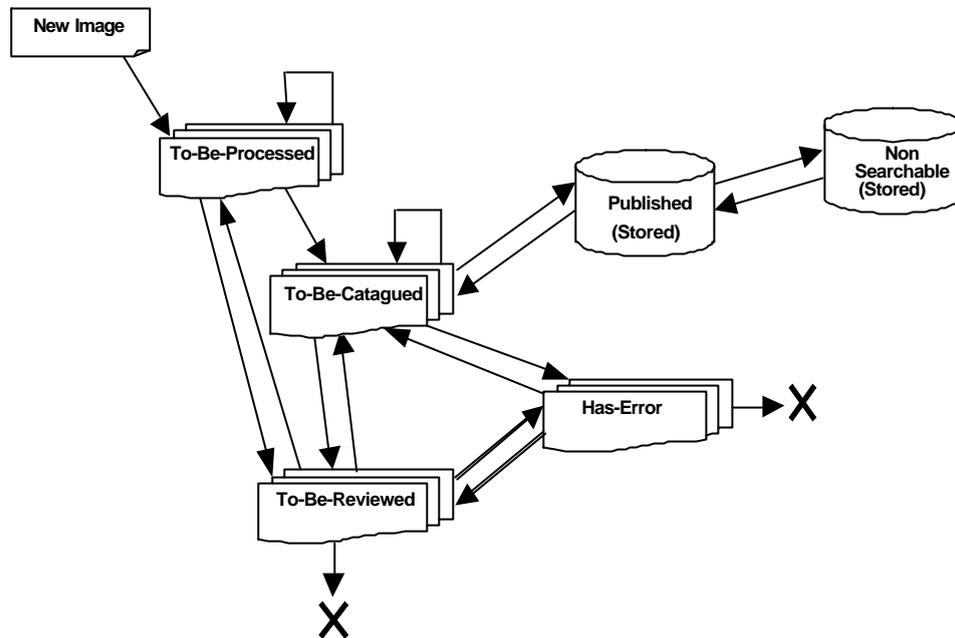


Figure 1. Medical Image States within Processing and Cataloguing Workflow

End-users access the digital library through the Web and are provided with the following search options:

- Simple search based on specific metadata fields (e.g. *find all images depicting tissues from a human liver*)
- Combined search on the same or multiple metadata fields (e.g. *find all images depicting tissues from a human liver or lone, or find all images depicting tissues from a human loan having cancer created by a researcher whose name starts with 'SMIT' within the last two years*)
- Combined searches on the multiple metadata and data fields (e.g. *find all images related with liver cancer*)

Access is granted only to staff and students of the Medical School. Privileged users are allowed to download images in predefined formats. The content of each collection is mainly used by the teaching and research staff of the corresponding laboratory when composing presentations or papers and by students studying laboratory courses.

The system should be bilingual, supporting Greek and English languages both in data and metadata description. Both languages should also be dynamically supported at the interface level. Bilingual support increased complexity during system implementation and operation as well, as discussed in the following paragraphs.

Servlets are used to implement the web-based *DL Search* application. Since the system should be open, existing standards regarding communication interfaces are supported. Results are presented using XML pages containing entity related information and links in the body part and the related metadata information in the header using RDF format (Amann, 2000).

AMS DL system architecture is based on a multi-tiered client-server model and is implemented using Java and *IBM Content Manager* platform (IBM, 2000). The system consists of three main levels: The lower one (Data Storing) consists of Content Manager components and APIs providing basic digital object storing and searching services. The middle level (Data Management) consists of the AMS DL Server components. The AMS DL Server consist of two modules, the *DL Access* module acting as a client for the Content Manager servers and the *DL Management* module responsible for providing the desired functionality to the users. The upper level (Data Access) consists of Java clients, e.g. *AMS DL Administration* and *Processing and Cataloguing* applications, and servlets, as *DL Search*, used to provide web access.

2.1. Dynamic Collection Management

Since the number of supported collections is not predefined or static, two requirements are identified: a. the need to easily create new collections and b. the need to extend or modify collection characteristics. The term *dynamic collection management* is introduced to denote the support of automated collection definition and management within an integrated digital library environment. A *collection dictionary* is used to maintain collection related information.

The term *digital object* is used to denote material stored within the Digital Library. Digital objects are usually compound objects/documents consisting of *parts* of different medium type (e.g. text, image, sound, video), which are indexed by different tools. The digital objects belonging in the same collection are characterized by the same metadata set. Each collection is characterised by *general* metadata information, common in all collections, and *domain specific* metadata, useful for researchers in the specific domain. Thus, for each collection added in dictionary, the administrator must define the corresponding object structure and metadata scheme forming *collection description*. The metadata scheme used may be a standard one (e.g. DC), a variation of it or even a local one.

Collection description can be derived from existing ones by extending the object structure and metadata model, e.g. a collection description can be defined as the descendant of an existing collection description, while additional object parts and metadata fields can also be defined. This feature allows flexibility during collection definition and facilitates collection description in a simplified manner.

In order to efficiently support dynamic collection management, AMS DL facilitates dynamic interface creation. The same interface is used for all collection, while screens presented to the user are dynamically formed based on collection description. A more static approach is to automatically create a separate interface module for each collection supported. The main disadvantage of the static approach is that, since automated code generation is needed, the implementation complexity during collection creation is increasing, while it cannot support a new collection in real time. It is also multilingual, currently supporting Greek and English languages. The user is responsible for choosing the client's *locale* property. Searching and presentation activities are performed using the selected locale. The user interface was built using Java Swing. A snapshot of the Processing and Cataloguing client, while processing the Histological Collection, corresponding to the Laboratory of Histology, is presented in figure 2.



Figure 2. Stand-alone Client – Histological Collection- Image Creation Menu

Creation of new collections and modification of existing collection description can be performed by a cataloguer with administrative privileges.

To facilitate dynamic collection management the AMS DL supports uniformly storing and accessing objects having different structure and being characterised by different metadata. Thus, the same services can be supported for different collections.

3. DATA AND METADATA REPRESENTATION

Since, most of the supported collections include medical images, we have decided to define a generic *Medical Collection* and use it as a prototype to create all laboratory specific collections. For each collection the object structure and metadata model must be defined. The metadata information is divided into two parts: general metadata, which are common for all collections, and domain-specific metadata, characterising each collection. The *Medical Collection* includes *medical objects* described only by *general metadata* presented in the following. The *Medical Collection* is practically empty, while all other collection definitions are easily defined as its descendants by adding *domain-specific metadata fields* and extending the properties of medical image objects

The following parts are included in the *medical objects*:

1. *Original image*. It is the original image produced in the Laboratory usually stored in TIFF format. This is a high quality image, which cannot be efficiently transferred over the Web and should be strongly protected regarding copyright issues. Thus, access to it is restricted to the producer.
2. *Derivative Image*: It is produced from the original image usually in JPEG format to be accessed through the Web. Access to it is restricted.
3. *Watermarked Image*: It is produced from the derivative image and is watermarked using the symbols of the University and the corresponding Laboratory. All end-users have access to it.
4. *Screen Size Image*: It is a medium-quality image produced from the derivative image to be easy shown through the Web. All end-users have access to it.
5. *Thumbnail Image*, to be shown in the Collection Search application.
6. *Image Description* in Greek and English (as the application should be bilingual)

The original image and the description are produced by the researcher, while all other formats are produced by the cataloguer during image processing.

The metadata scheme introduced to describe the *general metadata model* is based on Dublin Core (Duval, 2002; Weibel, 1998), although it also supports many customisations for medical material. Dublin Core is a widely adopted scheme for cataloguing digital images (Day, 1999), which has also been used for medical images (Bristol, 2000) and health care applications (Sakai, 2001; Davenport, 2001). The DL fields forming the *general metadata model* and the corresponding descriptions are presented in table I. Implementation properties, e.g. whether a field is bilingual, multi-valued or mandatory, are also included. The value type of each field is also recorded. Restricted value lists are also supported for specific fields.

The DC.Subject field was extended to support NML medical subject headings and local thesaurus schemes. The DC.Date field is used to maintain information related with the creation and management of images. The DC.Format field is properly extended to maintain information related with the image file characteristics. The Dublin Core Identifier field is used to store the Medical Image DOI produced automatically by the Library Server. As indicated in table I, a lot of DC fields and subfields, such as DC.Type, obtained default values. Although Creator, Publisher and Contributor information are actually maintained as independent entities, they are added in the header of XML pages representing medical image objects using the format presented in table I.

Domain specific metadata scheme can be defined using Dublin Core basic fields or extensions or even local fields. As an example, we present the *Histological Collection*. The *Description of Histological Collection*, corresponding to the Laboratory of Histology, is derived from *Medical Collection Description* by adding the *domain specific metadata fields* included in Table II. These fields are considered as *local* (they are not Dublin Core fields), since they are useful only when searching the specific collection. No modifications were need in the *Medical Object* structure.

Table I. General Metadata Field Description

DC Field	Description	Implementation Properties			
		Billing	Mult	Mand	Type
Identifier	Medical Image DOI			X	string
Title	Title Information				
Title.Main	Medical Image Title	X		X	string
Title.Alternative	Medical Image Alternative Title	X			string
Description	Medical Image Description	X			string
Creator	Creator Information (usually corresponds to a researcher)				Value list
Creator.Name	Researcher Name	X		X	string
Creator.Category	System created As "PERSON"	X		X	string
Creator.Title	Researcher Title	X		X	string
Creator.Description	Notes regarding Researcher's work	X			string
Publisher	Publisher Information (usually corresponds to the Laboratory)				Value list
Publisher.Name	Laboratory Name	X		X	string
Publisher.Category	System created As "INSTITUTION"	X		X	string
Publisher.Description	Notes regarding the Laboratory	X			string
Contributors	Rest of the staff contributing in image creation		X		Value list
Contributor.Name	Researcher Name	X		X	string
Contributor.Category	System created As "PERSON"	X		X	string
Contributor.Title	Researcher Title	X		X	string
Contributor.Description	Notes regarding Researcher's work	X			string
Subjects	Subject Related Information		X		
Subject.Scheme	Subject Type (e.g. NLM, Mesh, Keyword)				string
Subject.Description	Subject Descriptions (e.g. keywords or subject heading according to the subject type select)		X		string
Rights	Intellectual Property Rights related with the Medical Image				
Rights.Name	Right Name	X		X	string
Rights.Description	Right Description	X			string
Rights.Type	Right Type (e.g. URL, FREE-TEXT etc)		X		Value list
Rights.Content	Right Content	X	X		string
Date	Date Related Information				
Date.Creation	Image Creation Date		X		Date
Date.Insert	Image Insertion Date		X		Date
Date.LastUpdate	Image Last Update Date				Date
Type	System defined as "IMAGE"	X		X	String
Format	Image file characteristics				
Format.type	Format type (e.g. tiff, jpeg, etc)	X		X	Value list
Format.resolution	Image resolution	X		X	Value list
Format.size	Image size	X		X	string
Format.color	Image colour characteristics	X		X	string
Language	System defined (GREEK, ENGLISH)	X	X	X	string
Relations	Used to define relations with other images		X		
Relation.Type	Relation type (is-part-of, is-referenced-by)				string
Relation.Indentifier	Related image DOI				string

Table II. Histological Collection Specific Metadata Field Description

Local Field	Description	Implementation Properties			
		Billing	Mult	Mand	Type
Organ	The organs presented in the medical image	X	X	X	Value List
Source	The source of the tissue presented in the image (human, animal)	X		X	Value List
Gender	The gender (male, female) of the source of the tissue in the medical image	X			Value List
Scientific Equipment	The scientific equipment used for the production of the image	X		X	Value List
Decease	The decease the tissue is affected from	X		X	string

Domain specific metadata fields are also included in the header of XML pages representing medical objects. Since these fields are collection specific, the field structure also includes collection information. We adopted a DC-like RDF structure for the domain-specific metadata fields, where the collection is depicted similar to a DC qualifier, as presented in the following:

```
<AMS:local_field_name>
  <AMSq:collection>collection_name/< AMSq:collection>
  <rdf:value>local_field_value/<rdf:value>
/< AMS:local_field_name>
```

3.1.Implementation Issues

Since the system must support both exact and approximate search in combined multi-valued metadata fields, the searching capabilities of a relational database, such as the one facilitating AMS DL operation, were poor to ensure *DL Search* application performance. Thus, database search is applied for exact numerical and date metadata field search, while string exact and approximate search is performed using the free text search capabilities provided. Metadata information is stored both within the underlying database and within a tag-structured text part in the corresponding Medical digital object. *The Metadata part* is indexed using Text Search Server. This hybrid metadata maintenance schema ensures the provision of the desired performance during Collection Search.

Medical Image data and metadata internal representation using Content Manager constructs are presented in figure 3. As indicated in this figure, the original image is stored in a separate digital object, to implement a strict access policy. The digital object used to represent the Medical Image consists of all derived images and image descriptions. Metadata information is stored within *Metadata* text part.

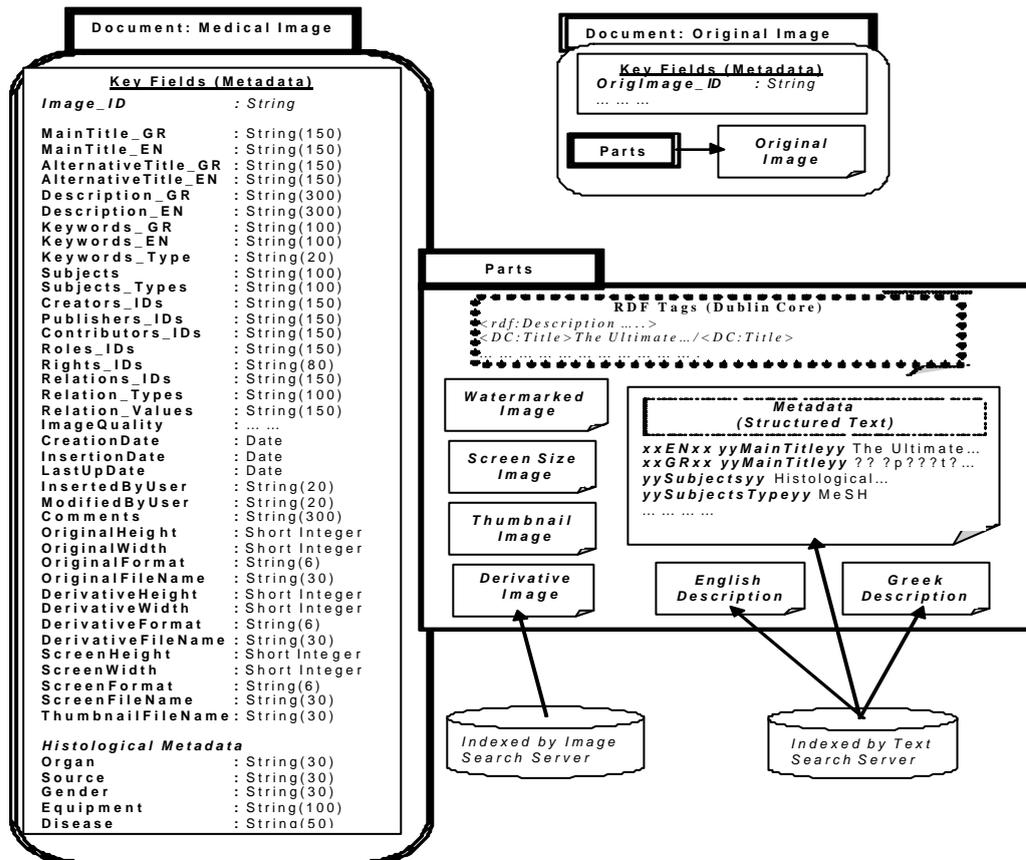


Figure 3. Histological Image Data and Metadata Internal Representation

Different tags are used to support Greek and English languages, while all properties of a specific metadata field, e.g DC.subject, are included within one tag. As an example, the structure of subject field is presented.

```
<Language_Mark><DC.Subject_Mark>SUBJECT_VALUE<DC.SubjectType_Mark>
TYPE_OF_SUBJECT<EndOfLine>
```

All metadata fields are also stored within the database, since the provided capabilities for field manipulation and presentation reduced programming effort. The *XML Tag* part consists of the RDF representation of metadata fields and is used for constructing XML page headers, while presenting the results of Collection Search application, to improve performance.

4. EXPERIENCE USING AMS DIGITAL LIBRARY

AMS DL is currently under testing. The system is installed on a server hosted in the Libraries Computer Centre. Three laboratories are feeding the DL with new images, while two cataloguers in the Central Library of Health Sciences are processing and cataloguing them. These locations are connected through a high-speed ATM network, providing the necessary throughput to support images transfer. More than two thousand Medical objects are already available to end-users. One of the problems we faced during system employment was to integrate Medical Image creation in researcher's daily work. Selection of images takes place while the researcher is examining properly processed tissue samples with specialised microscopes capable of producing digital images. The digital image can be stored in a hard disk but, in order to add it in the library, the researcher must leave his position in the microscope and enter the Image Creation application operating in the workstation next to it. This was not feasible due to researcher's workload. Thus, it was decided to store images during tissue examination, while review and characterisation of images are performed by researchers on a weekly basis. Cataloguers receive new material in bursts. Processing and cataloguing new images are time-consuming tasks. It takes approximately two days for a new image to be published, while a cataloguer processes and catalogues less the six images per day.

5. CONCLUSIONS

Athens Medical School Digital Library (AMS DL) supports the maintenance of digital medical material produced by the laboratories of the Medical School. IBM Content Manager middleware platform was used for its implementation. Dynamic collection management was one of the strong requirements imposed. Parametric implementation of the system to allow dynamic collection creation, restricted value-list metadata field support and maintenance of additional metadata fields to support bilingualism increased system operation complexity. This affected system performance during image processing and cataloguing and collection search and increased hardware requirements, especially on the AMS DL server site. The hybrid Metadata Maintenance Schema introduced helped us address performance-related problems.

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A NEW INTEGRATED BUSINESS MODEL

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ABSTRACT

This paper intends to analyse the threats and challenges of e-business, focusing on the necessity to create integrated models able to combine the following three structural domains: the business area and its projection to virtual environments; the functional structure required to support the new organization, and at last, the technological infrastructure.

At the level of business area, the configuration will be sustained by three forces: the customer – the demanding source and the business driving force; the business – the way to organize resources in order to achieve company targets, involving its key competencies, internal responsibilities and behaviours, and; the company's positioning – the role that the company aims to achieve making use of its key competencies. All these elements will be involved in a value network of bi-directional, complex and *fluids* relationships.

The functional structure points out the fact that companies should become simple and flexible units in a way to quickly adapt to market behaviours, and constitute *quasi*-atomic entities in dynamic business configurations.

Finally, the technological *side* recognizes web services have the necessary potential to support the behaviour of economical agents networks with distinct and sometimes non-compatible platforms, and to overcome major technical barriers.

KEYWORDS

Web Value; E-Business Model; Focalisation; Web Services; Technological Model; Leverage Growth

1. INTRODUCTION

The Digital Economy emergence, sustained in a new concept of enterprise organization, has in the Web and in the Internet its foundation and main operational sustainability.

The rise of this new economical view brings an enormous anxiety to the enterprises, stirring up the necessity for a quickly evolution in a new economical model vaguely defined. At this moment prevails the idea of those that advanced first would benefit, and the others, which could not keep up with the tendency, incurred the risk of being left out in the turbulent change, devoted to the old economy. Therefore, the necessity to give primacy to "time-to-market" and the intrinsic association of a New Economy with the current technological revolution, were factors that created favourable conditions for the implantation of merely technological solutions. Large investments were made in the most recent technology ignoring the economical and financial analysis results, which were not always favourable, but also ignoring the organizational changes necessary for the sustenance of this new business model. The solutions that involve restructuring and the adaptation of organizations and business were completely ignored because they are very slowly and also because the organizations are saturated of internal changes resulting from the recent tendency in reengineering, downsizing, ...

But the changes that followed demonstrated that it is an inconsequential attitude to build ignoble palaces on top of sand, because the smallest tempest could ruin it. And in fact, the threat of an eminent economical crisis, the attacks of 11th of September and the consequent shaking in the security and vigour of the society and organizations, calmed down the fever of New Economy and collapsed some empires.

The reactions to this crisis settled two distinct keynotes: for some it was the last call for a new economy, the end of economical models sustained in the virtual organizations, in the proximity and interaction of the real time between the economical agents and the consequent return to the classical models and the old

economy (Porter, 2001), for others it dealt with a bad beginning in a emerge of a new economy, a restart was necessary (Kalakota and Robinson, 2002).

In spite of the crisis climate, there are some factors that exist in order to determine that in fact we are not in the presence of the end of a new economy, but actually in its rebirth. The fact is the behaviour of the organizations, which moves in the sense of the notion of virtual organization, virtual and casual partners (unforeseen partners, involved in a suitable moment to take place in a profitable business solution). In the limit the company could be a group of people with know-how, initiative and a sense of opportunity that will mobilize partners in an exact moment, independently of the physical localization. In short, the tendency is towards a creation of a market, where there are, predominantly, less hierarchical and more flexible enterprises, virtual organizations and complex inter-organizational structures. This new acceptance of organization is based on a new philosophy of leverage growth (John Hagel III, 2002), i.e., the companies rely even more on an increase of strategy without any proper assets mobilization, creating in this way a business network, where the value creation is based on the specialization of know-how and the increase of dynamic performance developed by each participant.

On the customers' side we assist a dynamic innovation impelled by a more informed and active consumer and with a pattern demand more ambitious. In order to satisfy these requirements the company should extend their knowledge of the markets and their customers: "We usually evaluate the customer based on the actual and foreseen sales. In the future we will start using our customers in that which we call foreseen value, ... in order to determine what the people will want as products and future services and then start to create these products/services in order to have more value for the customer" Chuck Martin (1999), which reinforces the bond between the real value of the product or service and the consumer.

Instead of Value Chain (where the orientation leads to believe that the enterprise is responsible to create value to the customer) we will assist a rebirth of a network value where the customer is involved in the organization and where he will have an active participation in the creation of value that he himself will recognize in the company. In this way, the Value Chain will loose its consistence, and will be substituted by a network of fluid, flexible and bi-directional relationships that are know as a Network Value.

It is important to point out that the emergence of new economic models and the consequent rupture of the classical models, represents for the enterprise not only a technological change, but also significant evolution in the concept of business, it's organization and configuration, to benefit from a new auspicious technological and social context. Therefore, it is a particular demanding evolution in the formation and people involvement, but it is extremely interesting for the new work view. Bear in mind that the electronic business should correspond to an enterprise posture and not exclusively of some managers and informed co-workers. It is a new organization, business and work philosophies.

This study intends to make an analysis of the treats and challenges of Electronic Business, approaching the necessity to creating integrated models, at various levels, that will reflect the fundamental structure domains of business, from the strategic level until the technological implementation. In fact, the prevailing culture does not make an easy cooperation between the business strategy and the technical knowledge solution that supports it. As soon as the answers are found for the various levels of analysis and as soon as the procedures are normalized (legislation, knowledge management, workflow, ...) the links will or should be different from the results of analysis in each level.

There are many definitions of business model, sometime antagonistic; nevertheless in the contents of this paper, the business model is defined by the organizational configuration that is necessary for the realization of the strategic options of an enterprise. This configuration will be defined upon three structure domains: business area study and its projection to virtual environments, the study of the support of functional structure to a new organization, and at last, the study of a technological model to implement and support the former defined models.

2. A NEW BUSINESS MODEL EMERGES

The transition to a virtual business depends on the capacity that the companies have in order to release themselves from the physical and geographical concept of organization, distribution systems and market definition. It is necessary to think on a virtual space, virtual enterprise, ... but with real components. In the

limit we would think of a business where a company does not possess the means of production, but nevertheless it has the strategy and the control of activities carried out by a group of partners.

Imagine the construction of a virtual business that uses the Internet (or another technological resource which reaches and is accessible to all the interested, with no restrictions, independently of its geographical localization) and suppose that this model was arranged to interact with all the stakeholders in the company (all the governmental corporation relationships, the management of the suppliers orders, the sales, the services, the assistance, the information, the knowledge integration, tele-work and video-conference in order to support the activity of the workers). What kind of company is this one? In a physical concept it could not even exist and it would only limit itself in one office in order to maintain all the information, technology equipment and for eventual meetings between the elements related to the company.

The virtual business does not depend on the nature of good, it portrays first its essence and its way of function, in this way being the transaction goods either physical or digital.

2.1 Model Basis

The virtual business concept connects itself with some basic ideas and concepts:

- **Omnipresent Enterprise** – the relation between stakeholders is based on technology, bearing in mind that independently of its geographical localization, any person at any moment can interact with the company;
- **Virtual Enterprise** – in the limit all business areas will be working on the Internet, releasing the concepts of geographical localization and physical space. On the other hand, these areas could belong to the company itself or be external units with whom it will establish virtual partnerships. The same physical company could make part of other various virtual companies;
- **New Strategy JIT** – by integrating all the stakeholders and participants of the company in the same inter-relational space, it will enhance the resources management. In the limit a custom-made order can be directly reset to the suppliers or distributors who will deal with the logistics delivery;
- **Service Tailoring** – the customer himself will demand the product he intends, directly to the company, and the company should find a trans-national market segment that will enhance the available resources. In this context, the enterprise value creation fades away to give place to the concept of demand of value from the customers side;
- **Anticipation of Needs** – the company should be prepared to anticipate the customer's needs, even those that he himself has not discovered yet, and therefore has not requested. It will be in this sense that the new concept of value creation will reside.

The Value Chain Model of Porter has been, in the last years, the basis to analyse the organizations and its relationships, using for that, four complementary views (Porter, 1996):

- **Geographical scope** – delocalisation and globalisation;
- **Segment scope** – variety of products and market segments;
- **Industrial scope** – relationships and partnerships created with other companies operating in the same industry;
- **Vertical scope** – vertical integration and outsourcing.

From the comparative analysis between this model, in all its variants (competitive scope) (Porter, 1996) and the virtual business concept, we can conclude:

- I. In the Value Chain Model, the enterprise is the epicentre of value creation for the customer: one-way direction, the enterprise produces (obviously taking market studies in consideration) and the customer consumes. Nowadays we have a more demanding, informed and active consumer, as also a global competition more at reach. Therefore, the new emerging model should focalise in a bi-directional orientation between the business and the customer. The new value model shall focalise in the companies' capacity to create value to the customer, but also in its capacity to interact and personalize the relationships with him. The customer will be the driving force in the value creation, is that value that he himself will recognize in the company. At this stage, it is of extreme importance the gathering and integration of knowledge. The company's knowledge will not be just centred in its internal resources but it will focus mainly on the customers' demands. According to a published study by Harvard Business Review, the customers have great potential and an active participation that is

relevant for companies' innovation. Most of the products that obtained great commercial success were projected by customers and not by traditional R&D departments. Normally these products are developed by pioneer customers (companies, individuals and organizations) that are more advanced in terms of demands for the product at stake having needs beyond market average. Observe figure 1, that represents the contribution of users in three different sectors: computer industry, chemical industry and scientific instruments;

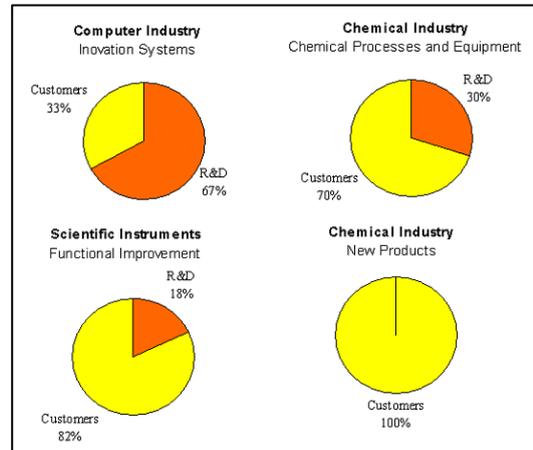


Figure 1. Customers Innovations

- II. Value creation will rely on customer's interchange and participation in products conception and development, and in the study of the customers' profile to find new needs that they ignore. The customers will provide the relevant information for companies that will permit to enrich the organizational knowledge based on a good internal knowledge management and integration versus external knowledge;
- III. The generation of the company's value settles in tight relationship with business partners, ceasing these to assume the providers role to keep a closer relationship with the company/business. At this level the Porters' Value Chain links assume its plenitude managing a real time coordination of all participants in the company's business process (suppliers, distributors, production, Human Resources, ...) and allowing a JIT management more efficient and effective. However, this relation should go beyond logistic issues, the company as client of its partners should also pursue an active strategy, in a way that, in conjunction with them conceive better products. Contrarily to the Porters' Value Chain, we detect in this network, flows in both directions also in the relationships with partners: it is the foundation of the virtual business concept;
- IV. There is a new element to consider in this network value, bringing a source of knowledge for companies: companies acquired or merged. On the contrary, the attitude towards incorporated business should not be of subordination or submission but of cooperation and mutual learning, reaching synergies at knowledge level which will enrich the whole even more;
- V. There must exist organizational flexibility towards partners, and in its internal operation to give an effective answer to solicitations and to quickly adjust to new changes. The inter-connection between the company's internal activities must be closely related with cooperative actions. Highlighting the importance of the activity responsible for the integration and the knowledge management arising from customers, partners, and acquired companies, as well as from internal knowledge. The main goal of this entity is to be a business promoter, working in direct cooperation with the research and development, marketing and sales areas.

2.2 The Value Unit Model

In this new context, the embryonic unit of Value Network Model, i.e., the business, shall be represented by the diagram in figure 2 (Domingues and C.Gomes, 2000).

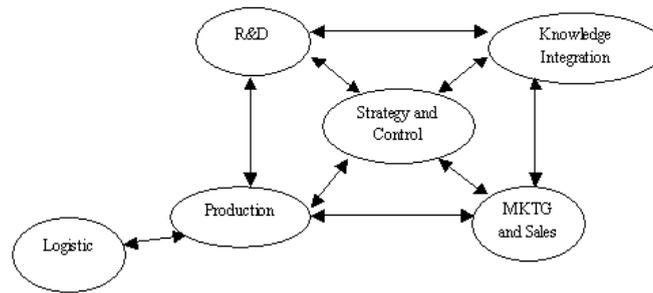


Figure 2. The embryonic Unit of Value Network Model

The model of this unit represents the main business activities, but the disposition it is no more linear in the same way as the business process. In fact, a web of complex relationships exists, but only the most relevant and critical for the company success are represented. The logistics will only make sense to businesses related with production of physical goods, never in the case of digital products or in commercial business sort, or services that might enjoy the benefits of a digital delivery, or an assistance and on-line purchase.

Even though the web, which is represented in figure 2 may work without a coordination function, that may constitute an eminent danger, it is the only responsible for interact with and control all participants. We shall not forget that the strategy and control activity may be the main value source for business, because it has a privileged position inside the network that permits to evaluate and define new business strategies.

2.3 The Value Network Model

In the virtual space, this unit shall be aggregated with the units that with her relate in the value creation, constituting that which we may call the value network. (Figure 3)

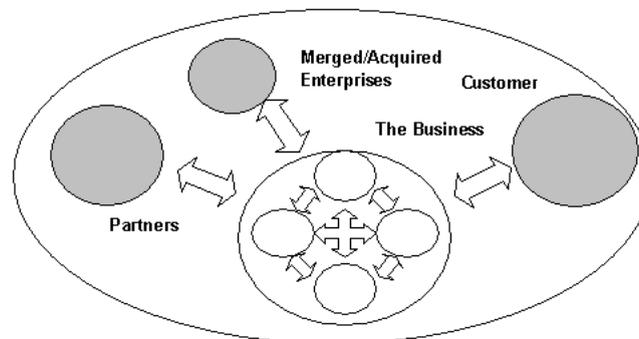


Figure 3. Value Network

The underlying philosophy of this diagram is not of a sequential chain but an interrelated network of value units. Remember the analysis of figure 2, where the element of unit designated by Knowledge Integration represents itself a narrow interconnection with external knowledge sources: value units, and therefore with other value network. This successive aggregation network will form more complex network that needs to be analysed in order to discover business opportunities and threats.

This new model is based in knowledge integration and management, bearing in mind that the real value for companies does not depend only on physical or financial issues, according to the traditional economic evaluation, but also and mostly on the capacity to create wealth, normally designated by intellectual capital.

When inserted in a value network, the company besides the internal assets dispose also the one made available by its partners (including acquisitions and mergers) and customers. The capacity, in harmony with the market, to afford and coordinate this value, is the key for the “new” virtual company success established in the value network.

3. FUNCTIONAL STRUCTURE

In a first approach to the concept of functional structure, we can infer that a network business structure suggests as well a network functional structure, involving different units that participate in the companies' value network.

The development of the organizational functional structure, should be tuned with the supporting principles of the value unit analysis, i.e., it should answer to the following requirements:

- **Customisation and reduced time-to-market**– on one hand the functional basis should provide a flexible solution that will permit at low costs create tailored offers (products and services). On the other hand, the innovation effort should be rewarded with a quick movement in way the goods are timely launched at competitive prices (prices that hardly competitors may practice). The creation of modular business structures (in production, in distribution, in the post-sale service, ...) supported by a rigid coordination and control system will be a critical factor of success to obtain an increased value;
- **Integrated networks** – the creation of business networks with the integration of various economic agents should be established by a network functional structure that will promote a knowledge share and an integration of services, necessary to reach the final goal;
- **Virtual network potential** – the most relevant characteristic in the economical view, in the acceptance of the virtual business, rely in the foreign assets mobilization to company's value creation. The association of this fact to the referred business modularisation translates the emerging necessity of focalisation/specialization process focusing on the operating areas division.

3.1 Basic Principles for the Functional Analysis

The requirements cited, evidence the fact that the firms will become simple units, focalised and flexible in order to quickly adapt to the market behaviour, in creation of *quasi* atomic modules, in dynamic business configurations. These configurations supported in networks that are created and coordinated by the business orchestrator. Therefore, three principles fundament the new functional model:

I. The **focalisation** should incise in the division of each functional area (relation with customer, management of infra-structures and innovation) in this way being able, through specialization, each one may obtain the economics benefits desired. In reality most of the companies compromises the performance in each of these areas by keeping them together, developing internal politics of trade-off in order to guarantee a respective functional coexistence. Refer, for example, the cultures, the goals, the skills and economical perspectives that normally distinct the production area (operational skill, focusing on economies of scale with cost conscious culture) and marketing area (Direct Marketing skills, focusing on economy of scope and service-oriented culture). The division will establish itself on the following functional areas (John Hagel III, 2002):

- **Customer relationship** – The units specialized in this type of activity should associate others in order to follow up and better answer the markets' challenges. It should therefore, promote cooperation relationships with other partners who will permit the development of this activity but with no interference with the process of each element who is involved;
- **Product innovation** – is from all the activities, where it is needed a more flexible functional, where the participants are in cooperation. This platform is based on that which Mark Vandebosh and Niraj Dawar (2002) designed the future of strategy, that consists in reducing the risk of customers, working with them in industry standards, in new technological processes that make it possible to innovate and reduce the cost associated with the time-to market. In this case, the concept is more wider, it is not only limited to the work with the customers but also includes any virtual network partner or other business networks. In this case the participants decide whether or not to enter or exit of the network by their own will, this decision will be made in function of the economical incentives proportionate by the orchestrator, being the participants behaviour heavily influenced by market behaviour;
- **Infrastructure management** – with the skill of the operations and infrastructures management establishes in more complex and defined platforms. A platform marked by the harmonization of a process network that involves several entities, will contribute to the fulfilment of the production activity. This process network is organized in a way that involved organizations fulfil an activity

sequence of a business process. These activities sequences in the same way as the participants may change a lot in a value network, depending on the nature of the product, the customer demands or both. Network creator defines the participation in this network in function of the fulfilment of selection criteria. The assignment of each element to the network is evaluated in a continuous way, which sometimes leads to the withdrawal of all, which affects the network performance.

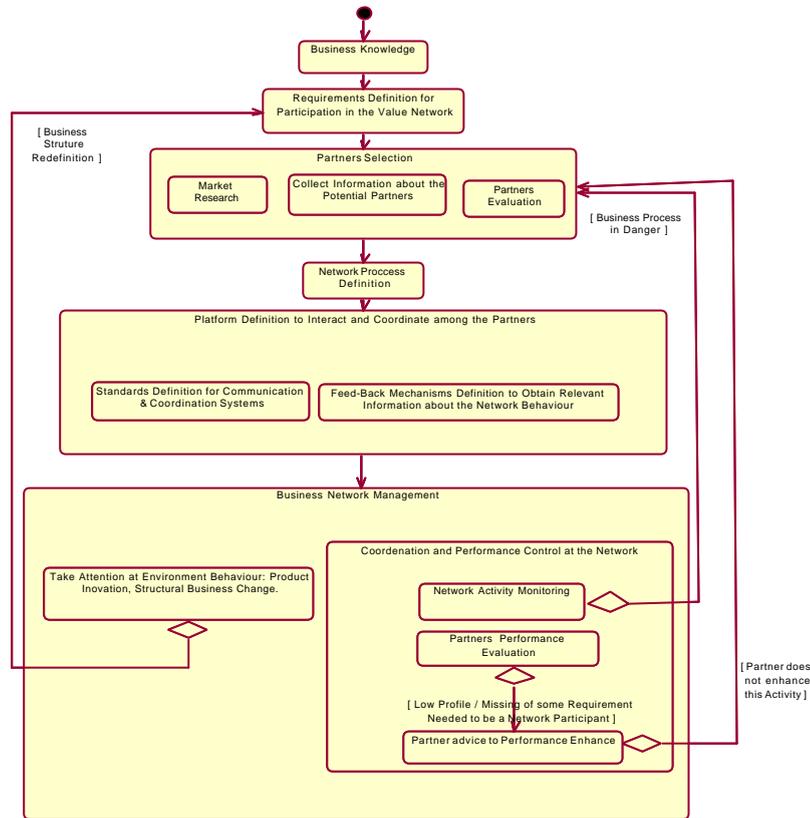


Figure 4. Orchestrator Behavior in a Process Network

But the same forces that require this focalisation also demands the rebundling, creating dynamic groups who are very wise in focalised business. As we can see, none of the new units focus is self-contained, needing to be integrated in one or more businesses in a way that its activity may have significance. The most attractive company, i.e., the one, which has the capacity to mobilize, and reward the other participants, will define the business requirements through the creation and **coordination** of a **network processes** loosely coupled between different companies – Network Value formulation. This company we call orchestrator, in the sense that it creates and coordinates the business, whose behaviour is translated by the diagram figure 4. Instead of doing the management of business processes activities, the main aim of the orchestrator is to focalise management of entities, deciding who should participate at each process stage and specifying the outputs that each entity should give in a way to conciliate their respective activities an to reach the main goal. According to this approach each entity must define which activities to develop to reach the purpose objectives. The guarantee of efficiency in a micro level (respecting the behaviour of each interconnected unit) is rewarded with its permanency in the process network, i.e., the company value network with the requirements of new services/products, if the performance holds itself at low levels, the orchestrator should search for new partners in detriment of the previous business relations. The orchestrator involves himself in the activities of the partner in an outsider perspective in long-term objectives that are not of day-to-day management. This involvement defines different information architecture from the common processes. The

coordination of all network activities and the control of performance's participants, moving away the less efficient and captivating the ones that may bring more value, is with no doubt the biggest challenge of this organizational process.

4. TECHNOLOGICAL SUPPORT MODEL

Since the beginning of 90's the biggest concern of the executives related to the information systems is the integration, having in mind the construction of systems where it is possible to extract with relative easiness more organizational knowledge to help with the definition of the strategy and decision making.

During that time the preoccupation was based on the integration of the internal systems, but in this new models the preoccupation extends beyond the company's boundaries – the interconnectivity between the firms and the business network.

The need of coordination and the associated economical penalties has in fact overcome the potential economic benefit obtained by the focalisation. These penalties, also designated by transaction costs, according to Ronald Coase, Economy's Nobel-Prize (In "The Nature of the Firm" published in *Economica*, 1937), are essentially originated by the activities associated to resources coordination. According to a study made by McKinsey & Company in 1997, for the quantification of these costs in economy, it was concluded that in the United States companies represent 70% of the operational costs, and even in developed economies like India, these interaction costs represent 40% of the operational costs (John Hagel III, 2002). One of the biggest sources of detected costs relates itself with the difficulty in order to access and process information. The technology that permits to optimise this relation will reduce substantially the weight of the economic penalties associated to the interaction between enterprises. The expansion of the electronic digital networks will also play a crucial role in reducing systematically interaction costs.

The new technologies should enable this focalisation and rebundling to be more efficient and effective.

4.1 Technological Requirements

The main goal is to create modular business elements with interfaces well defined and whose integration may be possible in the practice of plug-an-play, typical of the Electronic equipment installations. Bear in mind however, that this philosophy should be followed not only in the macro but also micro-activity, i.e., not only in the organizational domain as a whole but also in the domain of each internal activity. In conclusion, to guarantee the good function of this model we should bet on a technological solutions that will permit:

- **Distributed control centres** – no one has the power to impose the technology that should be used, because there is a value unit's proliferation that makes it impossible to impose whatever. Inside the company the managers can freely define a common platform, but when the boundaries transcend the firm then it is impossible to control or impose, in this its necessary to develop a technological platform that is able to aggregate all the partners at low costs, and with an adoption time almost instantaneous. A philosophy very different to those that are practiced by the EDI close network, where all the partners had to obey the same norms and platforms are dictated by the highest economical element, a heavy solution for those who want to integrate the business network. In these cases, it is the weakest link who supports the costs in so many technologies and platforms as well as the number of distinct partners;
- **Diversity in technological platforms** – proliferation of companies involved in the relationships of business without any structures of platform control implies diversity of platforms necessary for the inter-connection. An exponential problem arises. Another problem arises when we impose that the connection conditions should be accessible to anyone independently of its size, economic power or competence;
- **Dynamic environment** - in a dynamic environment the business conditions change, it is necessary to provide a rapid connection system at low costs. The entities that left or kept away from the network should not loose a lot for just participating (so that, there is no barriers in the entrance and exit).

If on one hand the component possesses here an important role, in the fact that being based on object-oriented analysis has basic principles on modularisation and encapsulation, creating in this way distinct,

independent units with a purpose and interface functional rigorously defined. On the other hand, it is necessary to integrate all these elements that ever though are developed by different technological platforms and many times incompatible, they should also be interconnected in wide networks processes. It is in this point that we wait for the technological emergence of web services, which may play an important role.

4.2 Are Web Services the Answer?

The web services present an interesting fusion between the services and components, in this a way new type of distributed architecture emerges, where generic interfaces transformed applications in modular services that may be used in any place and in any time. Contrary to other technologies that may focalise on the components of distinct characteristics (with no doubt that the componentisation is important in terms of reuse and productivity but the components cannot be considerate isolated) the new architecture sees in the web services the potential of a definition in a platform of interfaces standardized between the different components. In this context, we establish more flexible relationships between the organizations, which assumes special relevance in networks that involve more participants. In this way it is possible for any partner to have network access with his or her own resources by a low cost integration interface. These costs are very low when compared with EIA solutions and above of all that may be implemented gradually without promising the function of other systems.

5. CONCLUSION

There is no doubt that the business should provide the intensification of competitiveness in order to produce high levels of income and growth. To achieve that organizations should implement a structure allowing high levels of flexibility and collaboration. The good news is that the new technological platforms provide the adequate conditions. Management have in this case to develop new business approaches, network processes, focalisation and leverage growth. Therefore it is necessary to change the culture of the company so that it can take profit of the new business and technological trends.

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LEARNING, DESIGN, AND TECHNOLOGY: THE CREATION OF A DESIGN STUDIO FOR EDUCATIONAL INNOVATION

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ABSTRACT

This paper describes the creation of a design studio course for students in an innovative graduate degree program in the School of Education at Stanford University. While design studios are common in other fields, they are unusual in education. The rationale for this course is presented, our experiences running the course for four years are summarized, and implications for academic training in the information society are discussed. In particular, we highlight the overlooked role of design training in traditionally research-oriented fields.

KEYWORDS

Design-based research, educational technology, curriculum, design studios.

1. INTRODUCTION

The evolution towards an information society has driven changes in all aspects of work, home, and school. In this paper, we describe an unusual attempt in post-graduate education to prepare educationists who can effectively study and apply information technologies in educational settings. First we describe how information technology advances created an unmet need for experts in technology for learning, and how a new graduate program was created at Stanford's School of Education to meet these needs. Second, we discuss how tensions between research-oriented and design-oriented needs of the learning technology field led to a new design studio course, and how this course combined research and design training. Third, we reflect on our experiences running the course and how information technology challenges us to combine research and design in higher education more generally.

2. THE IMPETUS: TECHNOLOGY AND ITS IMPACT ON EDUCATIONAL PRACTICE AND EDUCATION DEPARTMENTS

While educational applications of information technology have existed from the very beginnings of digital computing, education departments at universities have been in some ways slow to absorb technological preparation into the curriculum. Of course, in the earliest days of computing and personal computing, the

technical expertise required to provide technology meant that most educational technologies were driven partly or primarily by technologists and computer scientists (for instance, the LOGO programming language for children was developed at MIT by researchers in computer science and artificial intelligence).

Three traditions of educational technology arose in university education departments. The first developed studies of online learning tools as an extension of other forms of media, applying many of the same research techniques that had been applied to filmstrips or movies before the advent of computing in schools, generally with an instructivist philosophy (Reiser, 2001). The second strand highlighted the role of computers from a policy and society perspective (Cuban, 1996; Means et al., 1993). The third resulted from inventive designs of computers for education, often led by individuals with a background in computing or in a computing-intensive field like math or science (Molnar, 1997) and linked to research in cognition. Although arguably the most inventive, this third strand often failed to have wide impact because the innovations rarely made it into the mainstream.

By the 1990s, there was pent-up demand for workers who could create these inventive applications of technology for education outside the “hothouse” of specialized research projects with government funding. In Silicon Valley, many educational technology companies were growing (Lucas Learning, Computer Curriculum Corporation, Sunburst Software, the Learning Company) and other companies were turning their attention to the education market (most notably Apple Computer beginning in the 1980s). Higher education generally failed to provide these workers who were cross-trained in technology development and design, modern theories of learning, and the pragmatics of school classrooms and education policy. It was in this context that Stanford founded the LDT (Learning, Design, and Technology) program.

3. THE CONTEXT: THE LDT MASTER’S PROGRAM AT STANFORD

The Learning Design & Technology (LDT) program at Stanford is a 12-month master’s program in the School of Education where students come together as a community of practice around becoming “learning designers.” The program provides students with an intensive year of study. Three main areas encompass the student experience: (1) taking courses in education, computer science, sketching, prototyping, product design and business, (2) working as interns in local learning design agencies, and (3) designing a final master’s project of their own choosing that addresses a significant learning problem with technology and serves as the culmination of all their theoretical and practical experiences. The program is designed for persons who aim to develop new and better ways to use information technology and new media for learning. LDT graduates continue on to professional work and study in a variety of roles in K-12 schools, school technology support agencies, colleges and universities, nonprofit organizations, and the corporate world. The goals of the program are to train students to be proficient in:

- Applying educational theory and cutting-edge research about learning
- Exploring the possibilities of emerging information technologies for learning
- Working individually and in teams to design creative, effective solutions to learning problems.

The program attracts students and applicants from a variety of backgrounds, including education backgrounds such as teachers, community technology center (computer clubhouse) directors, and museum exhibit designers; students from technology backgrounds such as information architects, product managers, programmers, and technology managers; and a variety of others with interests in education and technology including photographers, community developers, scientists, journalists, and book editors. Approximately 15-20 students form each cohort.

The program was conceived in the mid-1990s by several faculty members in the Stanford University School of Education, including Decker Walker, Jim Greeno, Mike Kamil, Brigid Barron, and others. The 1997-1998 school year was the first offering of the LDT Master’s Degree as a pilot test. In Fall 1998, we (the authors) both joined the LDT program; Hoadley as a consulting assistant professor on loan from a nearby nonprofit research institution, and Kim as a program assistant while a doctoral student in psychological studies in education at Stanford. Hoadley was entrusted with teaching an (as yet ill-defined) portion of the core seminar sequence for the LDT program, while Kim was responsible for coordinating academic matters and serving as a teaching assistant for the core seminar sequence.

4. THE ISSUE: RESEARCH AND DESIGN

The relationship between research and design in the LDT program is the central story of this paper. Below, we describe how research and design are often understood in academic education departments (in the US, at least) and examine several models from disciplines other than education of how scientific research and design can be linked.

4.1 The schism between research and design

In most fields, design and science are seen as separate activities. Science involves objective testing of models of reality against data, while design is trying to change reality to achieve a desired (possibly underspecified) effect. Traditionally, design is seen as a consumer of science. For instance, a physicist may uncover fundamental laws of mechanics, and the mechanical engineer (designer) then determines how to apply those fundamental laws to a particular problem. In this view, science is “pure research” where design is either “applied research” or not research at all. Indeed, many would argue that these two should not be mixed; if the scientist has the intentionality, the agenda of a designer, he or she may be more susceptible to biasing the results of the study.

However, in the social sciences (Flyvbjerg, 2001) and in applications of technology to human problems (Carroll & Rosson, 1992), the division between design and science is less clear. Scientists must produce the phenomenon they wish to study, which often involves significant design (Hoadley, 2002), and designers often must reduce ambiguous (but important) aspects of the design problem through the design process, and often collect data in the traditions of science (Kelley & Littman, 2001).

In education, researchers have explicitly identified the need to combine research and design in a deeper way (Lagemann, 2002; Robinson, 1998). One problem is the difficulty of applying theoretical models of learning to problems of teaching (Lagemann, 2002), while another is the degree to which findings are context-dependent and not easily generalized into universal laws like Newton’s Laws in mechanics (Design-Based Research Collective, 2003). Theoreticians have recognized that design can actually form a basis for the principled empirical investigation that is the hallmark of science (Design-Based Research Collective, 2003; Dewey, 1929).

Despite the recognized need and attempts over the last 100 years, blending research and design has largely not happened in education (Lagemann, 2000). Academic education departments do often comprise both research (often under labels like educational psychology) and design (under labels such as instructional design or curriculum and instruction). Usually, researchers enjoy high status while designers are treated as practitioners and have less status (Lagemann, 2000).

4.2 Challenge: Applying a research tradition to technology design

At Stanford, the College of Education has a world-wide reputation for excellence in research. In terms of non-technology educational design (such as curricular or instructional design) the School has generally not only provided for training of designers but has done so in the context of research on this training (e.g. Hammerness & Darling-Hammond, 2001). However, the preparation of technology designers was, in 1997-98, a new endeavor. The LDT Program in its pilot year had two primary means of accomplishing this goal. First, the students were placed in internships in area learning design companies or agencies. Second, the students took one course in human-computer interaction which was offered by a combination of the Stanford Computer Science department and the Symbolic Systems interdepartmental program. Yet, while these opportunities provided valuable experiences in technology design, they were largely disconnected from the rest of the curriculum, including the learning and educational context issues covered in the core seminar.

In trying to address this in the core seminar, we examined several models of how technology design could be blended with research, including human-computer interaction (HCI), engineering science, and education.

4.2.1 Models from HCI

Perhaps the closest model for blending research and design was the HCI model. In the HCI community, the design of new technological systems goes hand in hand with data collection on those systems, and design

decisions are justified on the basis of prior research in psychology and other social sciences (Card, Newell, & Moran, 1983; Carroll & Rosson, 1992; Norman & Draper, 1986). Indeed, HCI has pushed the forefront of psychology in several areas, most notably via the exploration of psychological models of learning with intelligent tutoring systems (J. Anderson, Boyle, & Reiser, 1985).

In HCI, students learn to identify relevant psychological or social science models, to build and refine systems, and to collect data on the interaction of the designed systems with users, comparing the intended vs. actual outcomes. Interestingly, HCI is an example of a domain where the scholarly (research) and practitioner communities overlap. The ACM CHI conference attracts both practitioners and researchers, with both academic-style research papers and demonstrations or “interactive experiences” and design cases that are more practice oriented.

4.2.2 Models from engineering science

In engineering science, design is often viewed as a process of optimization; both theory-building and design of technologies with interesting properties are creative activities sanctioned by the field. Students in this field learn a great deal of theory and analytical skill, and they also learn the pragmatics of making things happen in labs (for instance, how to anneal a particular type of material sample, or how to work with the practical limitations of laboratory measurement equipment.) One common way students are introduced to the relationship between design and research is to be introduced to research-friendly design processes or expose to studies of productive design practices in the domain (Finger & Dixon, 1989a, 1989b).

4.2.3 Models from education

In education, two trends bear examination: how designers already do research, and how researchers already do design. First is research in traditional educational design: instructional design and curricular design. While these two areas differ, in both research is part of the tradition usually through evaluative work. Often, summative evaluations of designs are the Ph.D. theses in these areas. In addition instructional design is well known for a heavy focus on design processes that uncover important elements of the problem, such as needs analysis. Thus designers do, to some extent, already conduct research.

A second trend related to the link between design and research is the role played by designers and practitioners in educational research traditions. For instance, the action research tradition (Aguinis, 1993; Masters, 1995) has documented ways in which researchers can productively and empirically explore educational “agendas” in a manner consistent with the scientific method.

The recent culmination of these trends has played an important role in the recent prominence of the area of educational research called the Learning Sciences. Interestingly, the learning sciences have been heavily involved in the educational uses of technology as well as interdisciplinary design and research. One methodological approach taken in the learning sciences is the *design experiment*, in which a design of an educational intervention is researched continuously through its design and deployment (Brown, 1992; Collins, 1992). More recently, this has been more accurately renamed design-based research methods in education (Design-Based Research Collective, 2003; Hoadley, 2002). Students in the learning sciences often experience long apprenticeships in which they learn both design and research skills by working with large, long-running research and development projects.

5. THE DESIGN STUDIO COURSE

In response to the survey of different models of combining design and research, Hoadley undertook to create a course that would train students not only in research and theory but also in application of these to problems of design. The course, titled: “Learning, Design, and Technology: Design Methods” is described in further detail below and was taught and refined over the course of the next four years with help and feedback from Kim and Decker Walker, the professor in charge of the LDT Master’s Program. For a summary of the course activities, see Table 1, or the online syllabus from 1998 at:

<http://www.ciltkn.org/protected/syllabi/syllabi/hoadley-f98.pdf>

Table 1. Major educational activities in LDT: Design Methods 2001-2002

Activity	Description	Frequency/Duration
Design diary (Individual)	Journal of design activities, used to support design activities and also to support reflection on design processes	All semester
Interview a designer (Individual)	Interviews of learning designers focused on their personal histories and design processes; students designed websites to represent expert design process to interested others	First six weeks of instruction
Design methods website (Whole class)	Class synthesis of "Interview a designer" sites with all readings on learning design methods	Middle six weeks of instruction
Final Design Projects (Small group or individual)	Design or redesign a technology supported learning environment (including curriculum) <ul style="list-style-type: none"> • Project proposals • Analyze needs • Create design and theoretical rationale • Formal design reviews • Empirical testing • Document design and rationale 	Last eight weeks of instruction
Design reflection papers (Individual)	Written paper on design process used for Final Projects	End of instruction
Show and tell activities	Students bring in examples for discussion and critique	All quarter
Design dilemmas	Students bring in design problems for class brainstorm	All quarter
Readings (Read individual discussed as a class)	Research and design readings on examples from learning sciences Design method articles on models of design processes from other disciplines and education	All but last two weeks of quarter

5.1 Studio models

Borrowing from architectural education, the course was created as a design studio, in which designing was the students' primary activity. Looking at examples, critiquing and receiving critique, and discussion are other ways students in studios learn. This course drew on all of these methods. The course involved two or three major design projects each year, culminating in a large final project that many students used as a springboard or pilot test for their master's project. A great deal of class time was devoted to sharing and helping with these final projects.

One attraction of the studio model is that it dovetails with other modern instructional techniques. In particular, problem-based learning (Boud & Feletti, 1991) suggests students should engage in authentic, open-ended, realistic problems as a context for learning ideas and skills. This provides a context for students to integrate ideas across topics as they apply to a particular problem, and offers some of the complexity they are likely to confront outside of educational settings. However, design studios, though rare, are not unheard of in education, nor do they necessarily help integrate research and design.

5.2 The role of examples

One means of addressing both design and research skills was to rely heavily on examples. Cognitive research suggests that case-based learning environments do support learning through case-based reasoning (Schank & Cleary, 1995) and these are widely used in professional education such as medical education, business and legal education, and, to some extent, teacher professional development. Over half of the course readings provided examples of work in the learning sciences that combined research with the design of a particular technological innovation. While predominantly math and science examples were included in the course reader, students also brought their own examples from other domains in a weekly “show and tell” time. In many ways, this is similar to professional participation in HCI, in that research and design are both valued as scholarly contributions and formed part of the basis of the course. The students also considered examples of designers and design processes, discussed more below.

5.3 The role of design process

In this course, design process was brought to the fore as an integrator of design and research. The learning sciences examples in the readings contained more information than typical educational research papers on design processes leading up to the interventions described, and were augmented with personal stories either by the instructor or guest lecturers on the evolution of these research projects and their designed technology over time. In addition, a number of readings from engineering, HCI, and education presented explicit models of design such as participatory design, reflective practitioner design, user- and learner-centered design, informant design, and so forth. (For full citations see the course syllabus.) In the first course project, students interviewed designers about their design processes and often uncovered embedded research activities as well. Students explicitly reflected on their own design processes in a number of ways, including in-class exercises using different design processes, by writing in their design journals, and by writing a design process reflection paper at the end of the course. In addition, the whole-class project (added in the final iteration of the course) provided students with an opportunity to synthesize these readings and the interviews with a framework provided by Hoadley.

Exposure to, and reflection on, so many design processes that were involved with research allowed students to see a variety of ways research can be embedded in the design process and vice versa, what Hoadley has termed elsewhere research-based design and design-based research (Hoadley, 2002). This process-oriented approach is similar to the process-oriented approach used in engineering sciences and also in instructional design.

5.4 The role of learning theory and traditional educational research

This course built on the students’ earlier experiences in the prior semester, where the core seminar focused on learning theories. In the studio course, students were always responsible to justify their work in terms of learning outcomes. This generally took two forms: either the students could justify their work with elaborated learning theory and design rationale, or they could justify their work with empirical data on their own designs. This type of justification was particularly emphasized for the final project proposal and final report, but also played out in class discussions, critiques of readings, and their master’s project proposals (due during or shortly after the course).

Students were also required to conduct at least one empirical investigation of their final projects before turning them in. These empirical investigations were sometimes informal [in the spirit of “Guerrilla HCI,” \Nielsen, 1994 #791] and took several forms. One common form was to perform a summative evaluation of the design near the end of the project. Another form was to perform a formative evaluation of the technology design early in the project. A third form, which harkens to design experiments, was to conduct a quick study to answer a theoretical question that arose during the design process, and without which the students might not know how to proceed. One interesting development was that we had to change some elements of the course to more forcefully emphasize learning outcomes rather than just usability outcomes—because many of the readings were drawn from an HCI tradition and most were concurrently taking an HCI class, students sometimes neglected to examine the learning outcomes, rather than usability, associated with their interventions.

5.5 Socialization into the field

One additional way to help students to link research and design was to help socialize them into the small field of learning designers who combined technology design with research in education. In particular, when students interviewed learning designers, they were encouraged to find exemplary designers, most of whom had some research background and many of whom were primarily researchers and only secondarily learning designers. The Silicon Valley location and the proximity to the University of California at Berkeley as well as the researchers in the School of Education made finding suitable interviewees much easier. Interviewees were invited to final project presentations so other students would have a chance to meet them. In addition, over the course of the semester students developed shared criteria for their design projects, which has been demonstrated to facilitate domain learning (Cuthbert & Hoadley, 1998; Frederickson & White, 1997). A backgrounded, but equally important, form of socialization occurred when students discussed the prospects for their master's projects related to the course project with their academic advisers, who emphasized the research side at least as much as the design side. We made heavy use of this aspect of the course to encourage students to think about learning models and not just the usability issues previously mentioned. "Where's the learning?" became a question posed frequently by both of us, and internalized by the students.

5.6 The CPC model and design ontologies

When learning disparate ideas, students run the risk of developing so-called "knowledge in pieces," or inconsistent, memorization-based understandings (diSessa, 1988). Hoadley provided two models he developed to help students integrate their understandings in the course. The first, an ontology of design methods (Hoadley, in preparation) provided a framework for understanding different ideas about optimal design processes and to compare them. This framework was used by the students in thinking through the whole-class project: a website on design methods that synthesized readings on design methods and the interview websites. The second framework to help the students, the CPC Model (Hoadley & Kirby, submitted), was used to structure the examples around three major advantages technology can provide in learning environments: advantages in *content* (multimedia or dynamic representations, simulations, and microworlds; extended information access), advantages in *process* (task-support, scaffolding, reductions in cognitive load, or productivity enhancing tools), and advantages in *context* (technology-afforded changes in the social context or milieu of learning, collaborations that cross the boundaries of the learning setting, changes to the learners perceptions of self or others that shift their learning context). These three advantages loosely mapped to the three major theories of learning they were taught: transmission models, information processing/cognitive psychological models, and socio-cultural models of learning. (For an overview of the latter two, see J. R. Anderson, Greeno, Reder, & Simon, 2000). The multiple applications of the CPC Model (Is it a design framework, an analytic framework, or a theoretical framework?) proved to be helpful in getting students to think through how theory motivated their designs, and how designing impacted the kinds of scientific questions could be asked about technology and people in learning environments.

6. OUTCOMES: SUCCESSES AND CHALLENGES

While the course was not perfect, we found great success in using the design studio course to help students integrate their research and design skills and knowledge. Like any instructors, we refined the course over time to improve it on the basis of our experiences, even if those experiences were not culled from formal studies. What we offer below are some informal observations on successes and challenges of the course.

6.1 Where LDT students went

Students from the LDT program have been competitive applicants in the technology market (especially during the dot com boom years in Silicon Valley). Many have found applied, design-oriented jobs in industry using their design skills and their education backgrounds. During the early years of the program, students mainly took jobs in educational software and Internet-related companies such as Ninth House, Achieva,

Yahoo!, LeapFrog, iPlanet, Cisco and Classroom Connect. In addition, some graduates are finding jobs in research and consulting in the educational research sector. Each year some students continue in their studies and pursue research-oriented doctorates in educational technology. A small number of graduates also head to K-12 education and find jobs as directors of technology for a school or district. This is notable because it confirms our belief that these students are capable of both research and design, and it also is striking in how students work in each of the three traditional strands of educational technology represented in academic departments, as well as the fourth area of applied educational design outside of research contexts. The graduates, as a whole, have had a remarkable impact on bringing innovative, constructivist learning technologies to fruition outside the academic “hothouse” of funded research projects. We view this range of successful outcomes as a hallmark for the success of our synergistic approach. Like the Bauhaus School in Germany which attempted to unite the more abstract fine arts community with the more practice-based designers in the skilled trades but whose graduates made advances in both areas (Whitford, 1984), our students have gone on to success that seems to surpass that of graduates of either instructional design programs or more traditional education degrees. In one iteration of the course, one group of students who developed a final project on a structured discussion interface for learning won an HCI competition held on campus, surpassing a few hundred other students, many of whom were majoring in HCI.

6.2 Reactions to the course

One measure of the success of the course is the degree to which its innovations were adopted in other settings. For example, the design journal activity was first initiated earlier by other faculty to the core seminar in the quarter prior to the design studio. Student interest was sustained as students continued keeping design journals even after the studio course was over, even continuing the practice on into their professional lives. Finally, an intergenerational tradition began in which alumni of the program would come back to share their experiences and their design journals with students currently in the program.

Another measure of the course’s success is the degree to which it helped students choose design-oriented courses from programs outside of the School of Education. During the quarter prior to and the quarter of the design studio, few students took design-oriented courses as electives. But two courses offered in the quarters following the the design studio (one on designing persuasive technologies and one on product design) grew so popular with the program’s students that one even came to have a special section offered especially for education students.

In general students responded favorably to the course and to the program. From 1998 until 2002 the program’s reputation and reach increased as evidenced by greater numbers of applicants from an increasingly international pool. While we do not have a formal student of the course, students have commented on several strengths of the approach that indicate design and research are both combined in their professional lives. One student (spontaneously!) wrote back a year after graduating that the course “was one of the high points of a program that I thoroughly enjoyed,” and that “The readings [the instructor] assigned and the projects... were integral to my growth as a learning designer. I use those lessons to inform my design decisions on an almost daily basis.” This particular student was employed at an e-learning company that produces online courses for secondary schools in the US.

7. CONCLUSION

We have attempted to present one model of how graduate education in learning and technology can embrace the overlap between research and design and use each to strengthen the other. However, we believe the issue of bringing design, theories of human thinking and learning, and social science research skills to bear on problems facing the information society are of importance in all sectors, not just for learning. Much as the business schools have grown their MIS programs, other departments specializing in other facets of human experience will need this type of program so that we may intelligently invent our technological future, and not ignore the lessons and tools disciplines outside technology can bring to bear. The development of human capacity of this sort will become increasingly necessary as the problems we wish to solve become less and less amenable to “canned” (fixed) solutions.

This will not be easy, for two reasons. First, as noted earlier, designers and researchers may not respect each other, and the boundaries between their work are powerfully drawn. Few disciplines (HCI is an exception) support scholars-practitioner dialogue in the same venues. Secondly, and more subtly, we will have to develop new epistemologies for *both* research and design that help us know how we know in these fields. Already, there are groups confronting this very issue; the issue of granting Ph.D. degrees in design has brought up these same ideas, confronting boundaries and developing new epistemologies in the context of graduate education. Two conferences have been held on the subject, in Ohio in 1998, and in France in 2000 (see:

<http://www.jiscmail.ac.uk/files/PHD-DESIGN/ohio.htm>, and

<http://www.jiscmail.ac.uk/files/PHD-DESIGN/france.htm>

for details). We will have to apply these newfound epistemologies and uncover new ways of training and developing capacity. Just as the Bauhaus created a new category of work through the invention of a new way of educating people with theoretical, practical, and interdisciplinary knowledge, we may find that the education of designer-researchers can help catapult us to new ways to apply technology in society.

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INSTRUCTIONAL DESIGN OF INTERACTIVE LEARNING MODULES BY EXAMPLE OF A SPECIAL FLOW SHOP PROBLEM

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ABSTRACT

Modern education of scheduling can be improved by using interactive learning methods in order to build and develop modeling and problem solving skills. In this paper we discuss some possibilities of supporting the teaching in the field of production planning and the demands for a digitally published virtual training course in order to depict scheduling problems vividly. To provide students with a valuable introduction to a representative cross section of scheduling problems we present an interactive learning module for a flow shop problem using the application SIMTOOL. This is a discrete event-driven simulation tool, especially designed for education within the classroom and the self-paced study to demonstrate main principles as well as internal processes.

KEYWORDS

e-learning, education, flow shop, interactive virtual learning, production planning, scheduling, interactivity

1. INTRODUCTION

Research and development in the field of e-learning is leading to a variety of virtual learning environments and support of education using information technology. These systems range from the simplest form of electronically providing students with slides of a specific course to complete virtual universities. The main goal is the improvement of education by increasing the availability of learning material as well as allowing the enrollment in entire virtual courses. This establishes the option for students to learn independently (in terms of location and time) from the presence university.

Currently several research projects exist with the objective to analyze the potential of using modern and innovative information technologies and to improve the education within (presence) universities. Especially virtual learning environments are seen as media to enforce variation of traditional academic education and, therewith, the overall learning experience of students.

While teaching a course on production in our institute we were enabled to gain experience on teaching scheduling problems by means of different presentation techniques. Within our lectures both static slides as well as animations are used to present learning material on the same subject. Furthermore, several subjects may be observed and presented from different perspectives allowing a deeper understanding of the material. Based on reactions from students subsequent to the course, animated slides seem to stimulate more interest and even promote a better understanding of problems in the field of scheduling.

In this paper we want to show how teaching at university level in the field of machine scheduling may be extended and enhanced with a didactical focus on web-based interactive technology. For this purpose, we developed a java-based prototype of a discrete event-driven simulation tool including certain mechanisms for virtual learning environments. This application is used as a platform to develop interactive learning units by

simulating the behavior of, e.g., a production system. The primary goal is the integration of simulation models for machine scheduling within self-paced studies allowing the students to interactively work with the learning material. Instead of showing static diagrams and presenting textual descriptions of applications and procedures, we want to give the opportunity to explore the treated problem and develop solution procedures in a self-guided fashion with detailed feedback.

Scheduling describes the problem of finding a feasible schedule for a given set of m machines M_i ($i=1, \dots, m$), which have to process a given set of n jobs J_j ($j=1, \dots, n$). A schedule consists of the assignments of time intervals for each job to one or more machines. Schedules may be represented by Gantt charts showing the usage of machines (job-oriented Gantt chart) or processing of jobs (machine-oriented Gantt chart) on a timeline, cf. Figure 1. The overall processing time (makespan) is determined by the finishing time of the last job or machine, respectively. Furthermore, a job J_i may be split into m_j operations O_{j1}, \dots, O_{j,m_j} .

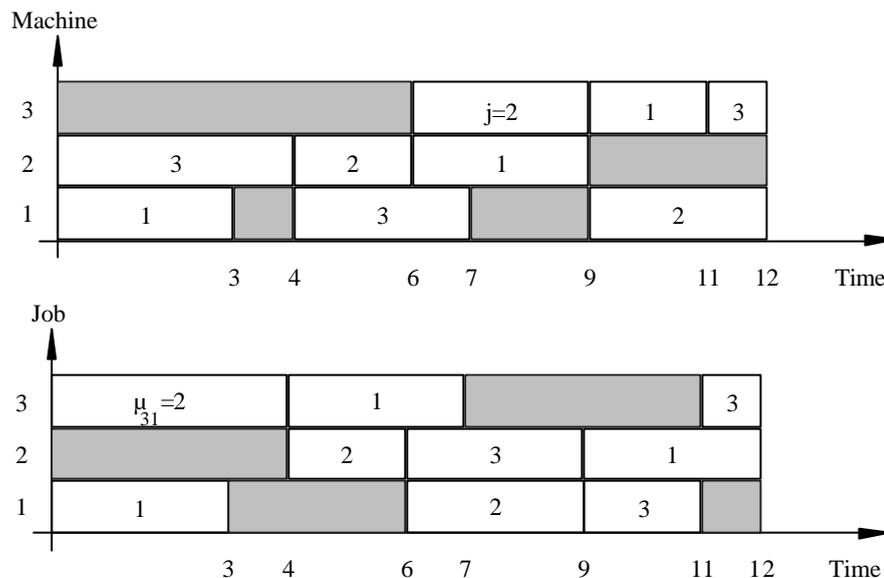


Figure 1. Gantt charts (j indicates a job and μ indicates a machine)

Schedules may be subject to certain restrictions. These restrictions describe the characteristics of the jobs, the machines, and their relations. Examples for job characteristics are preemption and precedence relations, examples for machine characteristics are, e.g., the number of machines or the kind of environment such as the flow shop. Within flow shops all jobs have to be processed on the machines in the same order. That is, each job J_j consists of m operations with operation O_{ji} being processed on machine i .

Finally, an objective function has to be defined for the scheduling problem, which is commonly the makespan. While there is a long debate about the usability of corresponding problems in the literature (see, e.g., Reisman et al. 1997) they may serve as excellent examples for teaching purposes. For a comprehensive discussion on production planning, machine scheduling, and especially flow shop scheduling the reader may be referred to Brucker (2001) or Domschke et al. (1997). The classification and characterization of scheduling problems goes back to the work of Graham et al. (1979).

The paper demonstrates how a learning unit on machine scheduling can be designed. We focus on a special case of the flow shop problem where the jobs are transferred from one machine to another—as long as not all operations are performed—including the consideration of transportation times; cf. Stern and Vitner (1990), Panwalkar (1991), and Lee et al. (1997). The example in Figure 2 shows a rather realistic model of a flow shop problem with two machines (M_1, M_2), one warehouse, and three jobs (J_1, \dots, J_3), which are transported by an automated guided vehicle (AGV). The objective is to determine a feasible schedule, which minimizes the makespan.

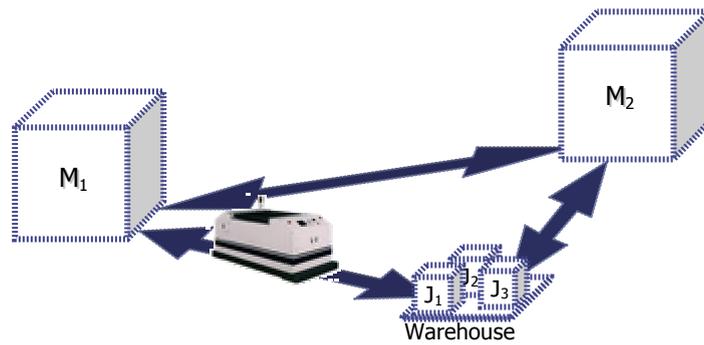


Figure 2. Two-machine flow shop problem with transportation times

This example demonstrates the production system, but is not very useful to show exactly how processing, transportation, and waiting times add up to the makespan of the whole problem. Therefore, we present an overview of different applets that can be used by students to understand the problem formulation and to interactively explore possible hazards in finding good (or even optimal) solutions, e.g., the order of the jobs, blocking machines, or transport units that are mainly moved empty.

In the next section we discuss some didactical aspects. In Section 3 we introduce the simulation tool SIMTOOL integrating the time dimension into the above model, which allows students to influence the production process and, therefore, the objective function value (makespan). Section 4 concludes the paper with a critical discussion on our approach.

2. DIDACTICAL ASPECTS

Advances in information and communication technologies lead to an increasing popularity of technology-supported learning. That is, most universities are involved in projects to transfer their learning material at least to electronically available documents. This fact poses the question how education can profit significantly from hypermedia and e-technologies. Within this context virtual and interactive learning modules have become crucial. Experiments are an important aspect of traditional scientific methods whereas a virtualization of such experimental exploration possibilities is difficult to realize in a way that allows the student to gain new insights of internal processes as well as to validate theories and methods. A primary goal of interactive learning material is to support the student to achieve better understanding for given problems by developing and testing own hypotheses.

Here, we demonstrate how to proceed from a classroom presentation to a learning unit for a virtual learning environment within a self-paced study. In general, the classroom presentation may contain slides, which are static—not counting special effects—like text zooming in or exploding screens. Therefore, a slide could contain the visualization of a flow shop problem as shown in Figure 3. Here, the transportation unit is in the focus transporting the job from the warehouse to the corresponding machine and vice versa. The lengths of the boxes for each machine represent the processing times of the jobs.

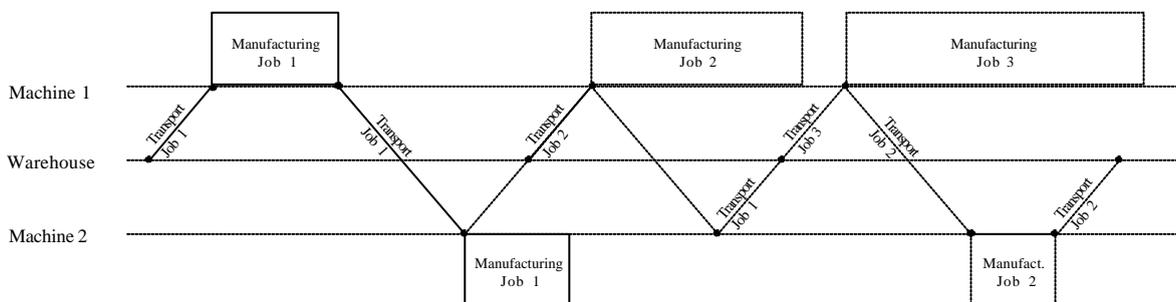


Figure 3. Flow shop problem, cf. Domschke et al, 1997, p. 394

The presentation of the example can slightly be improved by adding animations. Figure 4 shows an example where the transportation unit is moving between the warehouse and the machines while the time is visualized by an ongoing filling process of the jobs. Anyhow, the animation still misses interactive features such that a student is restricted to passively observe the presentation. Even simple features like moving forward and backward as well as changing the composition of jobs are not given.

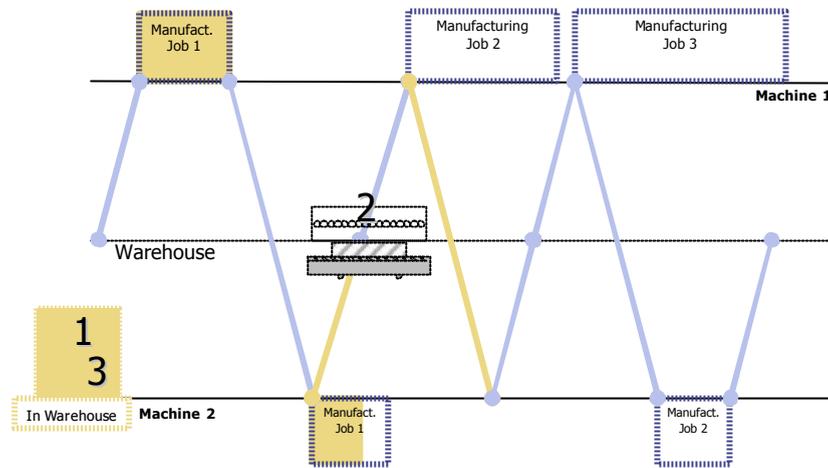


Figure 4. PowerPoint presentation with integrated animation paths

Even though the process-oriented presentation is probably an adequate way for education, another form is common and closely related to the previous design. So-called Gantt charts present a coordinate system with time-machine axes in which the jobs are drawn according to their properties. Here, the movements of the transportation unit are not given but instead the interdependences of the jobs are easier to recognize, in particular if each job is shown using a specific color.

Figure 5 demonstrates two examples of Gantt charts for interactive learning; cf. Hochbaum (2003) for the example on the right-hand side, and Hartmann et al. (2003) for the one on the left-hand side. Both applets demonstrate the usage of virtual and interactive learning but also miss certain important components. The student has to find the order of the jobs for a short time span by moving the jobs to a new location on the time line (using drag-and-drop). Errors and bad solutions are indicated but the user interface, first, lacks certain information, e.g., explanations, help, and traceability, and, second, at least of the applet by Hartmann et al. (2003), is not intuitive such that the student needs a large period of vocational adjustment.

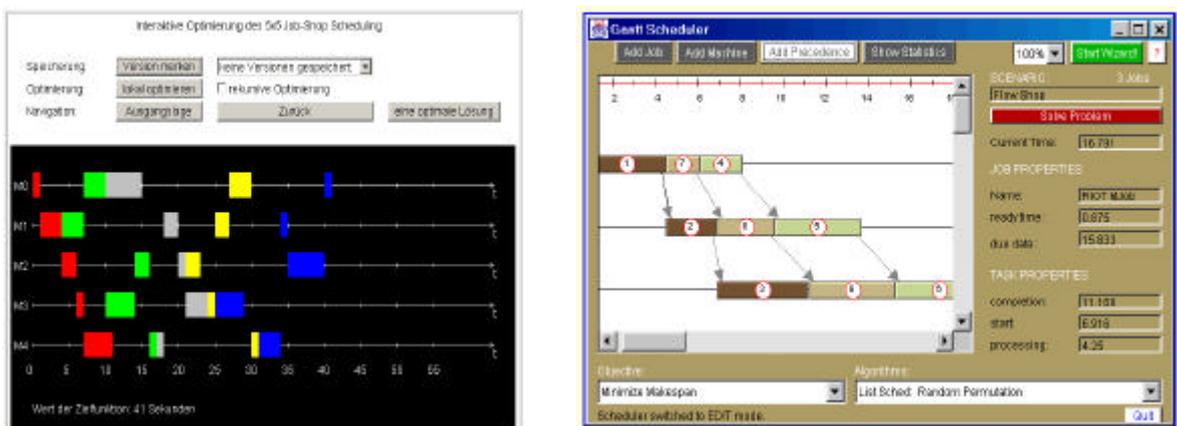


Figure 5. Examples for interactive flow shop applets within virtual learning material

The rapid growth in demand and usage of sophisticated technology does not necessarily result in a higher learning efficacy. For virtual and interactive learning material to be successful both its instructional as well as

the didactical design has to reflect the characteristics and possibilities of multimedia. Furthermore, the research publication in the field of cognition science should be considered for the design of the learning material, always with regard to the student. Particularly missing communication channels have to be considered. Teamwork or discussions like in traditional presence courses are not given to the same extent in virtual learning. In most virtual learning environments the student goes through the course by himself such that all required information has to be considered in advance. That is, all interactive components should be self-explanatory, a glossary should explain the most important terms, and prerequisites should be introduced, at least by short abstracts.

The use of complex technology without the consideration of the didactical structure of certain content may require a higher level of total participant effort. According to the cognitive effort perspective (cf., e.g., Todd and Bensabat, 1991) individuals will adapt their strategies in such a way that they limit their overall expenditures of effort, as the subcomponents of cognitive tasks are made more or less laborious (cf. Alavi et al. 2002). The cognitive effort perspective may provide some insights how well designed interactive learning modules may influence learning in a positive way. The easiest possibility to reach a qualitative improvement of virtual and interactive learning modules is the consideration of experiences from teaching traditional courses. On account of this we would like to present a more illustrative interactive learning module with further self-explanatory and motivating features in the following section.

3. INTERACTIVE VIRTUAL LEARNING USING A SIMULATION TOOL

Simulation tools are used to transfer the reality into a (simple) model, which can be used for experiments like introducing new scheduling algorithms, different machines to produce a good, or evaluating the influence of defects. There are several (commercial) simulation tools but most of these tools are not designed to be used within e-learning. That is, special visualization of internal processes, explanations, or adaptation to the student is not integrated. Therefore, we developed the application SIMTOOL, a discrete event-driven simulation tool, specially designed for education within the classroom and the self-paced study to demonstrate main principles as well as internal processes. Especially features like lesson specific configuration, feedback to performed actions, guidance by the simulation tool while solving a problem, and adaptation of the difficulty level regarding the student's background knowledge.

The design allows a high degree of configurability defined in so-called lessons. Depending on the aim of the lesson, simulation objects can be turned on or off and the functionality as well as the interactivity might be restricted with respect to required options to solve the task. Furthermore, XML-based scripts can be used to define macros as well as events that control the learning process; cf. Klie and Schalong, 2003. A sample lesson might be constructed as shown in the following example. The initial simulation model is built by executing a script in the beginning, whereas, subsequent to the building phase, the student has to solve the given problem formulation by interacting with the simulation tool. Depending on the difficulty level and defined events, the student is observed such that appropriate feedback is displayed. For example, if the distribution of a source has to be set to a normal distribution with a given mean and deviation value the event-action mechanism can be triggered in a way that all inputs that diverge by more than 100% from the expected values are rejected including a negative feedback in form of a textual explanation. This allows as much free exploration as possible without losing the control to the student.

SIMTOOL is still a prototype and, therefore, does not have a large library of components that can be used. The author of lessons might have to implement new components or extend the script language, which is intensively supported by the modular design of SIMTOOL. In the following example, some components need to be extended by further attributes and the control center has to be created. Even though this is a larger component and requires a skilled Java-programmer, several interfaces exist to access required information for the display and to implement the interactivity.

In the following, we sketch a learning unit allowing the student to explore the processes regarding a flow shop problem. Here, we mainly focus on the students' view about the design of components as well as the complete model. Incoming orders or jobs, respectively, (generator) are stored in a warehouse and then transported to the machine according to their properties. Jobs are represented by immobile units (here a box), which contain a list (attribute) of the processes to be accomplished (which machines and, if essential, in which order) before being delivered to a customer (order/job termination) as well as the status of each

process. In the lower part of the screen the jobs are shown including their status (a list of processes including the expected processing time in time units whereas a process can be not started yet (-), currently processed (p), waiting to be picked up by the transportation unit (w), or being finished) and their current location. The links between the warehouse and machines are non-movable. That is, the jobs can only be moved by a (automated) transportation unit (here emblemized by a palette, it can also be an AGV). Depending on the difficulty the amount of feedback as well as interactivity is set; the following description assumes a beginner.

After starting the simulation, the transportation unit has to transport jobs between the warehouse and the corresponding machines (as defined in their processing list). Here, the student has to decide on the sequence of the jobs as well as the assignment to a machine. This is accomplished by pausing the simulation whenever an event occurs; e.g., there are no further events in the event list, the transportation unit reaches its destination, or the status of a machine is changing. Whenever the model is paused, the student has the following options: (1) Load a job to the transportation unit, (2) send the transportation unit to a new location, (3) ask for hints, which can also be executed, (4) wait for the next event, or (5) just continue with the simulation. Assuming the situation as shown in Figure 6 where the transportation unit is empty on its way to the warehouse, machine 2 finished the processing of job 4 and waits for pick-up, and machine 1 is processing job 1. Note that the order of the jobs being processed is defined by the student and might not correspond with the best possible solution. Here, the transportation unit performed the following transports: job 4 from the warehouse to machine 1, back to the warehouse (empty), job 1 to machine 1, where job 4 is waiting to be brought to machine 2, back to the warehouse (empty). Furthermore, the transportation unit waited at the machines for several periods. In the moment where the transportation unit arrives at the warehouse, the student has to load the next job according to his considerations. In case of loading job 2, the transportation unit is send to machine 2. Afterwards, the event “job 1 at machine 1 is ready for pick-up” is triggered (the student just continues the simulation) the transportation unit arrives at machine 2. Here, job 2 is automatically placed on the machine, while job 4 is loaded onto the transportation unit. Then, the student has to define the next action, here the transport back to the warehouse to deliver the completely processed job.

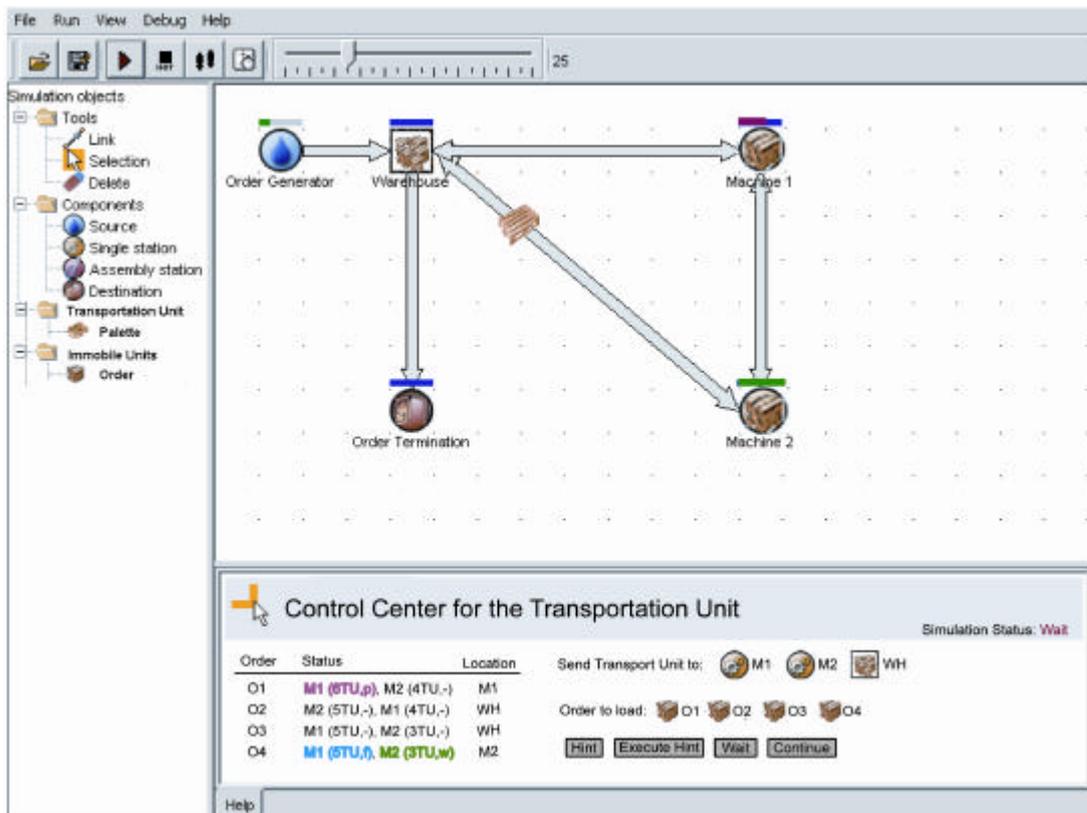


Figure 6. Screenshot of the SIMTOOL applet

The simulation is finished as soon as all jobs reach the destination (order termination). All actions are written to a protocol, which can be analyzed by the student, compared to an existing Gantt chart, or stored for a later comparison with another run of the simulation model.

During the learning phase with SIMTOOL the student is able to develop production planning skills, especially machine scheduling, based on own experiences. Additionally, the student may be motivated to go through further simulation trials in order to improve solution procedures (the final report shows the differences between various runs and the optimal solution). Over and above, within the implementation of a game-like approach solutions of different students may be compared in a high-score list, which should act as an incentive. The quality of the decisions made by the student is quantified by a score so the students can compete with each other. Hence, the motivation to deal with a complex subject may increase because the students participate more actively and absorb more of the presented material.

4. CONCLUSION

SIMTOOL as a sophisticated planning tool for teaching simulation allows a flexible, individualized, and experiential learning in higher education. The applet implements a learning unit that lets students interactively experience a two-machine flow shop problem with transportation times. Different from the traditional lecture and textbooks that are more or less forms of a one-way communication, the student can influence the production process and realizes the direct consequences of his action. Once the student manages to pass the task completely this leads to a deeper understanding and internalisation of the subject. Furthermore, learning is independent from time and location, i.e., one may choose where, when, and how fast to study.

Of course, interaction is limited due to the existence of trade-offs between interactivity/feedback and implementation costs. The teaching effort will not decrease through this new technology at short notice, since a website cannot replace the human lecturer. But new information technology surely can enhance teaching in the field of production planning.

Hence, there are compelling reasons to incorporate SIMTOOL into virtual learning environments as well as traditional classrooms. SIMTOOL simulates realistic problems, e.g., a flow shop problem, allowing the students to gain a better understanding of the problem itself and to design and test various solution strategies in an engaging environment. This allows the instructor to illustrate learning material using realistic instances that reflect the true complexity of diverse planning problems. SIMTOOL allows a flexible design of course units by writing scripts to guide the students. That is, certain milestones are defined using the XML-based script language, help texts have to be written that are presented with respect to the difficulty level of the students, and parts of free exploration with given limits are specified. The graphical representation of the simulation model can be adapted by including images.

Since scheduling problems usually consist of movable as well as non-moveable objects, which have to be related to one another over time in order to generate feasible solutions, the interactive simulation of the production process using SIMTOOL seems to be highly suitable. In addition to scheduling problems within production planning other fields such as project planning and scheduling, the scheduling of threads of computer programs, or flight scheduling can be realized by reusing learning units within other context.

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DIGITAL SECURITY, PRIVACY & LAW IN CYBERSPACE: A GLOBAL OVERVIEW

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ABSTRACT

Every day the news media give us more and more insight into the effects of digital security on our daily lives. Due to the enormous power of computer & communication technologies (ICTs), any lack of digital security affects privacy and ethics. The commercialisation of the Internet has stimulated considerable competition, both legitimate and illegitimate. The law governing intellectual property is not adequate to control the huge amount of information contained in cyberspace, which is defined as the realm of digital transmission not limited by geography. The change in the legal system is evolutionary, but the technological change is revolutionary. The immediate need for organizations to protect critical information assets continues to increase. It is a difficult task to establish a common international legal framework to maintain security and privacy in cyberspace. The new business environment, due to the explosion of Electronic Commerce (EC), has new security, privacy, legal and ethical problems that business people in the digital economy must be acquainted with, in order to handle them properly, and operate them effectively. The objective of this paper is to provide a global overview of major concerns in cyberspace as stated above. The author also discusses the Australian response to deal with those key concerns in the era of digital economy and globalisation.

KEYWORDS

Security, Privacy, Cyber Law, Internet, Electronic Commerce, Malicious Code, Cryptography

1. INTRODUCTION

Digital security, privacy, legal and ethical issues in cyberspace are attracting attention to industries and governments around the globe. Legal disputes and case laws are beginning to surface quickly. Many of the legal questions that arise in e-commerce are not settled due to lack of specific laws or legal guidelines. Online security is not about protecting hardware, but about protecting information. The field of digital security focuses on designing measures that can enforce security policies, procedures and law especially in the presence of malicious attack. The increasing importance of the Internet, growth of the digital economy and globalisation mean that there are new threats to security, privacy, and ethics. Other types of online harassment such as fraud and deception also exist. These malicious online activities must be controlled by a proper internationally accepted law, to minimise the negative effect of this ever-expanding technology on our society (Karmakar, 2002).

2. THE INTERNET STATISTICS IN A NUTSHELL

It is difficult to keep track of dramatic Internet growth. From about 50 million Internet users in 1997, there could be as many as 750 million by 2007 (Turban et al., 2002). According to a recent survey by Nua¹, the Internet population worldwide, as of September 2002, was 605.60 million. Table 1 shows the online population of the Internet around the world by the same survey.

Table 1. The online population around the world as of September 2002

Region	Online population (Million)
Africa	6.31
Asia/Pacific	187.24
Europe	190.91
Middle East	5.12
Canada & USA	182.67
Latin America	33.35

The Internet is the major catalyst for the convergence of information and communication technologies (ICTs), which are transforming most aspects of business and consumer activities including security and privacy (Karmakar 2001).

3. ELECTRONIC COMMERCE PARADOX

Electronic commerce (EC) has created a new business paradigm. EC firms must be open and closed at the same time. They must be open to sharing information with customers and vendors, but closed to hackers and intruders. Creating a security culture and procedure that straddles this fine line can make the difference between success and failure. When it comes to e-commerce, security is of utmost importance to a business. Security in e-commerce generally employs procedures such as authentication, ensuring confidentiality, and the use of the cryptography to communicate over open systems (Awad, 2000). As more and more businesses go online, confidential files are increasingly exposed to the risk of infiltration (Besserglik, 2000).

4. SECURITY THREATS

In a 1999 survey, 1,330 U.S. security professionals were asked “What security breaches or espionage occurred in your company in the past year?” Seventy percent of the respondents reported computer viruses. These and other breaches are summarised in Table 2 (Larson, 1999):

Table 2. Types of security breaches

Security Breaches	Respondents (%)
Computer virus	70
Unauthorised network entry	17
Denial of service	16
Data, system integrity loss	12
Information loss	10
Trojan horse	10
Manipulation of software applications	8
Trafficking in illegal materials	7
Fraud	7
Theft of data, trade secrets	5
Manipulations of system programs	4
Revenue loss	3
None	21
Unknown	17
Other	2

¹ http://www.nua.ie/surveys/how_many_online/

Malicious code or rogue program is software designed to damage, destroy, or deny service to the target system. The type of malicious code is summarised in Table 3 (Pfleeger and Pfleeger, 2003):

Table 3. Type of Malicious Code

Code Type	Characteristics
Virus	Attaches itself to another program & can cause damage when the host program is activated
Trojan horse	Hide their true identity (usually destructive), and reveal their designed behaviour only when activated
Logic bomb	Triggers action when condition occurs
Time bomb	Triggers action when specified time occurs
Trapdoor	An electronic hole in software that is left open by accident or intention, can be installed by a virus or worm
Worm	A virus that replicates on other machines through a network
Rabbit	Replicates itself without limit in order to exhaust resource

5. CRIME IN CYBERSPACE

From a network security standpoint, the 11 years between the appearances of the Morris Worm in 1988 and the Melissa Virus in 1999 were relatively calm. In 1999 cyber attacks began to escalate dramatically.

According to an estimate by the consulting firm PricewaterhouseCoopers, the business world lost \$1.6 trillion to hacker attacks in 2000. The firm based this estimate on a survey of about 5,000 information technology professionals in 30 countries (Oz, 2002).

The increase in computer attacks is also substantiated by data collected by the Computer Emergency Response Team (CERT) at Carnegie Mellon University. According to their statistics, the number of incidents reported to CERT increased from around 2,600 in 1996 to 10,000 in 1999, and then approximately 22,000 in 2000. Similarly, the number of vulnerabilities that were reported increased by over 100 percent from close to 350 in 1996 to about 775 in 2000, which is shown in Table 4 (CERT, 2000).

Table 4. Incidents and Vulnerabilities Reported to CERT

	1996	1997	1998	1999	2000
Incidents	2,573	2,134	3,734	9,859	21,756
Vulnerabilities	345	311	262	417	774

Survey data reported by the Computer Security Institute and the FBI (CSI/FBI) indicated that those organisations surveyed (643 US corporations and government agencies) experienced one or more attacks in 2000 (Computer Security Institute and Federal Bureau of Investigation, 2000).

In a similar sort of survey, Omni Consulting Group (Gerals, 2001) asked 3,000 businesses worldwide to assess their dollar losses resulting from lapses in security. They put the figure around 6 cents for every dollar of sales. Based on these figures, Omni estimated that security breaches cost European business \$4.3 billion in lost revenue in 2000. The magnitude of the security concerns can be gauged from recent surveys (the 2002 Australian Computer Crime and Security Survey², and in the United States, the 2002 CSI/FBI Computer Crime and Security Survey³).

Empirical evidence leaves no doubt that the rise in attacks against computers and networks has mirrored the growth of the Web. E-commerce sites are much more likely to be the victim of attacks than other sites, reaffirming the notion that the rise in cyber attacks on the Internet is a direct result of the rise of e-commerce (Turban et al. 2002). It has been said that most companies report a security lapse only if it becomes public. Reasons why companies are disinclined to report security breaches include the fear of legal liability if customer data is exposed, negative publicity and a backlash from investors (Los Angeles times, 2001).

Experts believe US cyber-warriors may be using viruses, worms and electronic-pulse tools to shut down Iraqi computer and communications networks as the coalition military forces battle sandstorms and Iraqi

² www.deloitte.com.au

³ www.gocsi.com/press/2002040407.html

resistance in the current war (Deane, April 1, 2003). Hacker activity has increased sharply in recent weeks due to the war in Iraq, but these attacks have not caused serious problems. Of the three war-related viruses discovered in late March, the most significant was the *Ganda worm*, which spreads by e-mail with text in both English and Swedish. Its impact has been greatest in Scandinavian countries. Ganda uses war related subject lines and messages to attract users' curiosity, such as offering Iraqi spy pictures, or a George Bush screensaver. On March 26, 2003 Swedish police arrested a suspect, who admitted playing a role in the spread of the *Ganda* worm (Mills, 2003).

In a similar vein, the *Prune* virus carries a subject line "Iraq Crisis" and claims to contain US government material. A third war related virus, the *Wanor* worm, appears to be intended as a political protest. The most widespread new threat for the month is the *Deloder* worm, notable for its efforts to attack users who set weak or obvious passwords. The worm tries to log on computers using a list of potential passwords; this has been detected on about 7000 PCs in March 2003. The top threat, *FunLove* was detected 300,000 times (Mills, 2003).

The Computer Emergency Response Team (CERT) was established to research and advise organization on computer security problems in the United States.⁴ AusCERT is the equivalent operation in Australia.⁵ A majority of Australian Information Systems Managers consider it important with regard to policies and audits; only a minority are prepared for an external attack (Hutchinson & Warren, 2001).

6. SECURITY POLICY TO SAFEGUARD PRIVACY & INFORMATION

One of the serious mistakes companies make when it comes to security is failing to establish good security policies and then ensure that they are followed. Policies should address the threats against which information must be protected in order to ensure *confidentiality*, *integrity*, and *privacy*. In a 1999 study in which companies were asked whether they had an established security policy, only 36 percent of those surveyed had written security policies. 39 percent had an informal policy and 23 percent had a written description of security measures. About one-half of the respondents reported their security policies were aligned well with their business goals. The majority of the respondents indicated the security technology provided by their hardware and software vendors were "mostly strong" or somewhat strong", yet 70 percent did not have a formal policy authorising counterattacks against intruders. Overall, the study shows that there is plenty of room for improvement (Weston, 1999).

The technology provides a foundation, but in the absence of intelligent management policies even the best technology can be easily defeated. Public laws and active enforcement of cybercrime statutes are also required to both raise the costs of illegal behaviour on the Internet and guard against corporate abuse of information (Laudon & Traver, 2002). The privacy of personal information is becoming a very important part of digital security. As long as hackers continue to hack on the Network the security and privacy issues are very serious. Personal information and privacy of communications must be protected without any question. In terms of e-mail generally, the tragic events of 9/11(11 September 2001) in New York have led to the governments increasing their powers to monitor e-mail traffic around the world, consequently diluting privacy.

7. BLUEPRINT FOR SECURITY

The top management should enforce digital security policy, standards, practices, procedures and guidelines. Policy should never contradict law, because this can create a significant liability for the organisation, which must design and create a safe environment in which business processes and procedures can function. Microsoft, for example, has published a set of best security practices at the Website.⁶ Microsoft focuses on seven key areas for their security (Whitman & Mattord, 2003):

⁴ www.cert.org

⁵ www.auscert.com.au

⁶ www.microsoft.com/privacy/safeinternet/security/best_practices/default_htm

1. Use antivirus software
2. Use strong passwords
3. Verify your software security settings
4. Update product security
5. Build personal firewalls
6. Back up early and often
7. Protect against power surges and loss

Encryption provides the key to providing greater security, and various organisations are considering policies on cryptography.

Companies are still trying to determine their IT security priorities according to recent Gartner analysis, which has identified the top 11 security concerns for 2003. These include:

1. Web services security
2. Wireless LAN security
3. Identity management and provisioning
4. Role of security platforms and intrusion prevention systems
5. Correlation of events for reporting/monitoring/managing consoles
6. The next Code Red/Nimda
7. Instant messaging security
8. Homeland security
9. Tactical security to infrastructure security
10. Protecting intellectual property
11. Transaction trustworthiness/auditability

8. LEGAL ISSUES: INTERNATIONAL DIMENSIONS

For most law-abiding citizens, the Internet holds the promise of a global marketplace, providing access to people and businesses worldwide. For criminals, the Internet has created entirely new and lucrative ways to steal. From products and services to cash to information, it's all there for taking on the Internet (Laudon & Traver, 2002).

Laws have always governed well-defined geographical territories. In e-commerce, though, parties conduct business in cyberspace. This poses legal challenges. Two opposing principles have been suggested for jurisdiction: country of origin and country of destination. Using the Internet as a medium for doing business has created an international environment in which multiple laws may govern the same transaction. Any national regulations may not apply to a foreign company because of the international nature of the Internet. Furthermore, it may not even be possible to determine in which country the company is located, so that enforcement of privacy provisions may not be possible. How does a business prepare for, and solve problems in this environment? Electronic signatures are now legal and binding in the United States and several other countries. Electronic signatures facilitate e-commerce but are prone to error and forgery (Oz, 2002).

Law and computer security are related, however the law does not give adequate control. The laws dealing with computer security affect programmers, designers, users, and maintainers of computing systems and computerized data banks. Computer law is complex and emerging rather rapidly as it tries to keep up with the rapid technological advances in and enabled by computing (Pfleeger & Pfleeger, 2003). Electronic commerce is the new challenge to the legal system, because the Internet is an international entity. Citizens in one country are affected by users in other countries, and users in one country may be subject to the laws in other countries. The international nature of computer crime makes things much more complicated. Many countries, such as the United States, Australia, Canada, Brazil, Japan, the Czech Republic, and India, have recently enacted computer crime laws. These laws cover offenses, such as fraud, unauthorized computer access, data

privacy, and computer misuse. Schjolberg has compiled a survey of different countries' laws to counter unauthorized access (Schjolberg, 2002).

Although computer crime is truly international, differing statutes in different jurisdiction inhibit persecution of international computer crime. In November 2001, the United States, Canada, Japan, and 22 European countries, signed a cybercrime treaty. This treaty makes a crime out of activities such as online child pornography; fraud committed using computers and computer networks, and malicious attacks. The significance of this treaty is not so much that these activities are illegal (which most instances they already were) but that the countries acknowledged them as crimes across their borders, making it easier for law enforcement agencies to cooperate, and for criminals to be extradited for offenses against one country committed from within another country. But to really support investigation, prosecution and conviction of computer criminals, more than just 25 countries will have to be involved.

The European Union (EU) has in place a legal framework for the promotion of electronic commerce within the Union.⁷ A collaboration of platform, software and technology vendors is developing a specification to facilitate security within PC operating systems⁸.

Although guidelines have been prepared by such bodies as the United Nations, they carry no legal authority. The most influential provision to date is the European Union Council Personal Data Protection Directive (EUCPDD), which was formally adopted in July 1995. This establishes a set of legal principles for privacy protection applicable to both public and private sectors and legislation has since been enacted by all EU member states modeled on the directive.⁹ Although these legal principles apply only in the EU, their effect is far reaching. This is because the directive also prohibits the transfer of data from the EU to countries, which do not have adequate data protection laws. Conversely, the import of data from such countries may also trigger the requirement of the importer to abide by the EU directive. This is one of the factors putting pressure on countries such as Australia to improve their privacy protection laws.

8.1 Australian Response

In Australia, the *Privacy Act 1998 (Cwlth)* provides privacy safeguards which federal government departments must observe in collecting, storing and using personal information. *The Privacy Amendment (Private Sector) Act 2000* extended privacy protection to personal data held by the private sector in accordance with the 10 National Privacy Principles (NPPs),¹⁰ a key principle providing a right of access to an individual so that they can check that the information is correct. Companies are given the choice of adopting these principles or adopting their own which, however, must comply with the principle. It remains to be seen whether Australia's privacy legislation is strict enough to meet EU laws.¹¹

The Australian Federal Privacy Commissioner has prepared guidelines on workplace e-mail, web browsing and privacy.¹² The guidelines stress the importance of the company preparing an in-house policy so that all employees understand what is acceptable use of the Internet and what individual privacy limits will be respected by the company. As a result, sales of employee surveillance software are booming in developed countries including Australia (Lawrence et al., 2003).

The Australian Government is pursuing an e-security policy to increase public confidence in the security of the online environment.¹³ It has introduced the Cybercrime Bill 2001, with the aim of providing a strong deterrent to persons engaging in cybercrime activities such as hacking, computer virus propagation, denial of service attacks, stalking and fraud. The legislation also allows for enhancement of enforcement powers

⁷ The European Commission. Commission welcomes final adoption of legal framework directive, europa.eu.int/comm/internal_market/en/commerce/2k-442.htm

⁸ Trusted Computing Platform Alliance, www.trustedcomputing.org

⁹ For an example see the United Kingdom's *Data Protection Act 1998*, www.legislation.hmsso.gov.uk/acts/acts1998/19980029.htm

¹⁰ www.privacy.gov.au

¹¹ UNSW (*University of New South Wales*) *Law Journal*, 'Valuing privacy: legal protection and exceptions'. www.law.unsw.edu.au/unswlj/forum/valuing

¹² www.privacy.gov.au/internet/email

¹³ Protection of Australia's National Information Infrastructure and E-Security Policy, www.noie.gov.au/Projects/Information_economy/e-security/nat_agenda.htm

relating to the search and seizure of electronically stored data. The key offences are consistent with the terms of the draft Cyber Crime Convention, which is being developed by the Council of Europe and other countries, including the United States.

9. CONCLUDING REMARKS

Designing for digital security involves five steps: adopting a security policy that makes sense, considering Web security needs, designing the security environment, policing the security perimeter, and authorizing and monitoring the security system. One of the greatest advantages of the Internet is the ability to turn a single Website into a world market for products. Exchanges in specialized industries have attracted thousands of sellers and buyers alike. However, the same tool that makes markets so efficient can also be used to violate *antitrust laws* relatively easily. The characteristics of information significantly affect its legal treatment.

Organizations and people that use computers can describe their needs for information security and trust in terms of five major requirements: confidentiality, integrity, availability, legitimate use and non-repudiation. Security of the encryption key, assignment of liability, responsibility for the key, and audit of access to the key are all ongoing issues that must be addressed (Amor 2000). There is no doubt that a cryptographic system, correctly managed and implemented, offers the highest security level for electronic information available today. But don't forget the education and security process re-engineering, as they will decide on the level of security of the whole company. Australian public and private organizations are not well protected by the existing national and international laws to have secure online transactions and business. The appropriate laws help ensure orderly, rational, and fair markets.

Many privacy organizations are fighting for setting up standards on the Internet, but as the Internet does not belong to anyone in particular it is not possible to enforce standards. New standards evolve slowly and need to bring advantages to the user in order to be accepted. Business and consumer concerns about security are legitimate, irrespective of countries we live.

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PRIVACY AND THE INFORMATION ECONOMY

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ABSTRACT

The development of information systems and the growth of the information society has stimulated interest in individual privacy. Individual information systems researchers and practitioners have made important contributions to the ongoing debate. We examine current approaches and question their efficacy in protecting privacy online. We identify two key areas of concern: the cost to the information economy of current privacy protection measures, and their mono-cultural origins. We then propose a new approach derived from Hegel's investigation of the concept 'private', and show how it has a broad application to privacy issues in the information society.

KEYWORDS

privacy, economic right, information economy, information society.

1. INTRODUCTION

The rise of the information society, the commodification of information and the growth of the information economy have led to growing interest in privacy. Much has been written about the nature of privacy, the extent to which it should be protected, and the mechanisms we might use to protect it. The approach that currently dominates the Internet is based on the empiricist tradition of Anglo-Saxon philosophers such as Locke and Hume. It is, perhaps, most widely known through the development of international human rights law since the founding of the United Nations in 1945 (see (UN 1945) in particular the Preamble, Article 1 par. 3 and Article 55 par. c). The 1948 the United Nations Universal Declaration of Human Rights (UDHR), includes an explicit right to privacy in Article 12: "No one shall be subjected to arbitrary interference with his privacy" (UN UDHR 1948). A similar right is included in the International Covenant on Civil and Political Rights (UN ICCPR 1976), which expands and clarifies the civil and political rights set out in the UDHR. Thus: "In the international law of human rights 'privacy' is clearly and unambiguously established as a fundamental right to be protected." (Michael 1994).

However, this is only one approach to privacy. "It is a commonplace that privacy is culture specific" (Michael 1994), and that different peoples have different views on what should be kept private and what can justly be made public. As the information economy expands beyond its European and American origins, companies must strive to understand and leverage cultural diversity to gain competitive advantage. For

example, Stoney and Hutchinson have investigated the ramifications of cultural difference for web site design (Stoney 2001). From the user perspective, Roth has questioned the contention that the Internet is culturally neutral territory: "Why should we expect Internet institutional systems, structures, sites, services and access and user politics to be any different from those evident in the societies from which they emerge?" (Roth 2000). Feminist thinkers have also questioned whether the Internet, as currently constituted, meets the needs of women (see for example (Herman 1999)). Thus the growth of Internet based e-commerce presents IS professional and businesses with a new challenge: catering for cultural diversity in a global village. Managing varied cultural expectations of privacy is an important aspect of this challenge.

A more familiar criticism of the human rights approach to privacy protection is that it restricts the growth of the information economy by placing undue burdens on businesses that seek to exploit the potential of e-commerce. This criticism is aimed squarely at data protection laws, and there is a growing body of work advocating alternative approaches to protecting the privacy of personal information (see for instance (Ellis 1972), (Wacks 1989), (Laudon 1996) and much of (NTIA 1997)).

In this paper we seek to explore some of the tensions present in current approaches to privacy protection, with particular emphasis on their impact on the growth of international e-commerce and the information economy. We summarize the results of our investigations over the past three years and suggest areas that would benefit from further research.

2. CULTURAL ASPECTS OF PRIVACY

"Of all the human rights in the international catalogue, privacy is perhaps the most difficult to circumscribe and define" (Michael 1994). This is clearly illustrated by the fact that, even in the context of "Western" thought, the human rights approach to privacy, rooted in the Anglo-Saxon empiricist tradition, is just one of a number of different approaches. This is not only true diachronically, with the philosophy of the Ancient Greeks being radically opposed to the philosophy of modern individualism, but also synchronically, with a number of widely differing views being held by different philosophers at the same time, as is the case, for example, of German Idealism and Utilitarianism. What follows is an overview of a very small number of differing approaches to privacy within the western philosophical tradition.

In the Greek philosophical tradition, specifically the tradition of Plato and Aristotle, a person was seen to only fully realize the nature of humanity as a citizen, a member of a polis, the Greek City-State. Indeed, the Aristotelian definition of mankind was *zoon politikon*, an animal that distinguishes itself by being a citizen, a member of a polis: it is only as citizens that humans differentiate themselves from animals, fully becoming humans; in Aristotle's words, only a god or a beast can be self-sufficient, not needing to be part of a polis (Aristotle, *Politics*, 1453a 25-30; an English translation is available as (Aristotle 1984)): man (and Aristotle did mean the male gender) therefore cannot exist as a "private" individual, and must as a necessity renounce his privacy and conduct a "public" life as a member of the state. Philosophers who advocated a "private", self-sufficient, life were branded as beasts: more specifically, they were labeled dogs, hence the name of the "cynical" (literally: "dog-like") school of philosophy, which was radically opposed to the idea that mankind (in this case without gender bias) could only be truly human by renouncing privacy and becoming part of a State.

The tradition of Aristotle and Plato was elaborated further by Roman thinkers. As if to corroborate the ideas of the Greek philosophers, an etymological examination reveals that the Latin word for privacy literally means "deprived", indicating that privacy was an incomplete and imperfect state: only by renouncing privacy, becoming a full citizen who shares all aspects of life with other citizens can a human being truly find fulfillment, happiness and, ultimately, humanity (for an example of Roman thought on the importance of citizenship, see Cicero's *De Officiis*, available in modern edition as (Cicero 1994)). The supreme good is therefore not the private good, separated from the rest of the community, but the common good, literally, the *res-publica*, "republic", in the sense of State which is not a separate entity from the individual, but is an enhancement and completion of the individual.

This concept changed in the Italian Renaissance with the political realism of Machiavelli (see Machiavelli's *Il Principe*, available in English as (Machiavelli 2000)), who saw ("cynically", one may add) the separation of individual and citizen, with the realization that in actual fact the State did not operate in the best interest of the individual, but was simply an instrument in the hands of the ambitious Prince.

The idea of the separation (and perhaps even opposition) of individual and citizen opened the way to the idea that individual freedoms could be separated from the laws given (indeed, imposed) by the State. This in turn brought, with Hobbes and Locke, the idea of the primacy of individual rights (for example the right to property) which are guaranteed by a contract: humankind is no longer seen as being fulfilled as part of a society; rather, society is seen as guarantor for those rights which enable humans to be humans. For Greek-Roman thinkers, the role of the State was to fulfill humankind rendering humans truly human; for Hobbes (see *Leviathan*, in modern edition as (Hobbes 1981)), Locke (see the *Second Treatise of Government*, available in modern edition as Locke (1986)), and their more recent successors, such as Rawls (1999) and Dworkin (1987), it was to protect the rights derived from the "state of nature" of humankind.

Hobbes' and Locke's idea of the primacy of individual rights was further examined by thinkers such as Rousseau (*Contrat Social*, available in English as Rousseau (1998)), forming the basis of the ideals of freedom and interest of the individual found in the French revolution. The ideas at the basis of the French revolution were profoundly influential on the next generation of thinkers, forming a constant point of reference in European thought. One of the most influential thinkers of this period, Hegel, has indeed been seen as giving "a theoretical interpretation of the French Revolution" (Marcuse 1955), providing a conceptual underpinning to the ideas of freedom and individual rights that the French Revolution sought to realise. However, according to Hegel, rights are not to be considered as abstract ideas existing in an imaginary "state of nature" as was the case with Locke and Hobbes; rather, he attempts to give a sound foundation to these rights by deriving them logically from the idea of abstract right and free will (see his *Philosophy of Right*, available in English as Hegel (1991)). On the other hand, Hegel also justifies the Greek idea that the individual must be part of a State in order to fully realise humanity, showing that individual rights (such as the right to privacy) only make sense within the wider scope of the State, through which, and only through which, they attain full reality: in other words, rights make sense according to Hegel in relationships between individuals, but must be renounced in relation to the State, as the State is a "higher" reality in which citizens no longer need to appeal themselves to rights. The ideas of Hegel were further developed by Marx and his twentieth-century followers, who argued that not only could the individual's humanity only be fully realised as a working member of society (albeit not the present society, but a future society still to be built), but, more radically, that the so-called "bourgeois" rights (including the right to property and to privacy) precluded humankind from realising its true potential (see (Marcuse 1955) for an exhaustive discussion on Hegel's legacy). The Hegelian approach, however, did not remain unchallenged, and was opposed, for example, by the individualism of philosophers such as Kierkegaard (and, in the twentieth century, Heidegger) who saw introspection, and therefore the private sphere of individuality, as the only way to "truth". A reaction both to the radical individualism of existentialist philosophers such as Kierkegaard and empiricist philosophers such as Hobbes and to the "socialism" of Marxist and neo-Marxist philosophers was, in the twentieth century, the so-called "Personalism" of philosophers such as Jacques Maritain (see, for example, (Maritain 1947)), who tried to find an alternative in the philosophical tradition of the mediaeval thinker Thomas Aquinas. According to Maritain rights (and hence privacy rights) are grounded in natural law; however, differently from what occurs in Hobbes or Locke, they relate specifically to the common good: it is this common good, and not individual rights, which forms the basis of the state. The right to privacy would therefore have to be revisited in the light of the idea of a common good, which takes precedence over the claims of the individual.

3. ECONOMIC ASPECTS OF PRIVACY

A second major criticism of the human-rights approach to privacy concerns the cost to business, and the wider economy, of implementing such a right. This criticism is one rooted in economics, transaction cost theory and free trade. A good starting point for our discussion is the criticism of the EU Data Protection Directive (Council Directive 95/46/EC). This is very much in the Anglo-Saxon empiricist tradition of individual human rights. It has been criticized in (Gindin 1998), (Hosein 2000) and (Pounder 2001) among others. The basic argument is that in an information age, data protection legislation could become "overly bureaucratic and cumbersome" (Cavoukian 1999), since it requires the state to regulate almost all use of personal information. This regulation necessarily imposes costs on any business that stores personal information, and may restrict the flow of information between them: an unwelcome brake on the developing information industry.

Worries about bureaucracy and the cost of regulation have led to several proposals to establish a form of economic right to information privacy. The idea is that market mechanisms can achieve an equitable balance between an individual's desire for privacy and economic efficiency; something that the human rights approach cannot do. The best example is Kenneth Laudon's proposal for a National Information Market (Laudon 1996). In Laudon's scheme, individuals would 'deposit' their personal information in a local 'information bank'. The 'information banks' would then pool their information deposits and trade them on a 'national information exchange', with a fee being paid to the individuals whose personal information had been traded. However, some argue that such a system would be just as costly to manage as the current privacy regime. Laudon himself recognizes that there would be "information-handling charges for both the local banks and the exchange, as well as any brokers involved". Whether the value of an individual's personal information is sufficient to offset these transaction costs is not clear. This opens the way for a Coasian re-allocation of property rights: if there are "significant transactions costs to making contracts ... an efficient allocation of rights would be one in which the transactions and negotiation costs are minimized" (Varian 1997). In other words, if the cost of trading information is greater than the value of the trade to the individuals who 'own' it, then the property rights to that information should be re-assigned. Typically, property rights would be transferred from the individual to whom the information pertains to the organization that collected the information. This may be sound economics, but is hardly an effective privacy protection regime from the individual's perspective.

Whatever the costs involved, whether setting up a bureaucracy or funding a transaction, it is clear that some form of privacy protection is necessary to *assist* the free flow of information. "Consumers are uneasy with their personal information being sent world-wide" (Privacy International 1999) and require some assurance that it will not be misused. Without the trust of consumers, the development of the information economy may stall (Cavoukian 1998). It was a concern to *promote* the free flow of personal information that led to one of the early attempts to agree basic data protection rules: the 'fair information practices' of the OECD's Guidelines On The Protection Of Privacy And Transborder Flows Of Personal Data (OECD 1980). This sought to ensure that differing data protection regimes did not restrict international trade in personal information. This is at the heart of the debate over the EU Data Protection Directive, which prevents the transfer of personal information about EU citizens to any non-EU country lacking adequate data protection.

Cost is not the only reason for advocating a switch to a property right in personal information. As early as 1972 the British Computer Society advocated that "personal information, whether of an individual, group or institution, should be defined as a property right" since "... there is little to be achieved by attempting a philosophic definition (of privacy), and that concentration on this elusive goal may well seriously delay practical measures to establish desirable levels of protection." (Ellis 1972). Thus as early as the 1970s some authors had begun to recognize the tension between the value individuals place on privacy, and the value of their personal information to business. For Ellis, the key problem was the difficulty of agreeing a definition of privacy for personal information. This ties in nicely with our discussion of cultural aspects of privacy; just whose definition of "private" should we adopt? Lacking any agreed definition, Ellis regards a property right as the next best thing, since it will allow individuals to make choices over what they reveal and what they keep private.

More recently, James B Rule, considering privacy protection in the USA, has also suggested that "legislators should ... create a property right covering commercial uses of personal information" (Rule 1998). This would "protect privacy without any new government agency - and without further misplaced trust in industry self-restraint" (ibid.). These remarks suggest that neither cost nor cultural sensitivity are the main influence on Rule's call for an individual property right to personal information. Instead, he does not trust business to play fair with the consumer, nor government to regulate the information economy effectively. Others share Rule's concerns: Privacy International has noted that "Companies regularly flaunt laws, collecting and disseminating personal information" and that "concern over privacy violations is now greater than at any time in recent history" (Privacy International 1999). Interestingly, N. Edouard and W. White, in a report for the UK Management Consultancies Association, claim: "The key battleground lies with the competing aims of individual (and corporate) privacy versus what can be described as national interest" (Edouard and White 1999). Thus businesses also worry that their privacy is under threat, even as they seem to threaten the privacy of their customers.

A property right to information is not the only market-based model for privacy protection. Various self-regulatory and compensation schemes have been suggested as alternatives to both the human right and the property right approaches to privacy (see for example (NTIA 1997), in particular the contributions in Chapter

1: Theory of markets). A real-world example of such a regime is TRUSTe. TRUSTe is an independent, non-profit privacy organization, which aims to promote, within Internet e-commerce, a form of industry self-regulation that it terms "self governance". Here, industry self-regulation is framed within existing laws and industry best practice under the scrutiny of an "informed marketplace" (TRUSTe 2001a; 2001b). Consumers can trust any organization that gains the TRUSTe seal of approval to play fair with their personal information. Unfortunately, TRUSTe is itself under criticism for a having "slipped from a consumer advocate to corporate apologist" (Boutin 2002). The accusation is that large Internet organizations have continued to use the TRUSTe seal despite what most Internet users would regard as sharp practice with respect to their user's privacy. This case illustrates the main criticism of self-regulation: that it is based on "wolves herding sheep - for the benefit of the wolves, not the sheep" (Clarke 2000).

Thus we are faced with a conundrum: to promote free trade in information, and the development of the information economy, we must ensure consumer trust by protecting privacy. Yet the most effective mechanisms to protect privacy may undermine the development of the information economy, through high cost. Worse still, the cheaper alternatives may actually undermine what consumer trust there is.

Our focus throughout this section has been on information privacy: the privacy of personal data and personal communications. This was necessary since few authors writing on economic approaches to privacy protection consider other aspects of privacy. To date, most developments in the information economy have been concerned with trading such data and monitoring such communications. This is likely to change. Privacy of the person, the right to refuse invasive procedures such as electronic tagging, is currently facing significant challenges. Developments in cybernetics, for example the use of electronic tags or implants to monitor an individual's whereabouts, are one such challenge. Schemes to monitor the whereabouts of offenders using electronic tags are already in place in the UK (see (Elliot et al 2000), (Airs et al 2000) and (Dodgson et al 2001, p iii).) Privacy of personal behavior may be threatened by developments in surveillance technology. For example Solution Products Systems Ltd, offers a tool that uses infrared cameras to analyze which products catch shoppers' gaze (see (SPS 2002)). Linked with iris recognition systems this technology could potentially track an individual's browsing habits. Thus, as technology progresses, the anonymity of the crowd, one of the main protection mechanisms for the privacy of personal behavior, could well disappear.

It is difficult to see how current proposals, rooted in existing technologies and the decades-old problem of information privacy, can be applied to resolve these new challenges. The differences of opinion over the nature and extent of the right to privacy; the profusion of competing protection mechanisms; and the perceived conflict between individual privacy and economic efficiency suggest that a fresh attempt at a philosophic definition of privacy is required. This definition must build on the work done in defining privacy as a human right, but acknowledge both alternative cultural approaches and the economic aspects of privacy.

4. A HEGELIAN APPROACH TO AN ECONOMIC RIGHT TO PRIVACY

As seen above, the concepts of "private" and "privacy" have been examined by a number of philosophers. Few however have looked at the economic aspects of the problem: one of the most compelling approaches, which, in looking at the concepts of "private" and "privacy", examines the relationship between the idea of rights and the socio-economic reality into which these rights must be realised, has been by Hegel, most notably in his *Encyclopaedia* (Hegel 1817) and *Grundlinien der Philosophie des Rechts*, ((Hegel 1821), available in English with the title *Philosophy of Right*, as (Hegel 1991)) . We shall concentrate here (and with no claim to exhaustiveness, given the density of Hegel's writing) on Hegel's *Philosophy of Right*, showing how an Hegelian approach can form a basis for an economic right to privacy.

For Hegel the idea of "private" is derived from a reflection on "right" itself: it is therefore the careful reflection on the abstract concept of rights which brings us to the idea of a right to privacy. The starting point for the idea of a "right" is for Hegel the concept of freedom, and, more specifically, the concept of a free will (*Grundlinien der Philosophie des Rechts*, par.4): hence, to understand the meaning of "right" we must first examine the concept of "freedom". For Hegel the starting point for the foundation of any right is not any "law of nature", but the fact that human beings are, as human beings, capable of making free decisions: it is this freedom to choose, or free will, that makes us human and which in turn determines our rights as humans. This means that when talking about rights we are talking about the expression of freedom, or, in other words, the expression of an individual free will. A right is in the first instance, to use Hegel's words, the "immediate

being" of freedom (par. 40): freedom is a being which finds itself opposed to a nature which is different from itself and therefore is revealed as the being of a subject (free will) in contrast to an object (nature) (par. 39). Human beings find that their free will is not infinite, but is constrained by surrounding nature: the free will therefore strives to act in order to take away these objective limitations to itself. In everyday terms, people, beings with a free will, find they are not infinitely free: their freedom is restrained, by nature, the world and other people. But people want their freedom, notwithstanding these limitations. Rights in general, and in particular the right to privacy, are therefore a solution to the contrast between the free will and the limitations imposed on this free will by the existence of other beings who also have a free will: rights are therefore derived from the desire for a person to be free in opposition to the will of others and who in turn want to express their liberty by intruding into this same person's freedom. Rights arise therefore when I seek to deprive others of their liberty in order to be able to express my liberty: what I consider my private sphere of action is deprivation (taking away of the private) for another who is not me. Privacy, therefore, intended as the right to be "private", belonging to me and not to others, is essentially a right which ensures the freedom of each individual.

A discussion of the right to privacy therefore leads directly to Hegel's treatment of property. Property is for Hegel the sphere of personal freedom (41), the first element of "Right", and, as such, the expression of the abstract free will (40). Property is the exterior object which I claim as my possession (45) and is therefore private property (45), or, in other words "mine"; it is therefore in the same relation to others as we have seen is privacy: its being mine de-prives others of its being theirs. The right to privacy is therefore essentially the right to property: the concrete expression of personal free will.

As we have seen, however, the free will is not isolated, and in reality individual freedom can only have existence in relation to the freedom of other individuals (70). Private property is consequently not just the result of my subjective will, but the result of a common will, the contract (70): I can't lay claim on something as mine without an agreement with all the other people who could also lay claim on that object. Moreover, a person is not an isolated owner of private property, but has needs which necessitate interaction with other people who are also owners of private property: this interaction, which may take place as exchange, gift, commerce etc., is the place of the contract and allows me to divest myself of my property. Hence the contract allows me to cease being an owner of something and grants ownership to another person (74). In Hegelian terms, I can alienate what is my private property (65): what I owned ceases to be mine and is seen as something essentially different ("alien") from me.

In the case of privacy, this means a person may "alienate" what was seen as their "private" sphere of being through a contract: what is commonly referred to as "privacy" is merely a type of private property and, as such, may be subject to contract, given away, exchanged or sold. The moment my privacy is subject to contract, it ceases to be mine and hence also ceases to be private: it becomes something "alien" which I may dispose of as I will. It is therefore perfectly reasonable to subject "privacy" to a contract in the same way as is work: as a free person I may decide to sell my work for a certain amount of hours a day, subjecting "my" work to contract so that it is no longer "mine", but belongs to the other party in the contract (a firm, for example) for the agreed term. But work is only one of many things which belong (are private) to me: work is, in other words, one of many examples of my private property or of my sphere of privacy. In the same way as I sell (by "alienating" it) my work, I can therefore sell other instances of my privacy by subjecting them to contract: indeed, the same contract that regulates my work may regulate the other aspects of privacy I wish to dispose of.

As can be seen, the central elements of this discussion are freedom and contract: because I have free will, I may dispose of my privacy through a free decision to enter into a contract with another person. A contract is therefore the result of an act of free will (75): it is my decision, free and unconstrained, which allows me to de-privé myself of my privacy by subjecting it to contract. Once this has been done it makes no sense to redress the issue as the contract was the embodiment of my freedom: I could have decided not to enter into the contract just as I decided to enter into it.

A firm may therefore appropriate any aspect of a customer's privacy that was subject to contract: the crucial element is that it must have been subject to a contract which was freely entered into by individuals capable of exercising their will freely. It is a customer's free decision whether to enter into that contract or not, but once entered into, the customer may not break the contract without committing a crime (see par. 82-103 on illegal acts, fraud and crime). In short, a business has a "right" to its customer's privacy insofar as this was subject to contract, and a customer has no right to grievance insofar as the contract was entered into freely.

5. CONCLUSION

We have discussed two different criticisms of the current approach to privacy protection. First, we have seen how it is rooted in a culturally specific view of the relationship between the individual and society: Anglo-Saxon pragmatism. There are other philosophies, other cultural viewpoints, and it is clear that in a globalized economy these viewpoints must be considered. Second, there are doubts about the economic efficiency of the current approach. Again, we have discussed some alternative approaches and shown how very different motives can be ascribed to advocates of very similar positions.

Seeking to provide global solutions to the problem of privacy in the information age, we have turned to the philosopher Hegel, and his general theory of rights. With its emphasis on free will, this seems a particularly appropriate philosophy for post-industrial society with its emphasis on the value of self-expression. We have seen how Hegel's investigations into privacy provide a clear foundation for privacy as an economic right. Hegel's analysis, being general, can be applied to all privacy issues, not just information privacy. Thus it may prove more robust in the face of changing technical and social circumstances. The Hegelian analysis also addresses some issues of cultural diversity. It does not rely on the notion of natural rights, derived from a state of nature about which different cultures may disagree, but from a careful reflection upon the idea of right itself. By pushing deeper into our shared humanity, beyond social structures into more fundamental notions, we can hope to overcome some cultural objections. [cut: In particular] Furthermore, Hegel's work does not see the individual as isolated, but as part of intertwined social structures: the family and the state. We are currently investigating the role of the family in protecting children's privacy, and other rights, online. Further work includes the role of the state, and privacy in the workplace. By investigating privacy using Hegel's philosophical analysis we hope to provide new insights into this important topic.

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USER DEMOCRACY AND DIGITAL CHANNELS

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ABSTRACT

This paper evaluates the formal digital access channels for exercising involvement of the users in the governance of local governmental institutions. The paper is based on an analysis of web-based channels for user and citizen involvement in decision-making processes within the areas of eldercare, childcare, schools, and municipality councils. Rather than painting an idyllic picture of citizen digital access to information and interaction, our analysis of three Danish municipalities suggests that the public sector has made no or very limited digital progress along the governance avenue.

1. INTRODUCTION

During the last 30 years, municipalities in Denmark have chosen to digitalize primarily internal administration and have been quite successful on this score. Digitalization of the municipalities progressed uniformly and simultaneously in supporting administrative functions. Years of experience with digitalization of administrative processes, the lack of local IT competencies and the perception of IT as a auxiliary administrative tool, forms the basis for our analysis in the sense that we explore the status of digitalizing of the governance issues.

During the 1990s, concepts of reorganization, redesigning and reengineering the processes gained popularity and — some argue — valuable impacts on the actual practices. Besides the initial articles and books (Davenport & Short, 1990; Hammer, 1990; Hammer & Champy, 1993), numerous books were published showing how IS was affecting dramatic and radical changes in an organization (e.g., Caudle, 1995; Champy, 1995; Davenport, 1993).

By contrast, the public administration community did not applaud the reengineering concepts as breaking new ground. Although, there were echoes of the BPR method (Osborne & Gaebler, 1993; Heeks, 1999), it was argued that BPR applied in the public sector would lead to misjudgement and actions inconsistent with the ‘spirit’ of the public sector (Thaens, Bekkers, & Van Duivenboden, 1995).

With its strong (US) management orientation and the idea of controlled change of the closed organizational room, the BPR faced a strong critique not only due ideological disputes but also due to the changed technology that both private and public incorporated. In the early 1990s most of the technologies were on office automation and data integration with the business partners. In the public sector, the late 1980s and the 1990s brought positive impacts of IT on capabilities (efficiency, effectiveness, data quality etc.) but few and mixed impacts on use of IT decision-making processes and interactions between citizens and government (Andersen & Danziger, 2001; Donk, Snellen, & Tops, 1995). With the massive spread of the Internet, our research is targeted towards gaining a better empirical foundation for understanding whether and possible how IT has progressed to also help support governance issues. We have only single point data observation in this paper wherefore the possible changes will be discussed at a more conceptual level.

Champy argues in his 2002-book that connectivity between the public sector and their users and that the principal benefits of using IT should be by creating benefits for the customers (Champy, 2002). We explore here if this has been done by the means of digital governance beyond the surfacing e-voting implementations (Browning, 2002).

2. COLLECTION OF DATA

This paper analyses digital governance mechanism in four areas: city councils and committees, education/schools, services for the elderly and day-care centers. All institutions within three Danish municipalities (Skørping, Hillerød and Aalborg) that belong in the four areas above have been examined. By simultaneously looking at institutions on the Internet within the same period, we have investigated the following variables in the areas of education, daycare and care of the elderly:

- Own homepage
- Homepage as part of the municipality's website
- Available contact information to the director
- Number of users
- Management structure
- Method of choosing management
- How often new members are voted on
- Appointment process for management members
- Agendas for future meetings
- Minutes taken of earlier meetings
- Handling of complaints
- Information about earlier complaints
- Number of people on the waiting list
- Number of transfer requests

We have not investigated the direct user democracy in education by the student council's work.

In the case of the city council we have investigated the following variables:

- List of city council members
- Committee structure
- Represented political parties
- Previous meeting agendas
- Future meeting agendas
- Council meeting minutes
- Office hours for committee chair people, as well as contact information
- Overview of committees, mandates, councils and boards
- Information about the work of the city council and committees
- Rules for Question Time

3. OUR FINDINGS

All three municipalities use the Internet to inform its inhabitants about general school issues but not in detail and with very little consideration for user input. By simultaneously analyzing schools, pre-schools, after school clubs and special needs schools in these three municipalities within the same period, there seems to be a correlation between the size of the municipality and information about the user management but no connection between school size (number of students) and digital information about user management. In the case of five schools in the Aalborg school system there is for example all information with regard to school board members and elections. In Hillerød there is only information available for a few schools while no school in Skørping offer any school information on the Web.

Table 1. School statistics in the three municipalities

	Skørping	Hillerød	Aalborg
No. of students	1.615	2.652	11.984
No. of schools on the Internet	2 out of 6	8 out of 10	37 out of 37
Information about school board:			
Composition	1 out of 6	5 out of 10	14 out of 37
Competencies	0 out of 6	3 out of 10	10 out of 37
Election System	0 out of 6	2 out of 10	15 out of 37
Goals	1 out of 6	5 out of 10	25 out of 37
Minutes and agendas	1 out of 6	1 out of 10	5 out of 37
Digital contact to school	3 out of 6	7 out of 10	19 out of 37
Digital contact to school board	0 out of 6	2 out of 10	3 out of 37
School schedule & operational plans	1 out of 6	6 out of 10	33 out of 37

The area of day care centers is clearly the worst represented on the Web. There is no transparency as to the decision processes here. There are no budgets for the individual institutions, no information with regard to transfers, waiting lists, etc. There is generally so little digital information and so few influence channels that the general conclusion to be drawn is that there are no or very negative indicators for digitalization in the area. There are only a few day care centers on the Web, but apart from the much-needed user influence there is also lacking information with regard to waiting lists and prioritization criteria, budgets or the number of users who reject the institution. In this area there are no indicators in the direction of cyber or user democracy.

Table 2. Day Care Center Statistics

	Skørping	Hillerød	Aalborg
No. of users/places	850	4.501	7.063
No. of institutions with own www.	0 out of 12	8 out of 69	2 out of 161
Presentation on municipality site	12 out of 12	0 out of 69	2 out of 161
Information about management			
Composition	0 out of 12	4 out of 69	2 out of 161
Election System	0 out of 12	1 out of 69	0 out of 161
Goals for Institution	0 out of 12	7 out of 69	13 out of 161
Minutes and agendas	0 out of 12	0 out of 69	0 out of 161
Digital contact with institution	0 out of 12	6 out of 69	0 out of 161
Digital contact with management	1 out of 12	0 out of 69	0 out of 161

The top scorer for available digital information channels in the area of elderly and handicapped care is Aalborg who offers comprehensive information on the following subjects.

- User influence for younger handicapped people and the elderly
- Preventative home visits
- Handicapped citizens council
- Fielding of complaints
- Instructions on how to complain

Besides Aalborg, the other two municipalities now offer digital information with regard to the fielding of complaints. In Hillerød there are 6726 inhabitants over the age of 60 where 4720 of them are retired. Other than that, there are 1516 inhabitants under the age of 60 that for one reason or another are in need of temporary homecare or to stay in a convalescent home or instruction with regard to a handicapped accessible home as well as other needs that allow citizens to continue an independent life without active daily support from this department. There are over 8300 people that are without any form of digital user information in Hillerød.

Table 3. Councils for the Elderly on the Internet

Municipality/Elderly Council	Committee	Meeting	Information	Information
Description of goals	Composition/ (possible) user representation.	Minutes and Agendas	About the presented initiatives	About election methods
Skørping				
Counseling the Elderly	Yes	No	No	No
Hillerød				
The handicapped advice				
Council	Yes	Yes/Yes	No	No
Complaint Council	Yes	Yes/No	No	No
Elderly Council	Yes	Yes/Yes	No	Yes
Elderly & Handicapped				
Committee	Yes	Yes	No	No
Aalborg				
Elderly council in each of the				
13 local areas	Yes	Yes/Yes	No	Yes
Elderly and handicapped				
Forum	Yes	Yes/Yes	No	Yes
Handicapped Council	Yes	Yes/Yes	No	Yes
Complaint Council	Yes	Yes/Yes	No	(No)
Committee for Retirees	No	No	No	No
Central Council	Yes	Yes	No	(Yes)

Table 4. Elderly Councils on the Internet

Municipality/Elderly Council	Electronic contact With committee members	Fielding of Complaints
Skørping		
Counseling the Elderly	E-mail	Yes
Hillerød		
Handicapped Council	No	Yes
Complaint Council	No	Yes
Elderly Council	No	Yes
Elderly and handicapped committee	No	Yes
Aalborg		
Elderly council in each of the 13 local areas	(Yes)	Yes
Elderly and handicapped Forum	No	Yes
Handicapped Council	No	Yes
Complaint Council	No	Yes
Committee for Retirees	No	No
Central Council	No	No

The greatest contributor to this digitalization is the city council of these three municipalities. They are considering a one-way communication channel, yet none of them are considering developing the capacity for two-way real time communication. Functions such as chat, news groups and mail services are not implemented. Nor has voice recognition or other technologies to aid the visually impaired as well as interface with mobile Internet devices and PDA's.

Two of the municipalities do not have the technology to support an email service to send out new meeting agendas or minutes. Citizens must download them off of the website each time. Office hours or contact information for committee chair people is not given.

Table 5. Meeting schedules, news and office hours

		Skørping	Hillerød	Aalborg
Possibility for registering for email newsletters				
With new agendas and minutes		No	No	Yes
Long term meeting schedules		Yes	Yes	No
Contact information for city council members	E-mail	Yes	Yes	Yes
	Tel.nr.	Yes	Yes	Yes
	Address	Yes	Yes	Yes
Office hours for committee chair people		No	No	No
As well as contact information	E-mail	Yes	No	Yes

	Tel. Nr.	Yes	No	Yes
	Address	Yes	No	Yes
Committee members contact information	E-mail	Yes	No	Yes
	Tel nr.	Yes	No	Yes
	Address	Yes	No	Yes
Overview of * committees				
mandates, councils and initiatives	Generel	Yes	Yes	Yes
Information about city councils and committees	Activity			
Rules for Question Time	Description	Yes	Yes	Yes
	Work			
	Description	Yes	Yes	No
		Yes	Yes	Yes

4. DISCUSSION OF ANALYSIS RESULTS

The analysis design of this investigation focuses on the digital medium of citizens and user democracy specifically at the institutional level. There were large, medium and small municipalities used in order to illuminate this digital democratization. The effects or suitability of digitalization are not discussed. The only discussion is whether Denmark is on the road to digitalization and if this digitalization supports traditional user democratic principles.

One point made was whether citizens are developing or have other democratic communication channels that already function satisfactorily and therefore the need for other digital channels does not exist. The innovation of cyber-democracy indicates a shift towards self-administration. Many investigations of for example local councils in Copenhagen, city quarter renewal projects in the Copenhagen municipality, investigation of Nyborg and Skanderborg municipalities conclude that user involvement is a functional imperative for both local and central administration. This means that there is increasing pressure to find new channels to support this as well as increased pressure especially to find digital channels.

The other point that there is a need for further study of this in a causal way. In this paper we have not illuminated if there is the advantage of economies of scale, competencies, the need for other democratic media, traditional or institutional explanation to support that the larger municipalities utilize digitalization to a greater extent than smaller municipalities. It is in any case a rather hasty conclusion that larger municipalities are better prepared to support democratic decision channels in an information society.

The third point is with regard to the cost function. The point of view of this paper is that democracy is costly. Implementing web-based user involvement (governance) channels, results in extra workload required by administrative and core function employees in order to help to facilitate the frictionless uptake of these democratic channels. We have taken the point of view that in order to make these institutions ready, it can be a real problem to support these new digital democratic influence channels for the simple reason that it utilizes a great many resources. This is not an argument to abandon the process of democratic information, discussion and decision channels. But it highlights the need for a resource prioritization strategy discussion. Most IT resources come from each individual municipality's operations budget. Yet with more budget decentralization within more and more areas of the institutional task inventory, institutional digitalization has become apolitical. It is surprising that exactly in this field there seems to be the seeds of change of content for user involvement and self-administration. At the same time, IT politics will become a more central part of the municipal political debate, as IT will require a still larger part of the budget.

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STRATEGIES FOR THE EVALUATION IN THE DISTANCE LEARNING: A BEGINNING OF COURSE

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ABSTRACT

The text aims at discussing one of the most controversial subjects of Distance Learning : evaluating students' learning process. After characterizing DL as educational modality, we present a historical view of the evolution of paradigms in evaluation. The third part of the text comprises the evaluation processes of distance learning, punctuating their most frequent difficulties. Taking Michael Moore's concept of " transactional distance" into consideration, it describes the requisites considered necessary for an evaluation of excellence and also devises, through a flow chart, the way it should happen in DL. At last, it exemplifies some evaluation procedures , in synchronous and non-synchronous situations, having as actors / appraisers the teacher, the system and the student himself.

KEYWORDS

Distance learning; Evaluation of the learning; Teaching - learning; Transactional distance.

1. INTRODUCTION

The distance learning (DL) - it is what exists of more representative in what we can call "change " (or innovation) in Education. We agreed with Lèvy:

The change has always been a fundamental topic in human life. We have lived in a time in which this change constantly accelerates, what means more risks and insecurities, but also more possibilities and possibilities. (2001, p 29).

Distance Learning can receive different names - teaching at the distance, learning at the distance, e-learning, for instance - but all designate a rich process in democratization possibilities of the access to the teaching. We are not able to, however to neglect of the learning, so that DL is not predestined to the discredit and the failure.

It is an educational strategy, of a group of alternative methodologies - and even complementary - to the "present" teaching ("not absent from" the classroom), that applies, in integration methods and techniques of individual work and in group, using printed pedagogic materials/papers or spread by virtual means. It is based, therefore, in new communication and information technologies (CIT), firmly focusing the separation (physic and/or temporary) between teacher and student and the autonomy of this last one in his learning

process. It uses the "mediated interaction" through the printed material/paper, already mentioned, or for technologies as radio, television, video programs or computer soft wares, for instance, instead of a teacher's oral exhibition.

It is a teaching modality characterized, among other aspects, for the use of technical means of communication, uniting the teacher and the students and mediating the construction of the knowledge; for the existence of a characteristic academic organization (planning, system organization, didacticism, evaluation), different from the organization of the "present" (not absent) education ; through the use of technological means (the author calls them "industrialized form" of education); for the possibility of the existence of meeting between the tutor and the students of the learning group ("semi - present" way of DL), although it exists, predominantly, the geographical separation among them; and the possibility of a " communication of two-way ", as well as " couple road " initiatives.

This set of procedures displays a deep change in the pedagogic relationship, and in the necessity of an own academic organization, including the evaluation strategies. In the same way that in the present teaching, however, the learning needs to be active, allowing the student to "build" his own knowledge. In the same way, the teacher's/tutor's existence is essential, as well as the planning and the establishment of a " didacticism " (although it has, in DL, very peculiar characteristics). In the same way, the EVALUATION is fundamental.

It is not just a matter of the evaluation of the students' learning (cognitive tools, of conversation and of collaboration, besides the learned content), for sure. We have the evaluation of the supplied course: of the didactic material and of the other sources of information used; support or technological tools used; of the teaching-learning strategies selected, of the context and social systems of support (including the process with a tutor; the "over-evaluation" (of the own estimable process); and the evaluation of the group learning , besides the self-evaluation of all of those involved in the process.

The evaluation of the learning consists of a continuous and planned process of gathering important information on the process of teacher's learning . It allows the establishment of judgements of value, in a comparative and corrective form, besides the decision-making process about the possible and necessary readjustments in the educational process. It allows, still, ultimately, the setting of decisions related to the qualification and the courses of the students' certification.

2. SIGNIFICANT ASPECTS OF THE EVALUATION OF THE LEARNING: ROADS ALREADY TRAVELED

Conceiving ways of evaluation of the learning presupposes a previous reflection on the several forms of conceiving the education, once, as Luckesi, there is not a way to understand and to practice the evaluation of the school learning in a " conceptual emptiness, but with a dimension of a theoretical model of world and of education, turned into pedagogic practice" (1996, p.28). In that sense, the evaluation, while area of knowledge of the education, suffers the influences of the different pedagogic, social, political, economical and cultural contexts, being also influenced by the adoption of own evaluation models of other cultures.

In Brazil, the evaluation of the learning went through the road of the North American production, stepped on in the theory of the measure, being used as synonym of measurement of the learning, almost till the late 70's. The positivism thought was the conductive thread of this model, whose literature was adopted in the courses of teachers' formation and they are still part of the bibliography consulted for many teachers in our country, having subsidized, besides, the state and federal legislation that governed the estimable practices in the fundamental (basic) school teaching, high school teaching as well as in college: superior teaching (Saul, 1991). This quantitative model of evaluation values the use of instruments and several technologies for measuring the student's performance in terms of reaching behavior goals, having as main representatives the North Americans Tyler, Popham and Bloom. According to some authors, the quantification of the acquired knowledge still prevails in the Brazilian educational thought and it is expressed in the practices of evaluation of the fundamental and superior teaching (Hoffmann, 1995; Lima, 1996; Luckesi, 1996).

In the late 70's, they began to appear in the literature, under a qualitative optics of evaluation, the movements of critical analysis to this technical and reproductive model , starting to question, among other aspects, the indiscriminate use of the standardized and commercially published tests and being emphasized, under Franco's point of view (1995), that the measurement of behaviors was not enough to reach the

individuals' psychological and social dynamics. Only starting from the 90's, more progressive qualitative visions emerged, standing out the emancipated, sociological, conciliatory and diagnostic approaches of the evaluation of the school learning (Alvarenga, 1999).

The emancipated evaluation was characterized by the perspective of Saul (1991), in relation to the evaluation of courses and educational programs, aspects that transcend the students' acting. On the other hand, the evaluation in a sociological optics, was analyzed by Ludke & Medium (1992) in research in the basic teaching, with reflexes in the superior education. The authors concluded that the sociological glance about the evaluation is necessary for a better understanding of the school and of its possibilities, once it establishes its own norms and criteria for the reaching of the school excellence and it emits certificates, at the end of the teaching, that will influence the students' life as future professionals.

The evaluation is conciliatory, in the constructive vision of learning supported by Hoffmann (1995), because it involves a dynamics of educational processes that propitiate the knowledge construction for the student. It is openly opposed, to the model "to transmit - to verify - to register". In this evaluation approach, the teacher contributes to the change of ideas among and with the students, using hypotheses, actions and several manifestations of them, in reciprocal movements of reorganization of ideas. This "two-way" relationship replaces the simple transference of contents in the traditional teaching and it favors the attendance to the individual differences.

For Luckesi (1996), the evaluation "is a judgement of value about important manifestations of the reality, aiming a decision-making process" (p.38). Its goal is to diagnose the situation of the student's learning, so that he can build his decision-making process for the improvement of its quality. The author also detaches that the evaluation is inclusive, once it includes and welcomes the student inside of the educational process to verify what can be done for his growth. The vision of Luckesi concerning the evaluation of the learning overestimating its diagnostic function took us to contemplate about other modalities of evaluation countersigned in the different existent approaches. It is worthwhile to rescue, for instance, the formative function, now so emphasized in the contemporary literature of evaluation and that is present in all the estimable models (Hadji, 2001; Bonniol & Vial, 2001; Afonso, 2000, 1999; Perrenoud, 1999, 1992).

Afonso (2000) presents in his work "Educational Evaluation: regulation and emancipation" some evaluation modalities, such as: traditional exams, standardized tests of intelligence, evaluation for norms, evaluation for criteria and formative evaluation. The author affirms that there are two different purposes that can be identified in relation to the school evaluation - the ones linked with the objectives of the school administration and the other ones linked with educational and pedagogic purposes. The first leans on in the cumulative evaluation and for norms; the second purpose leans on in the formative, criterion and diagnostic evaluation. To this respect, Perrenoud is positioned like this:

Perhaps it is more reasonable to place as beginning that the formative evaluation gives information that will be the teacher's and his/her students property. It's up to them to decide what to transmit to the parents and the school administration. If the school wants to have a precise idea about what the students know and about the teachers' effectiveness, it has to find out its own necessary instruments, not making unfeasible a formative evaluation which should remain, anyway, a subject between the teacher and his students, so that the trust contract is not broken (1992, p.165).

Bonniol & Vial (2001) point in their manual three evaluation conceptions: the evaluation as measure; the evaluation as administration; and the evaluation as problem of the sense, distinguishing in each one of them the cumulative and formative functions, that, it is worth to justify, they don't oppose. The first answers to the institutional demand of verification of level of conceptual construction, and the second answers to the demands of development of the aptitudes in the learning. The formative evaluation is centered essentially, in an immediate and direct way, in the administration of the students' learning. According to the authors, in that way, it locates in the perspective of a regulation assumed by the teacher, "whose task will be to calculate, at the same time the road already traveled by each one and what remains to travel, in order to intervene and to optimize the learning process in course" (p.237).

For Hadji (2001), the formative evaluation is nothing but a "promising utopia", being constituted in an ideal model. It means the hope of putting the evaluation to service of the learning and the conviction that this is desirable. That utopia is legitimate, once it seeks to correlate estimable activity and pedagogic activity and claims for evaluation at service of the learning.

Finally, the evaluation models are here shown. It is important to point that, in agreement with the vision that he/she has of man and of world and of the objectives that he/she traces for educational acting, the teacher should choose, previously, a specific model of Education that, basically, it will be more linked to the maintenance or social transformation. It is evident that the "pedagogic making", which has evaluation as part of it, will be politically committed with the leading presuppositions of such actions. After all, we cannot forget, that:

The evaluation of the learning is a kind of investigation and it is, also, an understanding process on the student's "former culture", with their potentialities, their limits, their lines and their specific rhythms. At the same time, it propitiates the educator the revision of his procedures and even self questioning his own way to analyze the science and to face the world. In this case, a procedure of mutual education happens to be. (Romão, 1998).

3. THE EVALUATION OF THE LEARNING IN THE DISTANCE LEARNING: ROADS TO BE TRAVELED

Detached the most general aspects of the evaluation, inherent to all the learning modalities, the specific evaluation of this process - when occurred in the Distance Learning - presents some peculiarities.

First is that, although there is a certain tendency to attribute the learning to the study materials used, it is necessary to distinguish among the portion that is provoked by these materials and the one that should be attributed to the tutor action, or to the interaction with the group. Even if some evaluation strategies are similar, the core of those learning should be distinguished.

The didactic material acts intensely on cognitive strategies for construction of component concepts of the content in the course, while the tutors and the group interaction provoke more linked operations to the social and communicative aspects and to the use of the technological tools, for instance.

Second, it is necessary that the learning at the distance is not restricted to the supervisor (or monitor), advisor and appraiser actions, but that two other functions are activated: the investigative one, being developed researches about the evaluation of the learning in this teaching modality, strengthening the existent theoretical body on the subject; and the prospective function, allowing thoroughly examination and expansion of the supplied courses, opening the indication, to the student, of other study possibilities.

The third subject refers to the multiplication and the variety of estimable strategies, since DL, compared to the other learning atmospheres, propitiates scarce opportunities to evaluate the students. Perhaps even more than in the present teaching, the students need frequent and diversified evaluation opportunities (formal and informal), to demonstrate what they learned.

One can't forget that in virtual atmospheres the faithfulness of the evaluation depends directly on effective systems of communication, so that there is the necessary feedback of the teaching - learning process.

One more key point is the actual value attributed to the Distance Learning. It is necessary that it is not seen under a deficit optics - less complete and valuable than the present one - and that the students involved in it are not noticed as lacking of compensation or of recovery of difficulties accumulated previously. This model - of deficient learning - emphasizes factual contents, as data objectives and authors' point of view, it uses formal and summary evaluations, valuing the cumulative modality of the evaluation.

The opposite model - the one of opportunity - worries about the consistence and the faithfulness of the evaluation, emphasizing its formative modality and offering varied options of estimable situations and stimulating the student's autonomy.

3.1 The most frequent difficulties in the evaluation at the distance

When we referred, in the title of this topic, to the beginning of a road, where there is still a lot to travel, we metaphorically refer to the long itinerary of overtaking difficulties that the evaluation of the DL needs to go through.

A good synthesis of those difficulties is presented by Gibbs (1995), and we started to summarize it. The author points with prominence, as difficulties in the evaluation in DL:

- The high attributed degrees, originating averages and landings high qualified.

- · Difficulties in establishing comparisons, of classifying purpose , among the individual results obtained in the evaluations.
- · Additional time requested to propose, to negotiate with the students, to apply and to evaluate the activities.
- · Difficulties in the authorship proof and with the relative subjects to the " plagiarism " in the evaluation activities.
- · Conflicts and self questioning provoked among the students, for the fact that the methods and evaluation processes are transparent and open to the critic.
- · Acceptance difficulties, for the students, of strategies of less common evaluation, as the group work, the inter-equal evaluation and the " portfólio " (folder), for instance.

To these difficulties we would increase some more, verifying recent studies and our own experience with this teaching modality: the lack of the present contact with the student, what hinders the use of one of the fundamental strategies of the evaluation of the learning: the teacher's observation; the frequent absence of the initial diagnosis of the group, conductor of the work to be developed and, consequently, first step of the evaluation; the lack of evaluation tools adapted and appropriate the this teaching modality; the use of methodologies and evaluation instruments, without the accomplishment of the necessary pre-test; and the current tendency to turn the evaluation of the Distance Learning excessively formal or, opposite, inconsistent.

3.2.The evaluation of the learning and the transactional distance

Learning evaluation in DL happens in a space that Michael G. Moore (1993) calls "transactional distance". The overtaking of this is, according to the author, the great challenge for the evaluation in this teaching modality.

It means much more than just a geographical separation between teacher and student, but the creation of a psychological and communicative " vacuum " , responsible for the potentials "noises " and misunderstandings among the teacher's inputs and the decoding of the same ones for the students.

The origin of Transactional's Distance" Theory gets confused with the initial attempts , in the English language, of enunciating a Theory of the Distance Learning, starting from the "transaction " idea.

Moore specifies two variables that determine the impact of the transactional distance: the structure of the educational programs and the dialogue. The first variable refers to the binomial flexibility-rigidity of the methods and the teaching strategies used; the second - the dialogue - quite explicit, which focuses on the quality of the interaction between teacher and student.

When evaluating the students' learning it is impossible to disrespect an evaluation of the quality of the transactional distance in which it happened, analyzing these two variables deeply. A flexible and " oxygenated " structure, allied to a democratic , clear and pedagogically stimulating dialogue, can extraordinarily facilitate the DL.

We believe that the learning evaluation in DL should follow some requirements, among which we highlight:

- To be based on a pedagogic focus, avoiding incoherence risks between objectives and evaluation strategies.
- To propose context and global activities.
- To promote an autonomous learning process by the students (self-directed learning).
- To Present clear criteria, expected results and evaluation patterns / certification.
- To be accomplished in favorable occasions and in sufficient quantity, taking into account the formative and cumulative focuses.
- To Develop in the students the awareness of the context in which the learning and the evaluation are accomplished, besides the interest in metacognition (the perception of the own learning process).
- To Conjugate the procedural evaluation (of the acquired knowledge) and the behavioral evaluation (of competences, abilities, attitudes, for instance).

The figure 1 shows, in a schematic way, the form in which learning evaluation in DL.

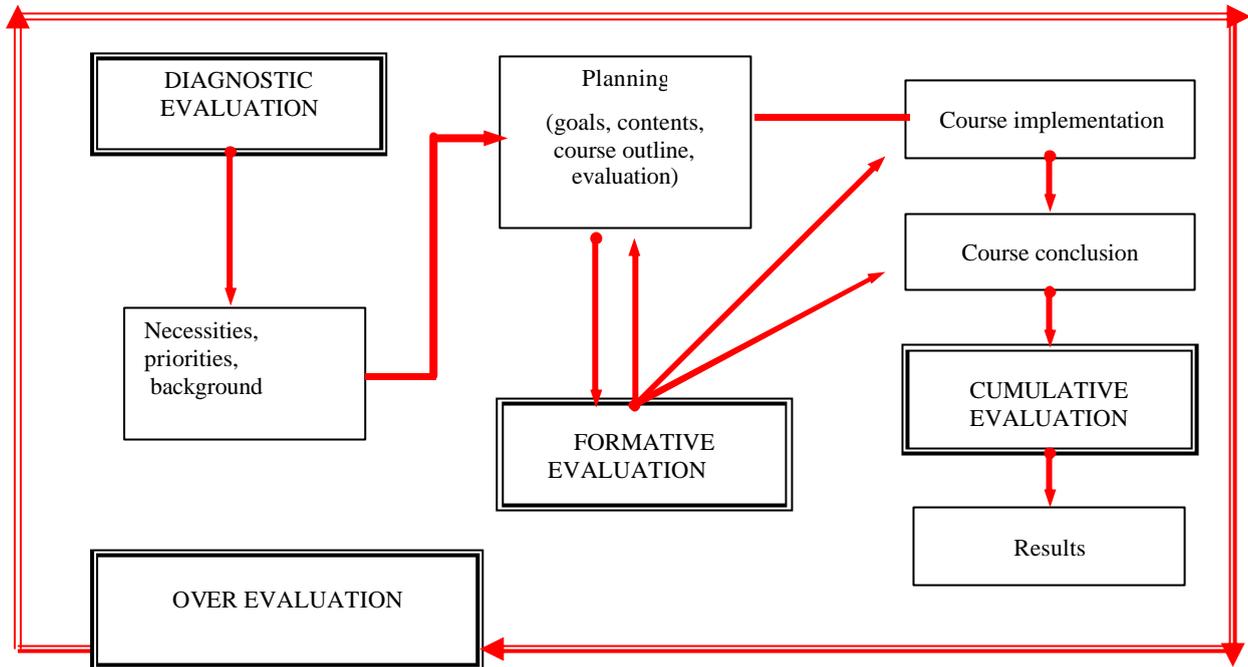


Figure 1. Learning Evaluation in DL

Observing the expressed flow chart in the Illustration 1, we notice the existence of four evaluation modalities, of which two happen directly on the students' learning. The formative evaluation accompanies, in a continuous way, the learning throughout the several stages of the course. It allows to adjust procedures, to correct deviations, to supply difficulties, among other actions that will avoid the failure in the learning, the lack of stimulation and the abandonment of the course. The cumulative evaluation, of classificatory stamp, verifies the learning degree obtained and it allows the certification at the end of the course.

Considering that the interaction between teacher and student, in the Distance Learning, can happen in two situations (synchronous, where the one who transmits and the one who receives the message are in the same temporary mark, and non-synchronous, where the temporary mark is different), we conclude this text with a picture of possible situations of evaluation of the DL, that we intend it can feed the debate on this subject.

APPRAISER	MODALITY OF COMMUNICATION	EXAMPLES OF ESTIMABLE PROCEDURES
Teacher (tutor)	SYNCHRONOUS	Exams, tests, tasks, resolution of problems, summaries and other activities, referring to the content of the course, present accomplished or throughout audio or video conference or in "chats" (conversation rooms). Observations that allow to confront the qualitative indicators of evaluation

	NON SYNCHRONOUS	The same procedures mentioned above, accomplished of non present form (through electronic mail, forum or discussion list FTP (<i>Files Transfer Protocol</i> or virtual library or hypertext, for instance). Activities that allow to evaluate the Quality of the students' participation, as researches, report of the memory of the " chats ", evaluation of the directed doubts and of the mistakes made by the students, final work including the most important aspects of the content of the course.
Teacher (tutor) or the own system	NON SYNCHRONOUS	Attendance of the frequency, time of execution for the tasks of the course (they are called the "hard" procedures, or purely objective).
Student	SYNCHRONOUS OR NON SYNCHRONOUS	Co-evaluation (evaluation of the other members of the group) in relation to criteria previously defined. Self – evaluation .

There are two last subjects that deserve prominence. The first is that, although the learning and its evaluation happen at the distance, the same ethical cares that should surround the present evaluation need to be respected. Among them, the right to access the results of the evaluation and the privacy in relation to the same ones.

The second, refers to the group of stages to be followed in the evaluation of the Distance Learning:

- Specification of the goals / objectives of the evaluation.
- Selection of the techniques and evaluation strategies.
- Preparation of the time chart and of the instruments.
- Application of the strategies / instruments.
- Students' response to the evaluation activities.
- Correction / gauging of the proofs, and instruments.
- Qualification (comparison between the results and the parameters previously established).
- Certification.

Without the pretension of ending up the subject, we hope to have contributed to progresses in this discussion, favoring what affirms García Aretio (2002, p. 30)

Certain evaluations are in charge of the processes, others of the results and others of the existent relations among ours proposals and the readiness of resources for their achievement. Finally, all the evaluations, if they seek to improve the quality of the product they would be due the necessary innovation for the achievement of this product of better quality.

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INTERNET IN THE ELEMENTARY SCHOOLS OF “TRÁS-OS-MONTES E ALTO DOURO” REGION – PART ONE: THE PROJECT¹

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ABSTRACT

The project “Apoio às Escolas” (AE) has for principal objective to give strong support to the elementary schools of “Trás-os-Montes e Alto Douro” region, in what concerns to the Internet’s use as a learning tool. During project’s first stage, we have adopted the visit—working session—visit method. By doing so, we have worked simultaneously with teachers and students at the school (we worked with 72 schools, and more than 276 teachers and 3000 students). We fulfilled three groups of working sessions and noticed that in the schools where we have directly contacted the teachers the participation ratio was higher. The topics covered in these working sessions were: web navigation, web search, email, IRC, personal home pages construction, and videoconference. We also produced introductory support manuals and an Internet portal (Espiguiinha—www.espigueiro.pt/espiguiinha). In the project’s second stage, we still adopt the visit—working session—visit method. We are now working with more than 1200 schools from elementary schools to high schools, 1700 teachers from elementary school and 13000 students. Parallely, we participate with Netmóvel unities in trade fairs, bookseller’s fairs, fun fairs, rock festivals, fashion events, etc.. With the help of the so far obtained results, we can conclude that a large number of teachers are motivated for the Internet use and apprenticeship. We may also see that the smaller the number of teachers by school the larger the ratio of assisting teachers to the working sessions.

KEYWORDS

Elementary school, Internet, learning tool

1. GENERAL CONTEXT

The current project “Apoio às Escolas” (AE) has for principal objective to give strong support to the elementary schools of “Trás-os-Montes e Alto Douro” region, in what concerns to the Internet’s use as a learning tool. It is included in the “Trás-os-Montes Digital—Serviço Cooperativo de Extensão em Trás-os-Montes e Alto Douro (SCETAD)” project.

In the project first stage (AEP), we have worked with 72 elementary schools, 276 teachers, and approximately 3000 students. We have adopted the visit—working session—visit method (see [7] for details). By doing so, we have worked simultaneously with teachers and students at the school. We fulfilled three groups of working sessions, the third one with the “Unidade de Apoio à Rede Telemática Educativa—uARTE” collaboration. The topics covered in these working sessions were: web navigation, web search, email, IRC, personal home pages construction, and videoconference. We have also produced introductory support manuals [1,2] and an Internet portal (*Espiguiinha*—www.espigueiro.pt/espiguiinha).

¹ POSI, European Union and FEDER support this work.

² The author is with CETAV.

In the “Trás-os-Montes e Alto Douro” region there were, during 2001/2002, a total of 1404 elementary schools. Now, project second stage, we are working with approximately 1200 schools, 81% of them from elementary school, with a population of approximately 1700 teachers and 13000 students. In order to give response to this boom, we have adopted the utilization of the *Netmóvel* unities—basically, a van equipped with training personnel, 13 notebook computers, a printer, a digital camera, an ISDN router, an ISDN videoconference system, *etcetera*. We still adopt the visit—working session—visit method. Parallely, we participate with *Netmóvel* unities in trade fairs, bookseller's fairs, fun fairs, rock festivals, fashion events, *etcetera*. In these kind of events we are no longer working with the scholar community but with the community in general, and with people aged from 4 years hold to 80 years hold.

2. DEVELOPED ACTIVITIES

As noted before, in the first project stage, we have adopted the visit—working session—visit method. This method permits us to work with teachers and children simultaneously, directly in the classroom, which was a decisive factor in the high ratio of computer use. As noted before, see [7] for details on the applied method and obtained results. Due to time limitation and student's increasing number it was impossible to work directly with them. As noted by [3]

“The lonely student at a computer terminal or with a book has difficulties to keep his motivation and some times he gives up. To surround this difficulty and make the loneliness less noticeable, we use human meditation, all in electronic mail form, distant tutorial (...)”³

This means that if the teachers do not have the necessary knowledge cannot motivate nor help their students with the Internet or computer use. So in our strategy we firstly reach the teachers and then the students. Also, we are using introductory theoretical sessions and practical sessions.

Also, we have only very recently initialized the work with students. It means that we do not have a large amount of data and so it would be presented simultaneously with the rest of teacher's results.

The followed activities were developed using a team organized by one coordinator, one vice-coordinator, three *Netmóvel* coordinators, twenty seven training people, three *Netmóvel* technicians, one web designer and two programmers.

2.1 Working sessions

The first working session had begun by middle May 2000 and it was finished by June 2000. We programmed to teach Internet web search (with Microsoft Internet Explorer), email (with Microsoft Outlook Express) and Newsgroups. Due to the various difficulties presented by the teachers it was impossible to cover the Newsgroups. We fulfilled twelve working sessions of this type, six of which in UTAD Vila Real (105 teachers were present), five in UTAD extension of Chaves (77 teachers were present), and one in UTAD extension of Miranda do Douro (16 teachers were present).

The second working session had for principal aims the consolidation of the subjects learned on the first one, and the teaching and planning on the web site construction. The web site full development was impossible because the teachers were not technically prepared. This lack of preparation was essentially due to teachers' general computing inexperience and not to Internet inexperience. The web sites presently finished are available at Espiguinha—www.espigueiro.pt/espiguinha/escolasaderentes.html.

For AE phase we still have the same subjects, with the exc eption of a small videoconference with the aim of stimulating teachers' interaction. By doing so we promote the use of Information and Communication Technologies and ideas or plans that can be implemented by schools geographically away from each other.

³ Authors' translation.

2.2 *Netmóvel* sessions

The general public can use *Netmóvel* to awake a desire for Internet knowledge. We wanted to bring it up to TMAD region. The planning had been made with uARTE cooperation. From this cooperation two seminars resulted, devoted to “School Internet use”, one at Vila Real (52 teachers) and another at Chaves (27 teachers). The following topics were discussed: the SCETAD-AEP project; the “Internet at schools” government program; various uARTE activities; and some projects and ideas for elementary school Internet use. To this last topic it was fundamental a videoconference with several experienced teachers. Also, several practical working sessions resulted. During these sessions IRC (Microsoft Chat) was introduced and web navigation, web search and email reviewed. At Vila Real, three sessions with 60 teachers were accomplished, and one session with 15 children and parents. At Chaves, four sessions with 85 teachers were accomplished, and one session with 90 children (the children were divided into 4 groups).

Other practical working sessions were accomplished without uARTE’s personal support. These sessions were carried out in the following places: Miranda do Douro (4 teachers), Sabrosa (12 teachers), Alijó (16 teachers), Lamego (12 teachers), Santa Marta de Penaguião (17 teachers), Torre de Moncorvo (7 teachers), Vila Nova de Foz Côa (1 teacher) and Macedo de Cavaleiros (4 teachers).

In the AE phase, all the working sessions in the “Trás-os-Montes e Alto Douro” region are being developed with *Netmóvel* support.

2.3 Other sensitisation and dynamization sessions

During phase two, other practical working sessions were accomplished in high schools with the *Netmóvel* unities, avoiding students and teachers travelling. Several practical sessions were accomplished during the “Informatics week” at the S. Pedro (Vila Real) high school. The students’ sessions covered Web and email topics, and the teachers’ were general Internet sensitisation and dynamization sessions. The same topics were covered at Camilo Castelo Branco’s high school (Vila Real).

A *Netmóvel* unity was present in a large number of events in all of the adhering villages and cities of “Trás-os-Montes e Alto Douro” region. As can be seen from Table 1, all the “Trás-os-Montes e Alto Douro” region is covered by these events and are held mostly in summer. It is to note that we are invited to be presented at these events, i.e., these events are not organized by us. As it has been said, we participate in several booksellers’ fairs handicraft and product of the land fairs reaching 8696 people.

Table 1. — Events in all of the adhering villages and cities of “Trás-os-Montes e Alto Douro” region.

Event Name / Type	Local	Date	Participants
Carviçais Rock / Rock Festival	Torre de Moncorvo	9-11 Aug 2001	326
Dance in Douro / Rock Festival	Régua	31 Aug - 1 Sep 2001	123
Produtos da Terra / Trade Fair	Macedo de Cavaleiros	31 Oct - 4 Nov 2001	185
Artes e Ofícios	Vimioso	16-18 Nov 2001/ F45	145
Ciência e Tecnologia / Science Event	Montalegre	21-Nov-01	28
Feira do Fumeiro / Trade/Gastronomic Fair	Vinhais	8-10 Feb 2002	118
Feira Transfronteiriça / Trade Fair	Freixo de Espada à Cinta	23-24 Feb 2002	62
Festa do Fumeiro / Trade/Gastronomic Fair	Valpaços	22-24 Feb 2002	348
Festa da Cereja / Trade Fair	Lamego	18-19 Feb 2002	52
Três Minas / Fun Fair	Vila Pouca	2-3 Mar 2002	35
Reginorde / Trade Fair	Mirandela	26 May - 1 Jun 2002	862
Lifestyle / Fashion Event	Chaves	23-26 May 2002	275
Homo Computerensis / Science Event	Miranda do Douro	31 May 2002	5
Feira do Livro / Bookseller's Fair	S. João da Pesqueira	1-4 Jun 2002	161
Feira do Livro / Bookseller's Fair	Montalegre	9-13 Jun 2002	331
Feira do Livro / Bookseller's Fair	Régua	15-23 Jun 2002	371

Alijóvem / Fun Fair	Alijó	22-29 Jun 2002	344
Feira de S. Pedro / Trade Fair	Macedo de Cavaleiros	22-29 Jun 2002	489
Semana da Cultura / Culture Event	Sta. Marta de Penaguião	24-30 Jun 2002	172
ExpoDouro / Trade Fair	Lamego	5-14 Jun 2002	374
Festas da Cidade / Fun Fair	Miranda do Douro	9-14 Jun 2002	270
Feira do Mel e do Artesanato / Trade/Gastronomic Fair	Vila Pouca de Aguiar	20-21 Jun 2002	81
Festival do Folclore / Fun Fair	Sta. Marta de Penaguião	20 Jun 2002	24
Concentração de Escuteiros / Fun Fair	Ribeira de Pena	2-4 Aug 2002	116
Carviçais Rock / Rock Festival	Torre de Moncorvo	8-10 Aug 2002	338
Feira do Fumeiro / Trade/Gastronomic Fair	Boticas	10-16 Aug 2002	221
FamiDouro / Trade Fair	Miranda do Douro	10-18 Aug 2002	707
Festa da Terra / Fun Fair	Outeiro Seco - Chaves	16-18 Aug 2002	145
Festas da Cidade / Trade Fair	Vila Flor	21-24 Aug 2002	192
Festas da Cidade / Trade Fair	Vila Pouca de Aguiar	2-5 Aug 2002	132
Feira da Maçã / Trade Fair	Carrazeda de Ansiães	29 Aug - 1 Sep 2002	277
Dia Europeu sem Carro / Fun Fair	Chaves	16 - 21 Sep 2002	187
Dia Europeu sem Carro / Fun Fair	Lamego	21-22 Sep 2002	102
III Congresso de TMAD / Congress	Bragança	26- 28 Sep 2002	64
Feira dos Gorazes / Trade Fair	Mogadouro	18-19 Oct 2002	330
Jornadas da Adolescência / Culture Event	Vila Real	13-16 Oct 2002	52
Dia da Internet / Science Event	Ribeira de Pena	19-20 Oct 2002	81
Dia da Internet / Science Event	Macedo de Cavaleiros	20 Oct 2002	13
Feira dos Santos / Trade Fair	Chaves	31 Oct - 03 Nov 2002	85
Feira da Castanha / Trade Fair	Carrazedo de Montenegro	8-10 Nov 2002	194
Feira do Cabrito e da Castanha / Trade/Gastronomic Fair	Vila Pouca de Aguiar	9-10 Nov 2002	69
Feira de Artes e Ofícios / Trade Fair	Vimioso	15-17 Nov 2002	158
		TOTAL	8644

2.4 Internet project samples

In this section we briefly present a few projects or ideas that we propose. The projects had been implemented by teachers with children that effectively use the Internet as a learning tool. One of them is related with “Alto Douro Vinhateiro” world’s heritage. The main aims are: to develop a permanent attitude of research, observation and students environment experimentation, to recognize the importance of Douro’s history importance, to create in children the consciousness of the need to preserve a world and natural heritage, to promote the direct contact between children living in Douro’s region towards their reality.

Other project is “Viajante RuralNet” (RuralNet Traveler). The main aims are: to know better student’s land increasing the value of their natural and cultural heritage, to confront student’s living style with other regions, promoting the contact with other social and cultural realities, to develop search ability and capacity, to narrate traveler lived experience.

We also promote the project “Memórias de um Povo” (Memories of a People). The main aims of this project are: to make known people’s *modus vivendi*: proverbs, habits, recipe and traditions of several present and past social groups, to promote children direct contact with their origins, to develop research, observation and experimentation attitude towards their present and past people.

Some activities that can be developed to these aims are: Internet search and browsing, records classification and organization, verification of different cultures between distinct epochs, register gathered information by using text processing and drawing, photography digitization, email opinions and information

interchange with other schools, develop a web site or page. In the RuralNet Traveler case the students may also register traveler information inside and outside classroom of “traveler” and “mother” schools.

3. THE ESPIGUINHA PORTAL

Along first stage-first working session of this project, we noticed the need for something simple to help the teachers through Internet browsing, so we developed the *Espiguinha* portal—www.espigueiro.pt/espiguinha (in Portuguese). It offers basically a set of Internet links or pointers to sites or services of teachers, students and parents interest. With this aim a site is being developed, based on educative programs and a set of activities/ strategies that comply with Ministry of Education guiding lines. Some of these activities are integrated in “Alto Douro Vinhateiro, Património Mundial” project.

Teachers from the adhering elementary schools have chosen the *Espiguinha* portal as their “gateway” to the Word Wide Web, as can be concluded from Figure 2. As we may see, Saturday and Sunday are the days with least number of accesses. Note also that accesses distribution along a day is concentrated on the school normal functioning schedule. Starting 7 September 2000 the accesses number are increasing. Until January 2001 we registered 8600 accesses [4], until September 2001 – 23500 accesses [5], until September 2002 – 126000 accesses [6], and now January 2003 – 163250. Also the holidays months are the ones with less accesses.

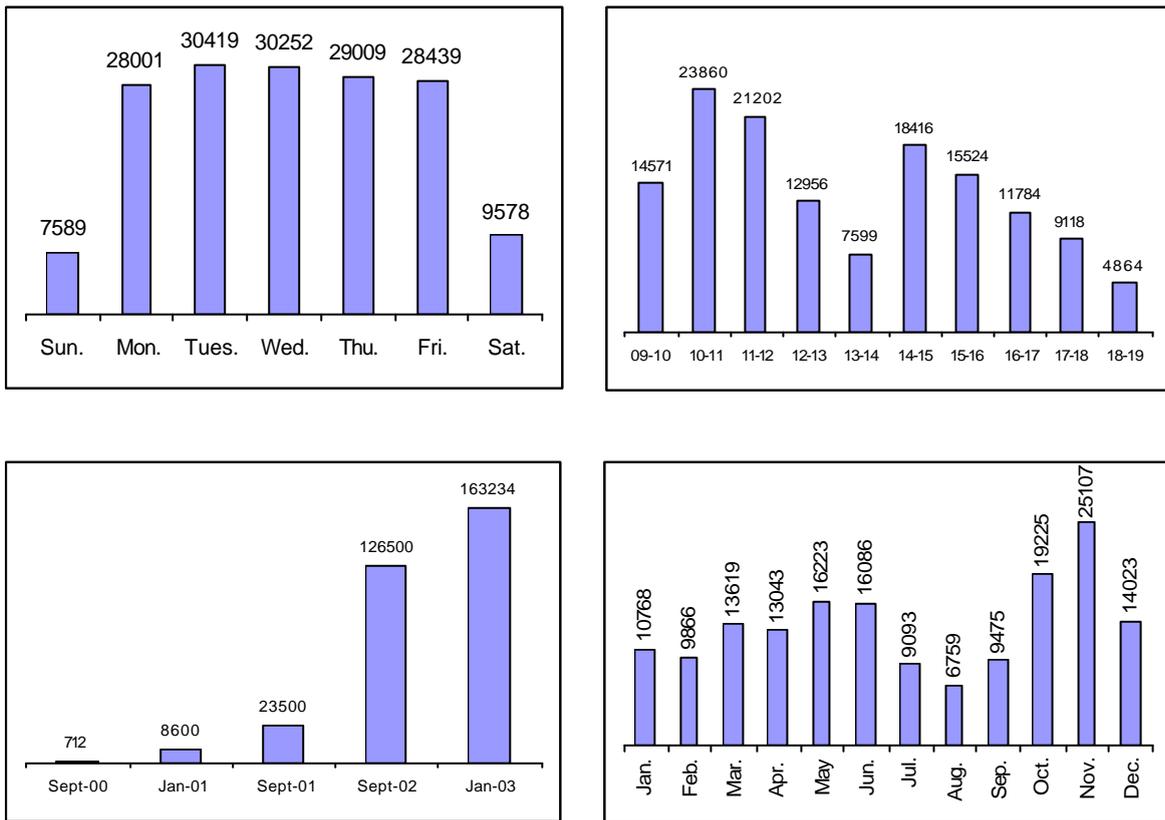


Figure 2. — *Espiguinha* accesses distribution. Up left: week day. Up right: day hour. Down left: accumulated total. Down right: months.

4. RESULTS

The projects presented here are not exhaustive processed. Its principal aim is to show teachers interest and motivation in this field.

4.1 Project first stage

The results obtained so far are very satisfactory. The teachers are very much interested and participative. For the first working sessions a global 72% adhering teachers was observed. During the second working sessions this number raised up to 80%, and for the third ones 79%. Note that in schools with less than four teachers this rate is higher: first session 95%; second session 83%; and third session 71%. This decreasing could perhaps be associated to teachers' mobility, and also to the fact that we could not contact all the teachers because they were no longer working at the same schools. Other possibilities can be related to pre-retire situation of some teachers, teachers' detachment in Information and Communication Technologies, and other post-graduate courses. In schools where we contacted with all the teachers the adhesion was almost 100%. Note that the same applies to elementary mediatized schools. This high rate can be partially explained by the fact that these schools are geographically very isolated and the Internet (web, email and IRC) can be used to communicate. Also, the teachers from elementary mediatized schools are experienced with TV use, and teachers from special education are used to work with computers.

4.2 Project second stage

From the results obtained so far, we conclude that they are also very satisfactory. The results are not definitive because we did not conclude all the working sessions — we have only finished the first one. We have also fulfilled several practical working sessions, reaching 92 teachers and 831 students from High Schools. As already stated the number of sessions carried out at trade fairs, bookseller's fairs, fun fairs, rock festivals, fashion events, *etcetera*, reached 8696 people.

5. CONCLUSIONS

From the results analysis we see that the applied method is good and that the first school visit is very important to the project's good achievement. We also noted that whenever the teachers were directly contacted they were more cooperative and participative. This was confirmed for schools with less than four teachers where the teacher's adhesion was almost 100%. A very high number of teachers is interested and motivated to Internet skill learning.

The continuous increasing number of accesses to *Espiguinha*, the satisfactory utilization of email, the interest and enthusiasm with material availability for Internet web sites construction, and some developed related projects, observed directly in schools, let us conclude that the project has succeed.

We would like to reinforce the idea that the projects briefly summarized at section 0 can and may be implemented in any country or any region, no matter sex, color, religion or culture.

In the near future we want to continue to help teachers with Internet use. Not only the ones from elementary schools but also from middle to high schools. Students and their parents are also included in our objectives. Last (but not least) we want to contact the greater possible number of general public with *Netmóvel* unities in trade fairs, bookseller's fairs, fun fairs, rock festivals, fashion events, *etcetera*.

Recall that the project's aim is to help the teachers with Internet use as an educational resource.

The high teacher's working session's adhesion can be interpreted as a teacher need of technical/ pedagogical (mainly technical) support to these, more or less, recent technologies Information and Communications Technology.

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ARE UK LOCAL AUTHORITIES ON THE RIGHT PATH TO eGOVERNMENT?

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ABSTRACT

ICT is pervading every sphere of life in the 21st Century, and government circles are no exception. In 2000, the UK government presented its vision of citizens and organisations being able to access local and national government services through electronic communications and set ambitious target for all Government services to be on-line by the year 2005. Research was undertaken at the University of Sheffield to assess some of the approaches adopted by a selection of Local Authorities to meet these targets. The study concentrated on efforts of Local Authority “Pathfinders”, who were chosen as pioneers of eGovernment implementation. Particular attention was paid to the issue of how local authorities intended to minimise the social exclusion through the digital divide.

KEYWORDS

eGovernment, Local Authority Pathfinders, social exclusion, digital divide. (Maximum of 6 words)

1. INTRODUCTION

The potential of eGovernment in the UK was first identified in the ‘*Modernising Local Government White Paper*’, published in 1999. This stated the government’s intention to enable all citizens to access all government information on the web by the year 2008 (subsequently been reduced to 2005).

“...There is no good reason why, by 2008, it should not be as simple and easy to do many of the main dealings with government as it is today to make a phone call or choose between TV programmes...”

(Cabinet Office 1999: Chapter 5 paragraph 19)

Indeed, since the use of ICT has become so widespread, British society has changed, with people now expecting better services, provided in an efficient and cost effective manner. However, dealing with government offices can quite often be time consuming, frustrating, and sometimes unrewarding. Citizens are now beginning to want the same level of service from the government as provided by the private sector, with easy and painless transactions, and without trailing from one office to another.

“...They are less tolerant of poor service in one sector when they have experienced good service in another. The challenge for the public sector is that the same growing expectations will be applied to government services...”

(Cabinet Office 2000:8)

The UK government clearly felt that the solution to this predicament is through implementation of electronic government services, recognising that economic and/or political benefits could also accompany a successful relationship with government. Potentially, advantages could possibly include a reduction in

apathy, policy awareness and greater social inclusion. In line with this, the UK Cabinet Office published a strategy paper in April 2000. In this, the government outlined its vision of citizens and organisations being able to access both local and national government services through electronic communications (Cabinet Office: 2000).

This paper will describe research undertaken to assess some approaches adopted by a selection of Local Authorities, with a particular emphasis on the issue of how authorities intend to minimise the effects of social exclusion through the digital divide.

1.1 The UK's Vision of EGovernment

According to Deloitte and Touche (2000), eGovernment can be defined as:

"...the use of technology to enhance the access to and delivery of government services to every citizen, business partner and employees..."

(Deloitte and Touche 2000:1)

Tony Blair, the UK Prime Minister, clarified this goal further, as follows:

"...By 2005 at the latest, all Government services will be on-line. This will mean that people and businesses will be able to access Government services 24 hours a day, seven days a week. It is a challenging target, which will require more joined up working between departments, less reliance on paper trails, and the development of new ways of working. But it is one we have to meet if our UK Online strategy is to succeed..."

(Blair 2000).

The Cabinet Office's strategy paper (Cabinet Office: 2000) envisaged use of an Internet portal or portals through which citizens and businesses can access a full range of services. Access to services such as registering births, ordering a passport, paying rates or taxes, etc. should be available '24:7', either via the Internet or through telephone call centres. However, whilst the paper described what should be accomplished, it failed to explain how various central government offices and local government authorities were to achieve this.

Whilst praising the virtues of information technology and illustrating its capability in a number of sectors from health to education, the UK government set local authorities numerous targets that sounded easy to achieve on paper, but in reality have proved more difficult to attain. For instance, the paper argues that use of information technology will make everyone's lives easier. One example is that citizens will be able to access government services through interactive television. Thus, if the rhetoric is to be believed, UK Online will make sure that government services are more accessible and thus transform the lives of citizens. This presumes that citizens actually want greater access to government services through new channels. For this reason, some authors, such as Jellinek (2000), question whether the ambitious aim of providing eGovernment services in the way described above can be realistically accomplished:

"... Will it [eGovernment] revolutionise the way citizens interact with government and alter the fabric of democracy? Or is it doomed to fail through lack of funding and political commitment, an experiment that will prove costly, not to mention socially divisive through the exclusion of those without expensive computers..."

(Jellinek 2000:paragraph 1)

The Society of Information Management Technology (SOCITM) also criticised the white paper, arguing that leading pioneer councils in the field would relish the challenge and the added incentives offered, whilst authorities that are already struggling to respond to other government initiatives would possibly fall further behind. SOCITM conceded that the presence of timescales and deadlines was a good thing, however, they also noted, that these may be difficult to achieve. They believe there needs to be a change of culture and thinking in order to be successful, which may take longer than the prescribed deadline.

For eGovernment to succeed in the UK, it is necessary to overcome the ingrained reliance on paper; change the ways of thinking and the provision of services. At present it appears that local authorities are attempting to embrace the new technology, whilst not adjusting their overall ethos.

1.2 Key Stages for a Successful eGovernment Strategy

The Economist (2000) published a special report on e-government highlighting current eGovernment schemes across the world. It pinpointed four key stages that an eGovernment strategy must embrace in order to be truly successful. Dempsey (2001) developed these further into five points as follows:

1. To publish material on the web 'a one way communication site'.
2. To interact, to allow the user to search for information and have the ability to make the search unique to the individual.
3. To transact, allow a two-way communication. For instance to allow the citizen to provide new information about themselves such as a change of address through this facility rather than telephoning or writing.
4. To integrate services 'joined up government'. The user enters the information once and it is sent to all the appropriate departments. Begin to challenge traditional working practices and processes.
5. A portal integrates a complete range of Government services and provides a path to them that is based on need and function, and not on department or agency. A single logon and password allows users to get in touch with any part of Government. New processes are created.

(Dempsey 2001)

These five points formed a basis for the evaluation matrix adopted in the research described in this paper.

1.3 The Structure of UK Local Authorities

Local Government in England and Wales was first reformed in 1974. In England, further significant changes were made by the implementation of 1985 and 1992 Local Government Acts. Initially there were two tiers of local authority, district and county council in non-metropolitan areas and single tier metropolitan councils in six areas across England and London Borough Councils in London. Between 1995 and 1998, forty-six unitary (all-purpose) authorities were created to cover certain areas in non-metropolitan counties. For this discussion, it is important to bear in mind that district and unitary authorities collect the council tax in full, and county councils receive a percentage of the total amount.

1.4 Local Authority "Pathfinders"

In February 2001, Pathfinder Schemes were set up as a way of experimentation with the implementation of eGovernment. It was hoped that through pioneer schemes, a blueprint of good practice might emerge that other authorities further behind in the process could emulate.

Out of the total of 140 local authority submissions received, 25 were selected to act as pathfinder projects. The pathfinders were identified as the best e-government providers in the sector at the time. They were chosen on the premise that they could develop their current IT work over the next three years and that these schemes could be easily replicated by other authorities.

"...Pathfinders will have to show that they are capable of adding value by delivering interactions in electronic forms which are capable of being rolled out as standard applications for core services across local Government and to disseminate their best practice to other members of local Government family..."

(Department of Environment, Transport and the Regions 2001:11)

2. SOCIAL EXCLUSION AND THE DIGITAL DIVIDE

The UK, and the world as a whole, is at a very important crossroad. The Internet, for the current 12.7 million in the UK (Pastore 2001) that can afford to access it from their own homes, is an amazing source of information accessible at all times. Many social commentators like to believe that the emergence of the Web (World-Wide-Web) will enable us to enter an era of 'enlightened communication.' (Uimonen 1997:1). However, the way innovation is used and the ability to access it ultimately determines if it is a successful one. Information is increasingly being seen as a commodity and web-based information is only available to those who are able and willing to pay the price of purchasing hardware, software and Internet service connections. Neither is wealth the only defining factor. Information via the Web is also only accessible to those with necessary computer literacy skills, thus excluding large sectors of the population.

The Internet has potential to be socially beneficial, especially if it is used to help alleviate poverty and improve access to health information and education but it is clear that a serious division is developing between the 'information rich' and 'information poor'. This "digital divide" can be defined as the gap between the people that have skills and the ability to access the new technology and those that do not. As argued by former President of South Africa, Nelson Mandela, (Telecom 95 in Geneva):

"...If we cannot ensure that this global revolution creates a world-wide information society in which everyone has a stake and can play a part, then it will not have been a revolution at all..."

Mandela (1995)

In this context, it begs a crucial question, what is to be done about those who cannot afford hardware and do not have the skills to make use of this amazing resource? As far as eGovernment is concerned, the debate is now, how far should public authorities go to provide access to the Web, and at what expense? It is true that many Local Authorities and councils are embracing e-government. However, is this seen as a way of reducing costs or extending inclusiveness? In part, the aim of cost reduction may be true as transferring to online transactions may help to get rid of some of the excessive use of paper and duplication. On the other hand, if replacement of human contact is intended, then it is imperative that issues of social exclusion and the digital divide be addressed and resolved. Efforts by a variety of organisations are being made to address the problem. For instance, the People's Network aims to develop lifelong learning, to provide facilities necessary for accessing the Internet at (if not always free) an affordable price, and to teach required computer literacy skills. It is hoped that the Web will encourage those alienated by formal education either due to culture or language to use the Internet as a tool for learning.

3. DESCRIPTION OF THE STUDY

This research included quantitative and qualitative data collection, beginning with an appraisal of Local Government websites. The aim of the website evaluation was to assess whether pathfinder councils matched central government criteria, and to ascertain levels of provision against Dempsey's (2000) five-point scheme: one-way communication, interaction, transaction, integrated services and a portal. The second research tool was a survey. It was decided that a questionnaire would be used for data collection because of its ability to "...provide a cross sectional picture of affairs at a point in time..." (Cornford and Smithson, 1996:48). As Moser and Kalton (1971) point out it also allows for a widely spread sample. This is an important factor to consider with regard to this particular sample, which was chosen due *pathfinder status* of a local authority by national government. Pathfinders are dispersed geographically around the country and questionnaires were sent by electronic mail to individuals previously identified within each of the pathfinder authorities. The final method of data collection was achieved through formal interviews with representatives of the West Midlands Local Government Association. The aim of the interview was to enable researchers to concentrate on certain aspects of e-government and allow particular areas to be discussed in depth, thus triangulating data collected earlier.

3.1 Design for Evaluation of Local Authority Websites

In order to carry out the website assessment, matrix criteria were derived from government guidelines and literature produced by interested parties. Each chosen sites was viewed, and to remove possible bias built up overtime on the part of researchers, all sites were to be evaluated over a two-day period. For each of the criteria, a score was awarded, i.e.: 0 = not available; 1 = partially available; and 2 = yes available. In order to produce an evaluative list, criteria were then further broken down into three categories shown in Figure .1.

Outgoing Information	Incoming Information	Transactional
Telephone Number	Environmental health services, ability to request a service.	To purchase licences
Email Address	Councillor details and ability to contact them	To purchase parking permits
Address	Email query facility	The ability to book leisure facilities or meeting rooms
Search facility	Message boards	The ability to pay council tax online
Frequently Asked Questions	Comment/ complaint forms	Council tax enquires or alterations
Life episodes	Chat rooms (related to the local authority)	Digital Signature policy displayed
List of services		Security policy displayed
Transport Information		Credit card facilities
Frequency of update		Online voting
Community/ Business Information		Application forms
Departmental breakdown		
Council Documents		
Council Broadcasts		

Figure 1. Matrix Evaluation Criteria Broken Down into Three Categories

3.1.1 Composition of Sample

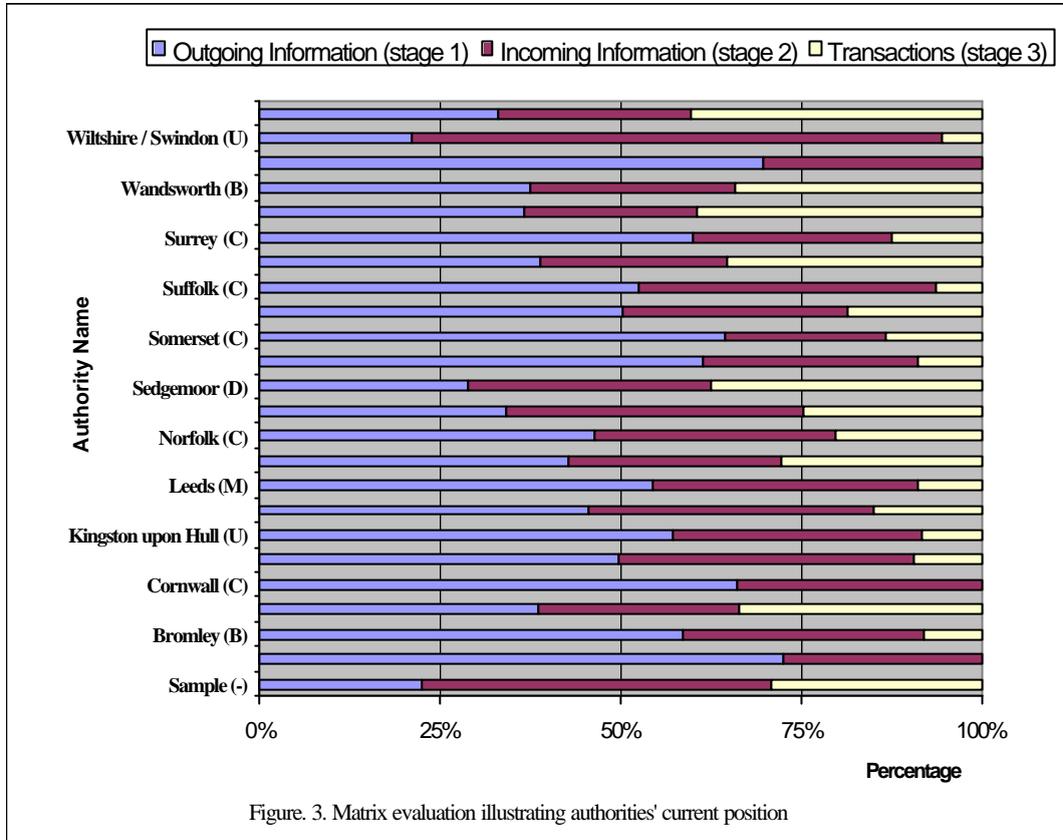
Over a two-day period, 25 nominated pathfinder authorities' websites were selected for assessment and scored on their ability to meet the criteria designed for the evaluation. It should be noted, that some selected authorities were not included in the final analysis, as their sites were still under construction at the time of this evaluation. However, a control website, Utopia Council, designed in an attempt to illustrate the potential of eGovernment, was included. Although Utopia Council was used as a pilot for the evaluation, it was felt that the results provided a useful yardstick for comparison. The authorities that were included in the matrix are listed in Fig.2 below.

Brent	Kingston upon Hull	Salford	Surrey	Wiltshire
Bromley	Knowsley	Shepway	Tameside	Wolverhampton
Camden	Leeds	Southampton	Utopia	
Cornwall	Newham	Suffolk	Wandsworth	
Huntingdonshire	Norfolk	Sunderland	West Sussex	

Figure 2: Nominated Pathfinder Authorities' Websites to be Evaluated

3.1.2 Services Provided

The graph, shown below, outlines percentage splits between the first three phases of development. Ideally, there should be equal effort attached to providing incoming and outgoing information as well as transactions.



In such a situation, some 33% would be scored for each category, a situation almost achieved by the control sample, Wandsworth and Wolverhampton.

4. ANALYSIS OF QUESTIONNAIRE RESPONSES

The breakdown of responses by authority is as follows.

Name	Type of Authority	Population
Bromley	Unitary Council	297,000
Cornwall	County Council	500,000
Knowsley	Metropolitan Borough Council	155,000
Melton	District Council	46,000
Norfolk	County Council	750,000
Salford	Metropolitan Borough Council	225,000
Surrey	County Council	1,000,000
Sunderland	District Council	300,000
Wandsworth	Metropolitan Borough Council	265,000
West Sussex	County Council	750,000
Wolverhampton	Metropolitan Borough Council	240,000

Figure 4. Table showing the breakdown of pathfinder responses by authority type.

Of the 25 pathfinders authorities surveyed, twelve responded with a completed questionnaire, although one was void due to incompatible software. This provided a response rate of 48% which was felt to be suitably representative and a better than expected rate of return. In order to provide a balanced and fair analysis the sample number for the purpose of this study is eleven, being the number of readable questionnaires returned.

4.1 Results Relating to the Digital Divide and Social Exclusion

In order to examine authorities views on digital divides and social exclusion, the question “*What steps have you taken to overcome the digital divide and social exclusion?*” was asked. On the whole, pathfinder authorities seemed quite aware of this particular issue and were actively attempting to tackle the problem. It should be noted that this assumption is based purely on the depth of responses provided by the pathfinder authorities, when contrasted against the West Midlands Local Government Association. Most responses featured the application of free Internet access in libraries, suggesting a lack of creativity. Other solutions suggested by a third of the respondents included one stop shops and kiosks. The importance of providing training, both in Internet skills and the use of information, features prominently. Some authorities (Norfolk and Cornwall) formulated links with educational centres, such as colleges and schools in an attempt to reach other parts of the community. For example:

“...Provision of free Internet access via twenty three libraries; development of nine electronic village halls in disadvantaged wards- providing free access to Internet enabled PCs; facilitation, signposting; training (including IT skills, literacy and numeracy); confidence building for different groups including the ‘grey force’; refugees; unemployed; youths; mothers and toddlers etc. Proposals for one electronic village halls per ward minimum across twenty four wards...”

Electronic village halls were seen as an important way of encouraging a community spirit, whilst also developing new skills that will equip all ages for the potential pitfalls of the information age. Electronic village halls also have an important role to play in the development of community information networks. It is thought that if people can identify with a project in their communities and perceive a benefit to them, they are more likely to become involved.

“...Developments of e-neighbourhood pilots in disadvantaged communities, involving capacity building- proposals for development and appointment of local community e-champions, who will role out more electronic village halls providing access to training; facilitation and e-services...”

Another pathfinder authority re-emphasised the importance of maintaining and improving traditional forms of access such as telephone call centres and face to face contacts. Although this research was focused on the role of eGovernment, it is recognised that that this medium should be utilised as an additional method of delivery rather than the sole provider. Even in this technology driven world, some citizens will always prefer a friendly face. A county council pathfinder also noted the importance of ensuring that the site itself was accessible to all. They adhered to the Royal National Institute for the Blind (RNIB) requirements. On reflection this perhaps should have been included as a criterion for the matrix evaluation, as it is important that sites should not only be accessed through the necessary technology infrastructure, but that the users can actually then read the site.

The West Midlands Local Government Association responses included similar solutions. Surprisingly, one authority doubted the existence of the digital divide; “*Our public survey suggests there is no digital divide.*” Unfortunately, details of this survey were not included. It would have been enlightening if the make up of the sample could have been examined. They did, however, acknowledge the problem of social exclusion and they were investigating the use of mobile technologies in partnership with social services in an attempt to include ‘the invisible citizen’.

4.2 Results Relating to Advantages and Disadvantages of eGovernment

As with the digital divide responses, there were similarities between the two samples.

4.2.1 Advantages of eGovernment

Many of the responses centred on the improvement of services for the citizen, not just in quality of service but also in ease of access. The responses also indicate that there will be a greater transparency of procedures and of democracy in general, as there should be better access at both a national and local level, e.g.:

“... Will provide a more customer focused service...”

“... Will help break down traditional boundaries both geographical and organisational...”

Other authorities, particularly rural ones, noted that Information Communications Technology (ICT) allows them to bridge geographical hurdles, especially when the authority has a low population density. They also acknowledge the importance of ensuring that communities are able to access the facility, as the traditional forms of Internet access (e.g. cable) are not economically viable for rural areas. Thus, they are investing in the infrastructure and investigating the use of broadband technology. They see this as an:

“... Opportunity to promote social inclusion through wider access to information services but this does depend on how it is rolled out in terms of access arrangements...”

eGovernment has also encouraged authorities to re-evaluate and reassess the services that they currently provide, ensuring that the facilities are more citizen focused. This two way process brings the usual consumer benefits of choice, satisfaction and responding to their needs, for example:

“... Improved services and access to those services by the public and other service users; accessibility of services improved- number of channel choices increased; time place and location will become increasingly less important; knowledge of supplier no longer important...”

“... Joined up services will mean service user no longer ‘does the walking’ between agencies, but suppliers do it (electronically) instead...”

“... Democratic renewal, the Internet is an enabler and will help stimulate involvement via online polling; voting; access to members; decisions etc; improved services and access to support mechanisms for members themselves...”

Although quotes above are all attributed to one authority, they represent the views of the majority of respondents. Since each local authority is at a different stage and speed of development, it is difficult to envisage what local eGovernment across the country will actually mean by 2010 and thus views expressed here are all theoretical. However, if eGovernment provides all these opportunities and re-invents government for the citizen, that can only be for the good. If citizens and government (central and local) interact on a more frequent basis, then eGovernment may be judged a success, provided it is based on quality interactions!

4.2.2 Disadvantages of eGovernment

Whilst development of e-government is often heralded as a wholly positive event, concerns have also been raised. As discussed in the literature, many believe that the Blair target is more of a hindrance than an achievable goal. Some authorities believe that targets are too simplistic and the best value performance indicators are too vague. In some quarters, there is an over expectation of benefits eGovernment will provide. The use of targets has also been questioned, as each authority will be putting their particular interpretation on the target, in order to argue that they have reached the necessary standard. In essence, there will be a lack of consistency across the board when, in reality for eGovernment to be successful, there must be uniformity. There also needs to be a change in the culture, both of the authority and the expectation of the public. Local government, in the past, has always been resistant to change, due in part to their socio-economic position and organisational structure. For instance;

“...Government (both central and local) may ‘hide’ behind their websites giving less face to face or telephone communication. eGovernment must be seen as an additional delivery channel but must never replace direct human communication...”

Unremarkably, this is a widely held concern both within the industry and the country as a whole. One of stated advantage of e-governance is supposed cost saving benefits. Many have assumed that this means reductions in traditional forms of access. If social inclusion is to be encouraged and improved, then more forms of access are needed, not less.

“...Important to ensure that all users know there is a choice, eGovernment is a chance to enhance, extend and provide an alternative route to existing services, not replace them...”

Others believe that the initial costs of providing the service and re-engineering the processes outweigh the potential benefits. One of the advantages of the pathfinder schemes is that authorities across the country will learn from their experiences the positives and the lessons to be learnt. It is anticipated that this should reduce the cost burden for other authorities currently less advanced. Another concern is that eGovernment and development of community networks may actually reduce the feeling of ‘community’ and community engagement as the need to interact directly with people is reduced.

“...Depending on how the system is structured and configured it may be limiting in terms of being able to meet all people’s service requests and enquires as opposed to, for example face to face transactions in one stop shops...”

“...Possibly exacerbate social exclusion unless a very clear social inclusion strategy is developed and implemented to tackle the dangers of the digital divide...”

There is also a belief that rather than reducing the digital divide, it may in fact exacerbate the situation. It may also be focused at the citizens that do not need the help.

“...Can (although should not) be seen simply as a high tech version of what we do now, requiring lots of investment to give a marginal benefit to a few users who are probably among the least needy...”

5. CONCLUSIONS

Several key themes relating to social inclusion of citizens affected by the digital divide have emerged from this research. In essence, literature suggests that there is no single answer to the problem of reducing social exclusion, and this survey’s data analysis corroborates this view. Each community is different and has differing needs. What is successful in one suburb may simply not be applicable to another, even within in the same authority. This indicates that it is important that, in consultation with the community, a variety of techniques and solutions are put into effect.

To reach adversely affected parts of the population, it is thought essential to use a diverse range of solutions, involving a mixture of both new technology and traditional methods. It is believed that schemes, such as the Peoples’ Network, ‘Single Regeneration Budget’ and Department of Culture, Media and Sport / Wolfson fund, the provision of the necessary infrastructure and staff and user training will help to make eGovernment more accessible.

Many authorities see the Peoples’ Network, intended to connect all public libraries in the UK to the Internet, as having a key role to play in the fight to reduce social exclusion and the digital divide. Public libraries are seen as useful partners in this crusade because they are perceived as a normal information access point, and therefore a non threatening environment where people can learn new skills at their own pace. Some see it as less formal and institutionalised than educational courses that take place over a set number of weeks. Website design also needs to be addressed, ensuring that sites are accessible by all. This includes multiple translations into ethnic languages and compliance with approved schemes such the RNIB.

One further question that should perhaps have been addressed in the questionnaire, was how the authorities are publicising e-government? Many citizens (both included and excluded from society) may well

be unaware of the possibilities and opportunities offered. If this is the case, then there is a clear need for greater publicity and education if the UK government's vision of connecting to its citizens online is to become a reality.

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Short Papers

USING ELECTRONIC PORTFOLIOS TO PROMOTE INFORMATION TECHNOLOGY IN SCHOOLS

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ABSTRACT

Twenty-six undergraduate teacher education students created electronic portfolios during their 2-year program. A major purpose of this assignment was to increase the preservice teachers' familiarity with information technology, thereby encouraging them to use elearning with their own students and to advocate for the use of technology in schools. Qualitative and quantitative analyses indicated students learned ways to apply technology and believed they were ready to do so. However, greater efforts should be made to encourage classroom and school-wide application.

KEYWORDS

Electronic portfolios; Evaluation and assessment; Preservice teachers; School applications; Teacher education; Research

1. INTRODUCTION

The use of portfolios to document teaching development and expertise has surged in recent years. Portfolios are now used for many purposes, including admission into teacher education programs, to document student teaching, to show inservice development, for interviews, for accreditation and, in the United States, for certification by the National Board for Professional Teaching Standards (McLaughlin & Vogt, 1996).

Increasingly, educators are using technology to enhance their teaching portfolios. Kovalchick, Milman and Elizabeth (1998) compared technology (electronic) portfolios with traditional portfolios:

A technology portfolio is similar to a traditional portfolio, but it specifically addresses technology skills and issues. Also, the medium is different since it is organized using a combination of electronic media such as hypermedia programs, database, spreadsheet, and word processing software, as well as CD-ROMs and the World Wide Web. Technology portfolios can be print-based, saved in a computer disk, compiled on a CD-ROM or HomePage, or a combination of the above. (p. 4)

Evaluation of electronic portfolios is the same as with traditional portfolios (Polonoli, 2000), and often involves rubrics.

Beyond the advantages of traditional portfolios, electronic portfolios have the added benefit of increasing students' comfort with technology. This is important since teacher education is the most direct, efficient, and cost-effective way to prepare teachers to use technology in their classrooms (Faison, 1996; Parker & Farrelly, 1994).

Research on preservice teachers' use of electronic portfolios has been largely positive. Creation of electronic portfolios has been found to be "positive and useful" (McKinney, 1998, p. 85), "constructivist, demanding, and multifaceted" (Milman, 1999, p. 1), and to have a positive impact on preservice teachers' self concepts (Ryan, Cole & Mathies, 1997). In addition, preservice teachers who created electronic portfolios learned an alternative way to think about and display their accomplishments (Wright, Stallworth & Ray, 2002). However, some preservice teachers who have created electronic portfolios fail to apply what they have learned to their own teaching, so teacher educators need to explain how electronic portfolios can be used in elementary and secondary classrooms (Meyer & Tusin, 1999).

Research on portfolios is still in its infancy and should be conducted in the programs where portfolios are used (Lyons, 1998, p. 248). This paper describes a study of an electronic portfolio project with undergraduate students who were preparing to be certified in elementary and special education. Twenty-six students used multimedia to present their teaching development during a two-year teacher preparation program. At three points during the program, students responded to open-ended questions in which they evaluated the electronic portfolio project and its probable school applications. The teacher education students also completed a 33-item Likert-scale survey based on results of the qualitative study and Kirkpatrick's (1994) four levels of evaluation.

2. METHODS

The undergraduate students participating in this study were in a 2-year elementary education program designed to prepare them for certification in both general and special education. The University of Hawaii's 2-year elementary education program assigns undergraduates to cohorts of approximately 25 students who attend most classes in their assigned groups. The program has a strong field experience component: Students spend up to 2 days a week in elementary classrooms during the three semesters prior to full-time student teaching. University faculty and classroom mentor teachers collaborate in planning and supervising all field experiences.

The majority of the 26 students were of Asian American heritage and female (23 females and 3 males). At the outset, most students had little or no familiarity with the technology that would be needed to create their portfolios. Therefore, workshops in PowerPoint, camera skills, and video editing were held during class time, and students had access to technology assistance while working on their portfolios. From this project, the teacher education students learned such computer programs as PowerPoint, Avid Cinema and iMovie. Students also learned to take digital videos; to scan photographs, writing samples and documents; and to add sounds and special effects.

Over the 2 years of their teacher education program, students used multimedia to present three instructional units they had planned, taught and evaluated. The three units were taught, one each, in the first, second and fourth semesters of the program. In the fourth semester, students completed their portfolios by adding: table of contents, resume, teaching philosophy, and self-evaluation based on state teacher standards to the three instructional units. Portfolios were burned on CDs with necessary software readers and links for navigating within the portfolio. Labels with the College of Education logo enhanced the professional appearance of completed portfolios.

At three points during the electronic portfolio project--the end of the first, second and fourth semesters--students wrote responses to a six-question survey. Open-ended questions called for students to evaluate the electronic portfolio assignment and describe possible applications of what they had learned. Responses were coded using the constant comparative method (Strauss, 1987). That is, entries were read and reread for possible categories. Once categories emerged, entries were reread and recoded as necessary. Responses that addressed more than one category were parsed at the point where the topic changed. For that reason, there were more responses than there were students for some questions. Interrater reliability of 94% was established by two Educational Technology faculty members who categorized randomly-selected items.

After submitting their final portfolios, students' perspectives were also captured on a 33-item survey. The author developed the survey in collaboration with an educational technology faculty member, using categories from the earlier qualitative research with the same students (Bartlett, 2002) and Kirkpatrick's (1994) four dimensions of evaluation: (1) reaction (attitudes), (2) learning, (3) transfer (application), and (4) results (impact on the organization).

3. FINDINGS

3.1 Qualitative Study

When asked how they planned to use their electronic portfolios in the future, the highest percentage of students said they would use them when applying for teaching positions (see Table 1). One student

explained: “After this class is over, I would like to keep adding to this electronic portfolio. I would add units from my other education classes and hopefully use the portfolio after our program to assist me in finding a job.” Students also planned to use their portfolios as tools for reflection. For example, a student wrote:

Both during and after this teaching program, I plan to use the electronic portfolio as part of personal reflection. I can see how far I have come as a teacher as well as look for things I need to work on.

Students also planned to share their electronic portfolios with others, including future students, students' parents, other teachers, friends and family, and their own student teachers. Some students planned to use the technology they learned from the project in their future teaching and a few planned to use electronic portfolios in their classrooms: “I think electronic portfolios could also be used for research projects in upper elementary. I think kids would really enjoy putting their own electronic portfolios together.”

Table 1. Percentage of Students: How Do You Plan to Use Your Electronic Portfolio in the Future? Please Include both During and After Your Teacher Education Program.

Category	Sem. 1	Sem. 2	Sem. 4
Job search	68	50	73.91
Reflection/teaching development	64	42.31	39.13
Show:			
Others		11.59	8.70
Students	4	11.54	21.74
Students' parents			4.35
Other teachers	8		17.39
Own student teachers			4.35
Friends and family	4		4.35
Computer teachers			4.35
Use technology learned in teaching	12	3.85	26.09
Keep updating	12		13.06
Unsure	12	11.54	
Use electronic portfolios in teaching	4	3.85	4.35
Applying for graduate school		7.69	
Not planning to use/no response		7.69	4.35
Make part of school-wide curriculum			4.35

Note: Semester 1 (N= 25); Semester 2 (N=26); Semester 4 (N=23)

When asked to rate the electronic portfolio assignment on a scale of 1-10, the means were remarkably stable over the three semesters when data was collected-- 7.56, 7.46 and 7.43. Reasons for the lowest ratings had to do with constraints, particularly time and difficulties with equipment. Students giving the electronic portfolio the highest score seemed to agree the assignment “was hands on and challenging but the experience was worth it.”

3.2 Quantitative Study

In items related to attitudes, students reported they valued electronic portfolios as a way to showcase their teaching and learning and to evaluate themselves (see Table 2). Students were also positive about using their portfolios during teaching interviews and putting portfolios on the Web. They considered electronic portfolios to be more powerful and convenient than traditional portfolios.

Table 2. Reaction (Attitudes) of Preservice Teachers to the Electronic Portfolio Process (N=23)

Item	Mean
Showcase teaching	4.13
Showcase learning	4.13*
Self-evaluation	3.87
Can be used during teaching interviews	3.84
Powerful/convenient	3.61
Like to put on web	3.22

Note: Scale ranged from 1 strongly disagree to 5 strongly agree.

*N=22

In the learning category, students were most likely to agree they learned about technology from the electronic portfolio assignment (see Table 3). They reported learning most about new equipment, followed by new software, familiar software, and familiar equipment. Students agreed they could apply what they learned while creating portfolios to future learning projects. For two items especially pertinent to their teaching careers, students agreed that the project helped them learn to organize and present ideas and to evaluate their teaching.

Table 3. Preservice Teachers' Perceptions about their Learning related to the Electronic Portfolio Process (N=23)

Item	Mean
Learned technology	4.57
Learned new equipment	4.35
Learned new software	4.13
Can apply what I learned to my learning	4.09
Improved use of familiar software	4.04
Learned to organize and present ideas	4.04
Improved use of familiar equipment	3.96
Learned to apply technology in learning	3.96
Learned to evaluate my teaching	3.91
Learned to evaluate my learning	3.83

Note: Scale ranged from 1 strongly disagree to 5 strongly agree.

In the all-important area of transfer, most of the students agreed they learned ways to apply technology to education and believed they were ready to do so (see Table 4). Students anticipated using their portfolios to reflect on future teaching development and, to a lesser degree, for job searches and graduate school applications. Students generally agreed they learned to apply technology to classroom teaching, and may show their portfolios to the children they teach. This group was unsure as to whether they would create portfolios in the elementary classroom or put their portfolios on the Web. However, they disagreed with the statement, "I do not plan to use my portfolio in the future."

Table 4. Preservice Teachers' Perceptions about Anticipated Applications (Transfer) of the Electronic Portfolio Process (N=23)

Item	Mean
Learned ways to apply technology to education	4.04
Can apply learning to teaching	4.04
Plan to use for reflecting on teaching/professional development	4.00
Learned to apply technology in teaching	3.87
Plan to use my portfolio in job searches	3.83
More likely to use technology in future employment	3.70
Plan to show portfolio to present/future students	3.52
Plan to use portfolio to apply for graduate school	3.22
Plan to have my students produce portfolios	2.96
Plan to put portfolio on the web	2.87
Do not plan to use portfolio in the future	2.30

Note: Scale ranged from 1 strongly disagree to 5 strongly agree.

In items assessing impact on their future school setting, students were generally positive about showing their portfolios to other teachers (see Table 5). They also believed other teachers would want to create portfolios after seeing theirs. The group was somewhat negative about preparing other teachers to create portfolios and about advocating for portfolios as approaches to student and faculty assessment.

Table 5. Preservice Teachers' Perceptions about Anticipated Impact (Results) of the Electronic Portfolio Process (N=23)

Item	Mean
Plan to show my electronic portfolio to other teachers	3.65
Predict professional peers will want to produce portfolios when they see mine	3.48
Plan to advocate portfolios by educators/employees as part of accreditation/quality process at school/work site	3.13
Plan to prepare others in the portfolio production process	3.04
Plan to advocate for electronic portfolios as part of the assessment process for students	2.95*
Plan to advocate for portfolios as part of assessment process for employees at school/work site	2.91

Note: Scale ranged from 1 strongly disagree to 5 strongly agree.

*N=22

4. SUMMARY AND CONCLUSION

At the end of the project, a quarter of the students noted they planned to use technology in the classroom and only one student said she would use electronic portfolios specifically. Some students who did not plan to use technology in their teaching expressed doubts that needed hardware and software would be available in the schools in which they would teach. However, this situation is changing in many schools, and technology is likely to be an essential part of teaching in the near future.

This study supported Meyer and Tusin's (1999) findings that teacher educators need to make explicit connections between technology learned during preservice preparation and teaching contexts. Since a major purpose of the electronic portfolio project is to encourage preservice teachers to use technology in their future teaching (and just over a quarter of the students expressed their plans to do so), the author plans to place greater emphasis on how technology can be used in students' future teaching. One way to encourage implementation is through assigning students to use technology during their field experiences. A second way is to involve mentor teachers in technology-related staff development, so they will be prepared to model the use of technology and support student teachers' efforts.

Overall, this electronic portfolio project was successful. Students learned about the technology they will need in their future teaching. Instead of adding a separate course in educational technology to an already challenging schedule, this content was integrated into students' existing methods courses. Future research will focus on students' actual use of technology as beginning teachers and its impact on the schools in which they teach.

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A WEB-BASED SYSTEM FOR THE EVALUATION OF CULTURAL WEB SITES

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ABSTRACT

In this work, we present a web-based system for the evaluation of cultural web-sites and the results from the first use of it. This system consists of a model questionnaire that is based on quality criteria presented in a previous paper "Quality Criteria for cultural sites accessible over the web" [3]. The purpose of the system is to provide a reference model for comparing/evaluating different cultural web-enabled products and to facilitate the development process of cultural web-sites, since it can be the basis for the provision of guidelines on how to design and develop high quality products and means to perform more effective quality assessment and control during the development process.

KEYWORDS

Quality, Evaluation, Web-site, Culture, On-line tool

1. INTRODUCTION

The web has promoted an increasing proliferation of on-line cultural applications. Almost every cultural institution or initiative today wants to be on the web, and to promote itself, to disseminate its content and activities through the Internet. Unfortunately, many cultural web sites are of uneven quality and, for this reason, may induce a negative image to the institution or initiative which holds the product, or not meet the communication objectives they have set themselves with respect to Internet users.

Although there are many general approaches to quality in general, i.e. for a generic S/W product, in the current state of art there are scarce results which investigate the notion of quality in the specific scope of cultural web sites. Therefore, a systematic and disciplined use of methods and techniques for the understanding, assessment and improvement for this kind of software should be considered a mandatory requirement. The adoption of different criteria and methods specialised for cultural sites, results from the particularities that they present. In contrast to a common web site, the main characteristic of a cultural site is that it is dominated at most by pictures and graphics and makes use of advanced technologies.

The work presented here is based on the Brussels Quality Framework [8] that appeared in the conclusions of the experts' meeting "The digitization of European cultural heritage on the web". However it has been enriched with more detailed information, after a complete and deep study about the quality [2], [13], [16], [17], [18], [21] and usability [1], [22] on web.

Below we present a summary of the quality criteria that create a basis of determining a high quality cultural site. As we can see, these criteria are separated into five broad categories (presentation, content, policy, design and interactivity). Each category contains more detailed criteria that help us to understand the specific aspect of a web site that the criterion is focused on. A complete list of the evaluating criteria may be found in the reference [3].

Table 1. Quality Criteria

CRITERIA	SUBCRITERIA
1. Presentation of the site	1.1 Scope Statement 1.2 Authority of the site
2. Content	2.1 Coverage/Completeness 2.2 Accuracy/Objectivity/Validity 2.3 Usefulness 2.4 Logical Organization of Information/Comprehensiveness 2.5 Authority of the Content 2.6 Currency
3. Policy	3.1 Legal Policy 3.2 Maintenance Policy
4. Design and Usability	4.1 Accessibility [23] 4.2 Navigability 4.3 Quality of Links 4.4 Aesthetic Design
5. Interactivity	

2. DESCRIPTION OF THE EVALUATION SYSTEM

Quality criteria must be complemented by evaluation methods, i.e., guidelines and procedure that define how the quality of a cultural web application can be measured and a system to gather measurements in an automated way. Although there are many quality evaluation methods [2], [4], [16], [17], the quality criteria identified provide an excellent basis for evaluating quality by heuristic inspection [22]: these quality criteria can be regarded as quality heuristics. In our approach, we have followed a questionnaire-based method presented below.

2.1 Description of the questionnaire-based method

The questionnaire contains detailed questions to collect the maximum available information for each quality criterion. The various questions are organized into groups, each group addressing a different quality criterion. For each question A_i , $i=1,..159$ we have assigned a weight (a percentage value), named w_i , $i=1,..159$, (where 159 is the number of questions in the questionnaire) that reflect the importance of the specific question in the overall evaluation process. The sum of these percentages is 100%. Also, for each question A_i , $i=1,..159$, we have associated a variable X_i , which can take a real value: the measured value. As each question can be answered in one of the following ways: Yes/no, 0-5, text, combination of the above, the acceptable values for each $?_i$ is $?_i = j$, $j = 0,..,5$. Therefore, $?_i \in [0, 5]$. One yes answer is graded with $?_i = 5$, while one no answer is graded with $?_i = 0$. Text is marked with $?_i = 0$. The function evaluating the quality percentage of each question is $F_i = X_i * w_i / 5$. The overall evaluation percentage is computed by the sum of F_i , $i=1,..,159$. Following this process, at the end of the evaluation and comparison process, we obtain for each selected Web-site a global quality indicator using the scale from 0% to 100%.

In order to gather measurements in an automated way, the questionnaire has been implemented as an online system, using open, web oriented technologies (Apache, PHP, MySQL, Linux). For reasons of

comprehensiveness, we have separated the description in two areas: the functional part of the system and the technical part of it.

2.2 Description of the functional part of the system

In this section we describe the system from the functional point of view. The system supports three main functions: the user authentication, the completion of a questionnaire and the presentation of the results. Before the interaction between users and the system, the user must log on to the system, as only authorized users can access the questionnaire and view the results. If the user is not a registered user, he/she must register first. After the user has logged on to the system, he/she can either complete a new questionnaire or view the results table. If the user selects to fill a questionnaire, then the questionnaire is presented to him/her. The user must complete all the required questions, which are stored in the database. If the user selects to view the results, then the results table, the graphical representation of them and some horizontal results of the most important questions are presented to him/her. From the result table, the user can have access to the web site of a particular evaluated site or to a read-only version of the specific questionnaire.

2.3 Description of the technical part of the system

In this section we describe the system from the technical point of view. First of all, the on-line system for the evaluation of cultural web sites is web-oriented. This means that the system is easily accessible on the web and supports user authentication. Only authorized users can access the questionnaires and view the results.

The second feature of the system is that it is database driven. The questions, named A_i , $i=1, \dots, 159$ that form the questionnaire and are the satisfaction indicators of the abovementioned criteria, as well as the answers, are stored in the database. In consequence, the definition of the questions and the changes made by the users (quality experts) are conducted in an intuitive and fast way. Also, the way of defining the answers is dynamic. The current system supports four types of answers (yes-no, 0-5, text, yes-no/text). These types are created in a dynamic way and are stored in the database. In particular, the answer type of a specific question is determined by the kind of the question and whether it has been answered or not. Therefore, the definition of a new answer type or the change of an existing type is conducted easily and requires no changes in already answered and stored questionnaires.

Furthermore, the results are based on a weighted questions system. Each question is assigned a different weight, named w_i , $i=1, \dots, 159$, depending on its importance in the evaluation of the cultural web site. These weights are also stored in the database. Therefore, the system supports easy result processing and has the possibility for re-evaluation with new weights.

Also, the system provides automatic report generation, each time a new questionnaire is filled the results are updated. The results are visually presented using custom-made graphic representations (pies and bar-graphs).

Finally, the system is implemented using open architecture/technology. It uses the MySQL database, the Apache web server and the code is written in PHP. So, the migration of the system to other platforms is easy.

3. RESULTS FOR THE FIRST ITERATION

In the first iteration we have evaluated ten cultural web-sites as a test. In this attempt we have selected well-known sites, such as the Louvre museum, the Hermitage museum, the Canadian Museum of Civilization etc. A table presenting the results of the first attempt of using the questionnaire and a graphical representation of them is presented below.

Table 1. The results from the first ten questionnaires completed as a test

URL	DESCRIPTION	EVALUATION DATE	USER	EVALUATION RATE
http://www.civilization.ca	Canadian Museum of Civilization [9]	2002-10-01	Sofia	0.814
http://www.moma.org	The museum of Modern Arts [20]	2002-10-01	Sofia	0.794
http://www.hermitage.ru	The Hermitage Museum [15]	2002-09-30	sofia	0.753
http://www.louvre.fr	The Louvre Museum [19]	2002-09-30	sofia	0.665
http://www.hdpweb.org	The Hellenic Digitization Project [14]	2002-09-30	sofia	0.6515
http://www.culture.gr	The Hellenic Ministry of Culture [10]	2002-09-30	sofia	0.724
http://www.benaki.gr	The Benaki Museum [6]	2002-09-30	sofia	0.692
http://www.cycladic.gr	Museum of Cycladic Art [11]	2002-10-09	sofia	0.6555
http://national.gallery.ca	National Gallery of Canada [5]	2002-10-09	sofia	0.748
http://www.fnmt.es	Fabrica Nacional de Moneda y Timbre [12]	2002-10-09	sofia	0.6395

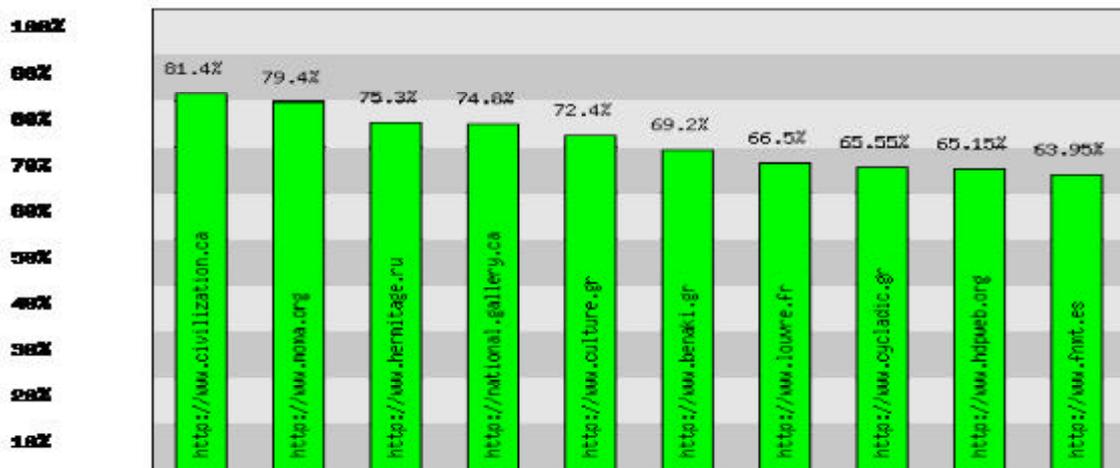
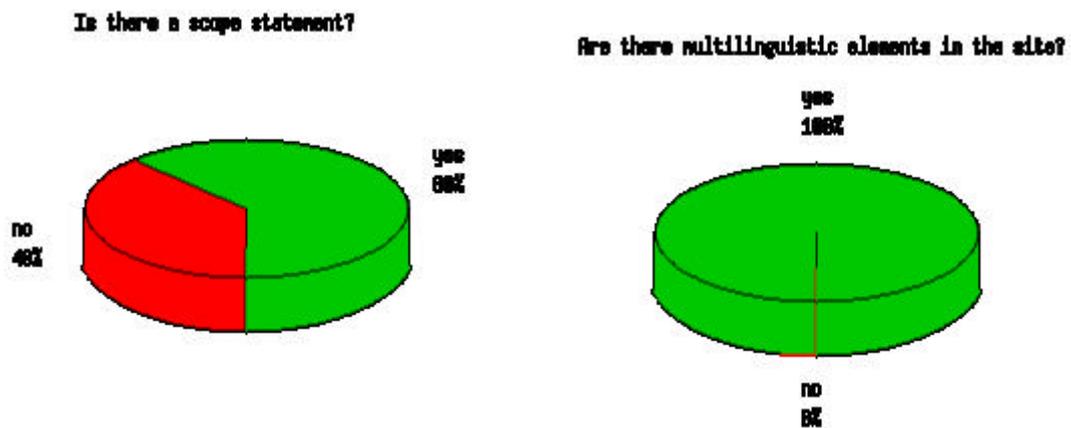


Figure 1. Graphical Representation of the Questionnaire Results

As can be seen from the above table most of the evaluated sites have gained a score of 65%-75%, that certifies for one more time that an important part of the cultural information accessible on the web is not of quality matching the importance of the content.

Except from these, a number of horizontal results based on some of the more important questions are presented separately.



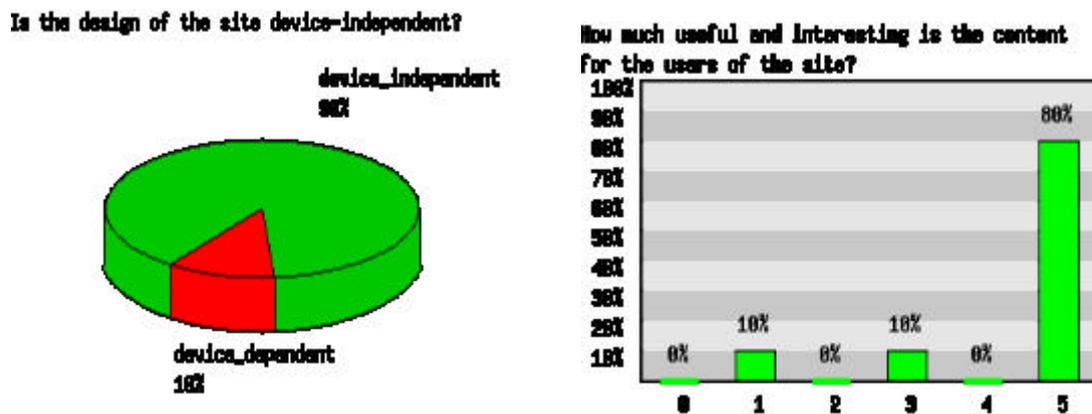


Figure 2. Horizontal Results

As can be seen from the graphics above, only 60% of the evaluated sites include a scope statement and only 50% of the sites offer feedback mechanisms to the users. Regarding the usefulness of the content, an impressive 80% of the evaluated sites include “useful” content. This percentage is very high, but is not reflecting the real world situation as the sample of the web sites evaluated is has not been randomly selected. The same goes for multilinguality. Finally, the design of 90% of the sites is device-independent. However, we must note that this percentage refers only to the interaction of the user with the site using mouse or keyboard and not other input devices such as voice or head wand.

4. FUTURE ACTIONS

The first practice on Quality Criteria for Cultural Web Sites was an extensive process during which the quality criteria were defined and an on-line tool for efficient evaluation was developed. The next step is the design and implementation of the second iteration of the process. The second iteration is aiming at approaching the issue from a different perspective. The criteria will be divided in two main categories. A set of criteria based on the end user view and a set of criteria based on the view of the technically expert. In this framework three questionnaires will be produced:

- The general, brief questionnaire (1 page maximum) for the end-users (visitors of a web-site that can evaluate it using our system), aiming mainly at the quick and easy questionnaire completion.
- The complete, wide-range questionnaire for the cultural organizations and quality experts.
- The complete technical questionnaire for the technical experts, web site creators and administrators, aiming mainly at evaluating the technical part of the Cultural Web Sites.

In addition, the results so far will be assessed extensively leading to the further refinement of the questionnaires. Based on the results of the questionnaires we aim to publish some guidelines pinpointing common mistakes in the creation of a cultural web site, in order to help developers create “better” sites. The second iteration will be incorporated into the generic on-line tool for benchmarking [7].

5. CONCLUSIONS

The conclusions can be divided in two categories, technical conclusions from the system implementation and qualitative conclusions based on the system testing using specific web sites.

The technical implementation of the system was a very good chance to test our ideas on creating generic and easily manageable web-based systems. Based on this implementation we are now finishing the implementation of a new system, where except from having a dynamic definition of questions and answers we have implemented the dynamic and abstract definition of any kind of questionnaire.

The questionnaire testing and evaluation has led us to the following qualitative conclusions on the creation of cultural web sites. First of all, we have observed that all the evaluated sites provide diversity and

several navigation mechanisms and all interior pages of a specific site point to the home page. Furthermore, the majority of the sites have a common design through the pages, avoiding the use of broken links and advertising, while they provide alternatives to auditory and visual content. Therefore, they enable the use of the site by people with disabilities. Unfortunately, the majority of them doesn't avoid the use of frames and doesn't provide the publication and the last update date. Also, only a small percentage of the sites use video, sound and animation that attract the interest of the user and add vividness to the content. Therefore, the design of sites offering cultural content must be made very carefully to reflect the importance of their content.

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- [9] <http://www.civilization.ca>
- [10] <http://www.culture.gr>
- [11] <http://www.cycladic.gr>
- [12] <http://www.fnmt.es>
- [13] <http://www.goethe.de/os/tok/bib/gerin5.htm>
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QUALITY MODELS FOR *E_LEARNING* - A CASE STUDY IN THE ITALIAN PUBLIC ADMINISTRATION

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ABSTRACT

This paper analyzes the problems related to *e_Learning* evaluation. In particular, it presents two types of "Quality models": *QMC* that evaluates multimedia courseware and *QMF* that evaluates a formative process.

These "Quality models" have been used in the activities of developing of courseware and training in *e_Learning*, contemplated by the Project "Rete Puglia" to benefit the Italian Public Administration.

The experimental results prove the *Quality model's* utility to evaluate the quality level of courseware and formative process in *e_Learning*.

KEYWORDS

e_Learning, teledidactic, distance learning, e-government, quality models.

1. INTRODUCTION

Since the time of Plato and Aristotle, the formative paradigm is unchanged and is based on the transfer of knowledge from teacher to learner, with "face to face" teaching process. In this context everything took place by speech and with the aid of simple instruments such as blackboard, chalk, as well as with books and notes for homework.

In the last few years, with the development of Telecommunications and Information Technology, the traditional lesson has been integrated, often substituted, by new communicative forms, that utilize new instruments and new teaching methodologies, either for the preparation of didactic material or for the supply of the lesson [10].

The formation's addressees aren't only students that frequent *full time* courses. Actually there are more kinds of learners, such as student-workers and adults that go through *lifelong education* [2]. In fact the participants of formation's request come from Public Administration and private enterprise, that are the 82%, rather than Universities and schools, that are the 11%, and private users that are the 7% [8]. Therefore the demand for distance learning has taken on social importance and not only economic importance.

Distance learning, that originated as mailing courses (*Correspondence Education*), was based in the 70's on lessons transmitted in broadcasting via TV without interaction. At present, distance learning has become *e_Learning*, with communication networks (LAN, WAN and Internet) and learning models such as *CBT* (*Computer Based Training*) and *WBT* (*Web Based Training*) [4].

e-Learning nowadays allows the execution of *synchronous* and *asynchronous* lessons. In *synchronous* lessons the teacher transmits from a remote room and the learners are distributed in different places and can interact with the teacher simultaneously, also with the help of courseware on CD-ROM. In the *asynchronous* lessons, instead, the students can directly access, via web, the didactic materials that are available on the *host* [12].

e-Learning is more widespread and it has become the principal application of Information Technologies and Telecommunications, because it satisfies the growing needs of training [2,7]. For example, in 2001 the *e_Learning* market had a global value of 41,3 million euro, that corresponds to the 76,9% of the TBT (Technology Based

Training) [3]. The European Union has adopted specific policies on *e_Learning*'s support. In fact the goal of the "Action Plan e-Learning" and the relative actions, is to create a new pedagogic scenario and a new digital literacy [5].

Information Technologies and Telecommunications have allowed *e_Learning* develop. However, the better methodologies for the production and the supply of educational services through these new systems haven't been completely defined [9]. In fact the new technologies used in the formation impose a deep modification on traditional didactic and formative methodologies. To increase the efficiency and the efficacy of the formative activities through *e_Learning*, is very important to individualise optimal practise to realize and to supply formative activities with high quality [11].

This paper proposes two "quality models", that have been projected and used in the Project "Rete Puglia", to evaluate the quality of process *e_Learning*:

- *Quality Model* that evaluates a multimedia Courseware (*QMC*)
- *Quality Model* that evaluates a Formative process (*QMF*).

The article is organised as follows: in Section 2 there the *quality models* described, Section 3 presents the experimental applications of *quality models* to the activity of the project "Rete Puglia", Section 4 reports the experimental results.

2. TO EVALUATE THE QUALITY

The *UNIENISO 9000-Vision 2000* defines quality as the degree to which a set of intrinsic characteristics satisfy requisites [13]. Then, the quality of a product or a service is represented by those characteristics that satisfy users. Hence, there isn't an absolute level of quality: users define product or service characteristics.

This paper defines two models: the *Quality Model (QMC)* to evaluate the characteristics of multimedia courseware, and the *Quality Model (QMF)* to evaluate the characteristics of the course supplied by *synchronous* lessons in teledidactic.

2.1 To estimate product quality: "Quality Model (QMC)"

It is possible to consider *courseware* as a particular kind of software product; in fact this term is often used more generically for educational software. So this paper uses the ISO/IEC 9126 standard, to detect the quality parameters [6]. This standard defines six quality characteristics in order to evaluate software products (Fig. 1): Functionality, Reliability, Usability, Efficiency, Maintainability, Portability.

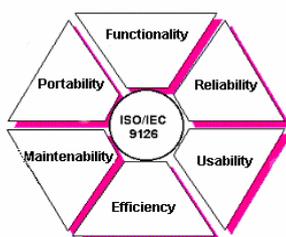


Figure 1. ISO/IEC 9126 Standard – Quality characteristics

The *Quality Model QMC*, that evaluates courseware, has been obtained by the ISO/IEC 9126 standard, defining his particular sub-characteristics. More precisely:

- *Functionality* is subdivided in the following sub-characteristics:
 - *Contents*: To evaluate the quality of the information held in the courseware. To examine if they adequately consider every argument, if they draw student's attention and if the concept is extensively defined.
 - *Coherence*: To verify if in the courseware there aren't any contradictions.
 - *Exactness*: To evaluate if concepts are exacts.
- *Reliability* is subdivided in the following sub-characteristics:
 - *Presence of errors*: To verify if in the courseware there are some syntactic or logic mistakes.
 - *Navigation reliability*: To check if it is possible to navigate in the courseware without problems.

- Usability is subdivided in the following sub-characteristics:
 - Comprehensibility: To observe if information are clear and explicit, and if the graphics (colours, images, etc.) help comprehension or make confusion.
 - Easiness of use: To verify if courseware is easy to use, also for beginners.
 - Structure: To evaluate the structure quality of courseware slides. To verify if information are homogenously distributed, if users can exit in every moment and if he can easily find navigation buttons.
 - Glossary: To verify if in the courseware there is a list of terms and definitions.
- Efficiency is subdivided in the following sub-characteristics:
 - Abundance of information: To check if there are abundant information and eventually, there are some links to deepen concepts.
 - Dynamic media and file audio: To verify if there are films, animations, music and every other thing in order to draw user's attention.
 - Self-evaluation test: Presence of tests and exercises that allow the user to evaluate his knowledge rate and help him in the learning process.
 - Choice the learning level: To verify if it's possible to choice a knowledge level (beginner, intermediate, advanced).
- Maintainability is subdivided in the following sub-characteristics:
 - Modifiability: To evaluate if it's simple to modify the courseware and if the courseware has to be often modified.
 - Stability: To verify if the courseware is stable, if it hold steady information (e.g. a Middle Age courseware is more stable than a Computer Science courseware).
- Portability is subdivided in the following sub-characteristics:
 - Installability: To evaluate if the courseware installation is simple.
 - Adaptability: To evaluate if the courseware is easily adaptable in different environments.

2.2 To estimate the formative process quality: “Quality Model (QMF)”

To evaluate the quality of the didactic-formative process, it has been defined “Quality Model (QMF)” . Trough this model learners can evaluate the *course contents*, assigning a score according to the level deep of concepts, according to the definitions correctness, according to the information abundance and according the interest of the arguments.

The *teacher* is also evaluated, for his expositive clarity, his capacity of inspiring interest and diligence, and to explain lessons with examples and applications.

Finally, in the quality model *QMF*, learners evaluate didactic, as comprehensibility of the didactic materials, the usefulness and the efficacy of the didactic instruments, the tests usefulness and the global course organization.

2.3 “To quantify” the quality

The principal problem is *how* measuring quality. Quality becomes quantity through an evaluation process, as a measurement, that identifies the parameters and defines the reference values for each parameter.

The two Quality Models defined in this work are usefulness to evidence the quality parameters for the courseware and for the formative process. These parameters are evaluated, according the standards of estimation (Table 1).

Table 1. Standards of estimation

Global Judgement	Level	Score
SATISFACTORY	Superior at the requirement	3
	Wished level	2
	Hardly acceptable	1
UNSATISFACTORY	Unaccetable	0

Every learner anonymously compiles the two quality models QMC and QMF, assigning a score from 0 to 3, according to the standards in the Table 1. In this way, learners express their judgement on characteristics and subcharacteristics, obtaining a comparable and improvable numeric evaluation, that evidences the strength points and the eventual deficiencies of the courseware and of the formative process.

The global evaluation is obtained summing the score of all characteristics and subcharacteristics. This value is expressed in percentage and it agrees with the following merit judgements: *poor* (20%), *sufficient* (40%), *discreet* (60%), *good* (80%), *excellent* (100%).

Quality models analysis and confrontation, evidence the characteristics that learners judge negatively. So, improving these characteristics it is possible to pursue the *ISO 9001:2000* objective, that is the “*continuous improvement*” of quality [14].

3. THE CASE STUDY: THE PROJECT “RETE PUGLIA”

The project “*Rete Puglia*” is supported by the Italian Ministry “Ministero dell’Istruzione, dell’Università e della Ricerca (MIUR)”, under law 488, Project “Rete Puglia” CINI-BA - D.M. n.600, 11-11-1999.

The objective of this project is the development and the experimentation of tele-didactic processes for the regional university system and of tele-work for cooperative designing in a network, as well as experimental activity in tele-education and tele-tutoring, also used in refresher courses for administrative and technical staff in local government and cultural institutions in Apulia. The aim is to promote the use of innovative communication tools in public administration to promote the *e-government*. The content of this paper concerns this purpose.

The local institutions that participate in this project are: the Bari Provincial Art Gallery, the municipal district of Bari, of Conversano (BA) and of Putignano (BA).

In each of these local governments and cultural institutions, a teledidactic room has been equipped. It is composed by: the hardware and software system *Aethra - Vega 2*, a visual presenter with a microtelecamera, a microphonic system, a television, a video recorder, a video projector and two personal computers.

In the “Rete Puglia” centre, a similar instrumentation has been installed in order to supply distance lessons (Figure 2).



Figure 2. A teledidactic room in the “Rete Puglia” centre.

4. EXPERIMENTAL RESULTS

4.1 The formation addressees

The aim of the project “Rete Puglia” formative activity is to give a homogeneous and adequate informatic competency to administrative and technical staff in local government and cultural institutions.

The competency level is defined in the “*European Computer Driving Licence*” (ECDL) Syllabus [3]. Besides, the lessons, supplied in teledidactic, have been integrated with two courseware, on hardware and Internet concepts, realized during the project.

The formation activities has been directed to functionaries and employees that already use or that could use the computer in their work.

More precisely the formation addressees have been 42 functionaries and employees of the Bari Provincial Art Gallery, the municipal district of Bari, of Conversano (BA) and of Putignano (BA). More or less learners is 48 year old, with a medium-high cultural level, how Figure 3 shows:

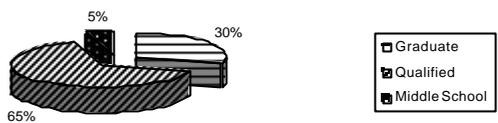


Figure 3. Cultural level of learners

At the beginning the informatic knowledge level was medium-low, referencing to Windows, video-writing programs, spreadsheet programs, database programs, presentation programs and Internet surfing programs.

In particular, the 60% of them never used a computer, the 25% knew only simple operations, only the 10% knew complex operations and the 5% declared himself as an expert user.

Therefore, the formative activity has been aimed to fill up the gaps of whom had already a certain competence, and to provide a minimum knowledge to whom approached to informatic instruments for the first time.

4.2 The “Quality Model QMC”

For the formative activities in the local governments and cultural institutions, in addition to a courseware on the ECDL arguments, already existent during the project “Rete Puglia”, other courseware it has been developed. These courseware have been supplied and then they have been evaluated by learners through the *Quality Model QMC*.

For example, the courseware (1) “*Hardware introduction*” has been judged between *discreet* and *good* (average evaluation=75%) and the courseware (2) “*To inform via web*” has been judged *more good* (average evaluation=88%).

Analyzing the *Quality Model QMC*, compiled by learners, both the courseware have been defined *excellent* for Functionality, Reliability, Usability, Maintainability, Portability. However, considering these models, it’s evident that Efficiency has to be improved. In fact, in the first courseware the multimedia aspect has to be improved and it needs to introduce some exercises. In the second courseware the number of exercises and examples has to be increased.

So it’s possible to discover the weakness of the courseware and to improve these characteristics that have been evidenced by the *Quality Model QMC* analysis.

4.3 The “Quality Model QMF”

At the end of every course, supplied during the project “Rete Puglia”, learners anonymously compile the *Quality Model QMF*, in order to evaluate the quality of the didactic-formative process. In general, the course is considered satisfactory, with *good* and *excellent* evaluations.

Figure 4, minutely, shows how learners have consider very interesting and exhaustive the course contents.

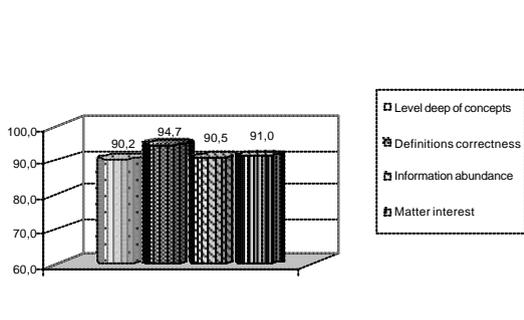


Figure 4. Evaluations of course contents (poor: 20%, sufficient: 40%, discreet: 60%, good: 80%, excellent: 100%)

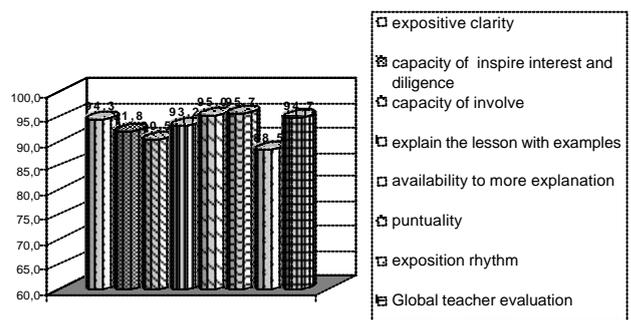


Figure 5. Teachers evaluation (poor: 20%, sufficient: 40%, discreet: 60%, good: 80%, excellent: 100%)

Figure 5 shows how learners evaluate the teachers for their expositive clarity, their capacity of inspiring interest and diligence, their capacity of involving, their capacity of explaining lessons with examples, their availability to further explanations and their punctuality. Only the teacher’s exposition rhythm is considered slow,

but it is necessary in order to facilitate the comprehension of teledidactic lessons.

At last, figure 6 evidences that learners evaluate *good* the course global organization. They define very useful and efficacy the didactic instruments.

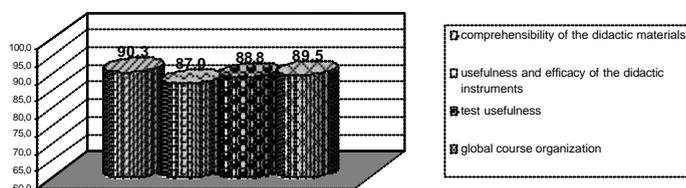


Figure 6. Didactic evaluation (poor: 20%, sufficient: 40%, discreet: 60%, good: 80%, excellent: 100%)

The entire formative process is judged “*nearly excellent*” (average evaluation=91,6%).

This positive judgement is strengthened by the getting through of every examination from the 80% of the learners, who are obtained the European Computer Driving Licence (ECDL).

5. CONCLUSIONS

This paper has tackled the quality evaluation problem for e_Learning products and process. In particular it has proposed the Quality models QMC to estimate a multimedia courseware and the Quality models QMF to evaluate a formative process.

The experimental results of “*Rete Puglia*” project, for the formative activities addressed to the administrative and technical staff in local governments and cultural institutions in Apulia, show how these models are good means to pursue the quality objectives. In fact they guarantee the continuous quality improvement, checking all the courseware and formative process characteristics.

ACKNOWLEDGEMENT

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THE B2B STANDARD IT FRAMEWORK

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ABSTRACT

This paper discusses the key issues and technical-technological requirements of B2B in order to define a suitable information technology standards framework for B2B systems and electronic commerce in general. After a short overview of the effects of the Internet and WWW to e-business, the lessons learned during the development of open systems are highlighted. The clear explanation of open systems, their key PSI attributes are also discussed. The central sections are dedicated to the key aspects of B2B, appropriate definitions and E-CIM as an example of B2B. Finally, a B2B IT standard framework is shown applicable for multi-tier e-business computing. Important components of this framework in the development, run-time and security platforms are described briefly. Some recent developments such as OTP, OFX and OBI are also described. Concluding remarks are given from three different point of views - engineering, managerial and scientific.

KEYWORDS

Open systems, EC, B2B, E-CIM, IT standardization, framework

1. INTRODUCTION

The Internet appeared in 1964 as a distributed, proprietary network owned by the US DoD (ARPANET) aimed to survive a nuclear holocaust and made in order to keep most important US secrets in the electronic form. ARPANET formally expired in 1989, a victim of its own success, found itself as a part of the Internet (.mil domain). Today, after forty years, it is known as "the network of all networks". Everyone uses it: ordinary people, wide-variety of professionals, scientists, etc. Internet is growing faster than any other technology that have preceded it. Comparing with television that took 13 years to reach 50 millions listeners that radio achieved, the Internet crossed that line in just four years [Shaw, 1999]. The number of Internet users worldwide is predicted to reach 750 millions by 2008 [Turban et al., 2002]. Following the data given by the Internet Software Consortium (<http://www.isc.org>), the number of Internet hosts climbed to 162 millions by July 2002. According to the Forrester Research Institute (<http://www.forrester.com>), the estimated range of on-line transactions in 2004 may be between \$2-\$7 trillion. Doing business by Internet should be an imperative goal of any company. In fact, it is not just another aim, it is about survival on the market. The questions are: is there lack of necessary standards again?, how much does it costs?, what about legacy systems and data?, what we learned from the past?, are there some bottlenecks?, and many other. This paper deals with a wide-open B2B framework that should meet all requirements needed for successful e-business and suitable to all kind of business.

During 1980's computers were used for production management in order to decrease costs and stocks and to increase the quality of the production planning (MRP, JIT, etc.). However such systems were supported by the other applications (financial, etc.) within the same companies, but there were many papers, errors and data delays between. Current limitations for something more than that were too large due to the kingdoms of closed systems as well as to the lack of IT standards. Data exchange standards between some production systems represented the first attempts to make some significant movements in that area. Standards such as STEP, CGM, WISS, and similar were on the top of the research topics. The idea to define one completely new platform for data exchange between hardware incompatible and geographically distributed computer systems also born (OSI). OSI has never reached its expected role due to its size, hard implementation and decision slowness. When something is desperately needed, there is no time for wait, we learned.

The appearance of Internet and Web caused necessary forces that might move things from an idea to the realization. Thus we reached another paradigm closely related to modern open systems, the NCC (Network Centric Computing), where the whole network may be thought as a big distributed multiprocessor machine. We also learned another lesson. When the things work, administrative limitations are not allowed. It is better to participate in, rather than hold down a procedure. Unlike classical EDI, the Internet has no limits in advance. Unlimited number of participants and almost unlimited number of scenarios are possible on Internet. The classical EDI also failed to take into account of the essential differences between suppliers. Large number of suppliers, usually small and medium enterprises (SMEs) remain out of EDI due to the lack of money for big investments and qualified staff able to implement and maintain EDI solutions [Johnston and Mak, 2000, Weitzel, 2000]. Thus, we learned another lesson from EDI failure. The solution for electronic commerce must be fair for all and it must be scalable.

Three basic attributes of open systems may be defined, known by common acronym PSI (Portability, Scalability and Interoperability). A computer system is a candidate to be an open system if PSI requirements are satisfied as follows: *Portability*. An application is open if and only if it is portable to another machine without changes in source code, *Scalability*. There is no portability limits between different levels of machines if a machine resource could meet application needs, *Interoperability*. Any communications limits due to geographical distances, computer architectures, operating systems behind, hardware vendors, etc. are not allowed. It is possible to reach all of this if supported computer technologies are based on the appropriate wide-accepted standards (de facto or de jure), as it is with the Internet and Web technologies. We learned another important lesson. Computer users have freedom of choice, vendors may cooperate, protect their investments and bring high-quality products to users. Finally, application programmers should not do the same things over and over again. Instead, they may concentrate on the application problems. We should stay in touch with these achievements.

2. E-COMMERCE AND B2B

Electronic commerce (EC) can be thought of as an emerging concept that describes the process of buying, selling, or exchanging data, services and products over the Internet. In fact when we thought about EC today we usually assume e-business. For years the area of EC was full of confusion and lack of organization [Applegate et al., 19996]. Ebusiness affects almost every aspect of how business is conducted [Shaw, 1999], information gathering, shopping, trading, brokering, banking, accounting, negotiating, manufacturing, scheduling, marketing, supplying, servicing, retailing, etc., all experienced the benefits from this emerging field. It may happen at any place at any time by any way, which makes the big difference with any other traditional way of doing business. It may be classified by the nature of transactions or by the business models [Turban et al., 2002]. By nature of transactions, we may distinguish B2C (Business-to-Customers), B2E (Business-to Employees), B2B (Business-to-Business), C2B (Customer-to-Business), C2C (Customer-to-Customer), E2E (Exchange-to-Exchange), G2C (Government-to-Citizens), etc. Today, most of EC are usually B2B. Various new business models are also established thanks to the e-business concept. Some well known ones are "find the best price", "name your price", group purchasing, supply chain management, on-line tendering and auctions, etc.

Let us define B2B as electronic commerce between two or more business partners via the third wave of EC [Gutierrez and Martinez, 2002]. The first wave of EC consists of a company website that offers a catalogue of its products and services. The latent consumers are able to meet their needs using keywords and the Web searching machines such as Google, YAHOO!, AltaVista, etc. Web farming is another familiar way where the websites of interest are known in advance. The second wave of EC carry the customers who have already established some kind of on-line shopping with a limited number of their suppliers (like classical EDI) using their websites and central database support. In both cases, one way of communication has applied. Individual customers, marketing-only companies, service companies, etc. may use above EC waves. But, production and E-CIM require more. E-CIM, as a surfer on the third wave of EC, requires production and marketing activities to be integrated via the Internet, which therefore involves many new requirements and anons into a B2B and E-CIM.

The state of the art of open systems at the middle of the 1990s has shown many new opportunities for further CIM development [Kajan and Djordjevic-Kajan, 1994]. Today we are able to define ECIM as

computer-supported manufacturing based on the Internet and Web and as a CIM which uses B2B and serves B2B in the same time, as shown in Figure 1. For example, E-CIM may use B2B to improve supply chain. B2B uses E-CIM as an information source about available stocks, spare parts etc. It may be organized also as a special kind of B2B known as CTE (Consortium Trading Exchange) owned and operated by the major group of manufacturers of the same kind of equipment that appears on e-market as a large group of buyers or sellers. Three different kind of business operating environments are possible using the Internet, Intranet or Extranet (known as IIXNET). Extranet may also be Intronets or Supranets depending on where the firewall is [Riggins and Rhee 1998]

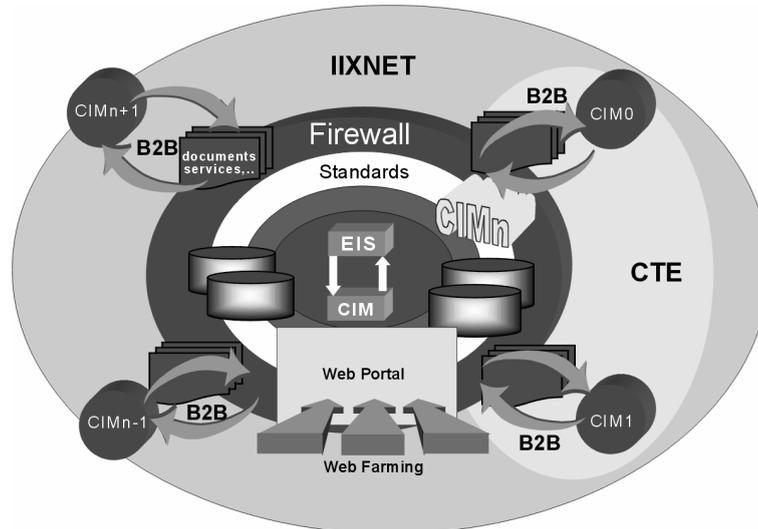


Figure 1. E-CIM and B2B

The main difference between a production company and any other kind of company is the production line with very sensitive product life-cycle. It refers to the whole life of a product from its idea to the end of its production, sales and maintenance. Product design, production organization and preparation, raw material purchasing, energy supply, final product stock, spare parts stock, contract's details and other important data usually is dispersed on different, very often geographically distributed, machines. Thus, one of the open systems premises that we do not need isolated islands of information in the strategy of E-CIM become one important issue. It is very important for a production company, which interacts with the market using B2B technologies, that its application integration (A2A) should be established inside a company at such a level that there is no information latency. ZLE, the name first coined by Gartner and Compaq, defines a business-technical strategy applied to data exchange across technical and organizational boundaries within an enterprise in order to make an almost perfect match between strategic goals and information available from technical resources (data bases, data warehouses, etc.). There are also some other names for it such as enterprise integration, virtual organization, etc. Some further steps are also under the research focus, such as partner-enterprise federalization that is more than ambitious E-CIM is.

B2B is not only the set of new Internet- and Web-based technologies, nor EDI between business partners, nor the strategy only, nor the simple copying of marketing brochures on the Web as well. First of all, it is a totally new and different way of doing things [Abel, 2002]. Firstly, the business webifying assumes that websites evolve from static content to dynamic content. In other words, instead of a window that is updated from time to time and then put online, available for potential readers via home page, it is necessary to provide a web information desk for an enterprise that is able to give appropriate information to appropriate customers at the right time. Such an information desk with the on-time information for dedicated customers only, is called a Web portal, or simply a portal. That is the fundamental difference between home pages and portals. Whilst a home page is the same for all the customers, the portal is different for all of them; the main purpose of home page is to inform, the purpose of portal is doing business.

Therefore, new challenges are underway. How to create a portal and avoid the same errors as before as the fastidious approaches (*lets design what we think they want, lets build what they actually want*, etc.)? Instead of that, it is necessary to create B2B projects with the business objectives [Abel, 2002]. However, at

the same time such a Web site must be designed for usability. Which tools and techniques should we use to obtain intelligent, intuitive and efficient elements for specific functions on the screen [Palmer, 2002]? A portal with huge quantities of constantly updated information is also a challenge for design according to fast navigation, response time, data formats, presentation formats, etc. Let us suppose that a portal has been launched with minimal risks with no errors from the past and that default business goals have not missed. The question is what else should be taken into consideration for B2B application success. Putting anything on the network, especially on the Internet involves the question of security and data integrity. On the other hand, a business system once webyfied and adapted its behavior to B2B significantly depends on the technology. Thus, the robustness of the system becomes another crucial design requirement. In addition, new business goals in the future, new emerging technologies or just new partners, etc. may require extensibility of the system and its flexibility without interrupting other services already employed. Besides, designers may find that their work should be scalable, i.e. applicable for different sizes of businesses, etc.

3. B2B ARCHITECTURAL IT FRAMEWORK

By default, B2B systems are both heterogeneous and distributed, which cause their strengths and weaknesses. Building and programming such applications is difficult due to the lack of a common underlying model. Figure 2 shows a common framework suitable for building an appropriate B2B architecture. The platform itself is multi-layered and multi-dimensional. Behind the framework is a three-tier Web application model that recognizes a thin client, a middle-tier (usually Web server and/or Application server) and data server (where the data are stored and updated, and from which they are retrieved). This should be recognized as the widely accepted architectural background for other dimensions of the framework. Vertical-side dimensions, Research/Development and Management/Security, are both influenced by all of the layers in the run-time execution environment.

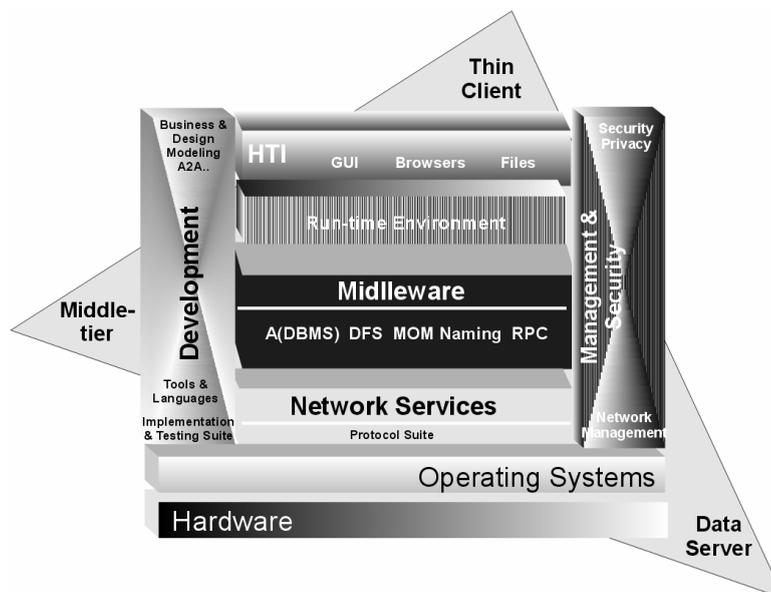


Figure 2. B2B System Framework

The framework follows component-based EC [Bichler, Segev and Zhao, 1998] and the main rules and achievements of open systems. Instead of delivering a system as a prepackaged monolith system, this platform should work as the Rubik cube offering a lightweight kernel and many other features to choose. Anyone, designers, development engineers, end-users, IT managers, etc., should be able to rotate a cube and tailor a platform of their own and therefore select the appropriate B2B architecture and finally get what they wanted. That means that researchers have already finished their mission, everything has been defined clearly and there are a number of widely accepted and implemented standards which are able to meet expected B2B requirements at any communication point established between two imaginary business entities. Things are

different in practice, of course. There are many boundaries in the heads of people (what do you mean by let us put everything we own on the Web), ROI dilemma (past and future), etc. Overcoming such a dilemma should be one of the strategic goals in the near future. Therefore, there are many research, standards and legal issues that should be carefully considered in order to meet the goals of the above framework.

First, we should take a quick look at the two bottom lines of any tier (i.e. hardware and operating systems). Regardless of hardware layer may be based on different kind of microprocessors (CISC or RISC) made by many vendors (Intel, IBM, TI, SGI, Digital, AMD, etc.), thanks to the layers above it we have not experienced any trouble with that. Also the physical layers of any communication media are well defined. In the operating systems arena, three platforms are established as dominant and almost unique: UNIX, Linux and Windows.

The next standard layer is based on the TCP/IP protocol suite and many communication services based on it. The IETF is recently developed IPv6 protocol suite with much more power than the current IPv4 has, including IPv6 that should allow IPv6-IPv4 proper encapsulation. Several important triggers have influenced the development of the new protocol. The address space was not enough yet, the encapsulation of the existing protocol stack takes time at every intermediate node on the network causing ES-ES communication overhead, new demands for additional services, etc. Actually, it may be thought as a part of the operating system, and in such a global framework should not be considered as a separate layer. The application overhead is also an important reason why we are looking for light technologies in EC, such as various agent-based intermediaries, agent communication languages, web miners, etc [Dignum and Cortés, 2001]

At the middle of the execution environment is a so-called middleware. This is the layer that should be a fast buffer capable to make uniformity between bottom layers, which are different by default, and various applications which are different by nature (e.g. by B2B business models). Various middleware platforms (which may also have their own protocol stack) are proposed and are in use. They provide distributed file system services, naming, messaging, resource sharing, etc. The idea of Web is an example of such a middleware. OSF DFS, X.500 Directory services, MOMA MOM, IETF LDAP, OMG CORBA, Jini, various RPCs, etc., are all wide accepted environments. Above acronyms and environments are explained elsewhere [Kajan, 2002a]. As a part of middleware, DDBMSs should also be taken into consideration.

In the field of security, various standards are proposed. From secure Email messaging using PGP or S/MIME, through SSL (Secure Socket Layer) to PKI (Public Key Cryptography). There are also several underlying crypto algorithms such as ECC, RSA, DH, IDEA, and MD [Kajan, 2002a] that may be used in above security standards.

There are plenty of programming tools that may be appropriate for portable code developing. Examples are C, C++, C#, Java, HTML, Perl, Visual Basic, PHP, some variants of COBOL, etc. There also integrated platforms that allow easy coding such as ACUCORP AcuBench, IBM VisualAge, Microsoft .NET, Sun J2EE, etc. XML (Extensible Markup Language) is, similar to HTML, based on SGML (Standardized Generalized Markup Language), an ISO standard for defining and using document formats. XML is specially designed for Web applications [Bosak, 1997, Bosak, 1998]. In fact, XML is a technology that allows the creation of an unlimited number of different markup languages for different purposes. UN/CEFACT and OASIS defined ebXML (e-business XML) to provide an XML-based open technical framework that allows XML for the exchange of business data in e-business environments. Unlike classical EDI, numerous applications can easily process the XML data stream and data stored in XML format can be adjusted to meet a number of different software and media requirements [Weitzel, et al., 2000]. Whereas EDI is for Fortune500 companies who can afford it, ebXML will eventually permit the other 98% world's SMEs to enter the global electronic marketplace, said Jon Bosak in an interview at the end of 2000.

Despite the lack of a general standard B2B IT framework, several interoperable EC frameworks are already taking place such as OTP, OFX and OBI [Bichler, Segev and Zao, 1998]. The OTP (Open Trading Protocol) is actually B2C solution that allows encapsulation of different payment protocols over the Internet and handles offers, invoices and receipts for payment and delivery. OFX (Open Financial Exchange) is intended for exchanging financial data and payment instructions between customers and banks. An open flexible framework for secure and interoperable B2B is represented by OBI (Open Buying on the Internet) standard developed by the OBI consortium (<http://www.openbuy.org>). The OBI architecture recognizes four entities (Requisitioner, Buying Organization, Selling Organization and Payment Authority) in a trading process. The OBI trading chain starts when a requisitioner at a buying organization searches an on-line catalogue, using a standard Web browser, at a selling organization and places an order into the shopping

basket (step 1). Such an order is processed by the selling organization resulting in an order request (step 2), transmitted to the buying organization for approval (step 3). The underlying secure communications are based on the Secure Socket Layer mechanism (SSL), while the OBI transactions are based on the standard X.12 EDI data formats. After receiving the order approval, the selling organization issues the invoice and transmits it to payment authority (step 4) using Public Key Cryptography Standards (PKCS) over SSL. For authorizing itself, the payment authority uses X.509 certificate, passes the crypted invoice to the buying organization, which pays the bill (step 5) using PKCS over SSL for reverse transaction.

4. CONCLUDING REMARKS

The question is whether the cube discussed above, consisting of many standards from different sources, is flexible enough. Maybe we are just half way to achieving the full maturity of open systems. It is the opportunity to comment it by three different points of view. From an engineering point of view we should agree that we may be satisfied with achievements we have got. From the managerial point of view, there is a discrepancy between results obtained from EC by big companies and SMEs in terms of fair, ROI and other relevant issues. There is also a lack of legal and privacy issues that should be taken into consideration as common legal regulations all over the world. From the scientific point of view, it seems that we currently have just a bunch of semi-isolated platforms instead of isolated data islands we had at the beginning of open systems. Thanks to the most of communications technologies which are perfectly standardized (i.e. everyone has agreed upon and used them) and some latest achievements such as LDAP, XML, UDDI, UML, SSL, SOAP, PKI, OBI, OFX, etc., we have the golden opportunity to stay in touch and make few steps further: from semi-isolated platforms to fully integrated business environments making IT standards cube more flexible and more usable.

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CHALLENGES FOR EDI ADOPTION BY SMALL AND MEDIUM-SIZE ENTERPRISES (SME)

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ABSTRACT

The advantages of exchanging data in electronic format between companies – called EDI, for Electronic Data Interchange – are well-known after more than 30 years of experience. However, contrary to large companies, Small and Medium-size Enterprises (SME) have always demonstrated enormous reluctance to invest on EDI probably based on excessive investment costs when compared to the perceived benefits.

This paper explains which are, in our opinion, the real challenges for EDI adoption in general and how can “Internet EDI” in particular be transformed into a popular technology for all companies, including SME. As we learnt the hard way, simply using XML on the Internet, even with built-in security, solves only a small – perhaps the easiest – part of the problem. The main challenges are, on one hand, to provide a complete technical solution (including the integration with the ERP) and, on the other hand, to convince SME that an investment on EDI can be recovered in less than one year with the benefits obtained.

KEYWORDS

EDI, SME, XML, B2B integration.

1. INTRODUCTION

Although business-to-business electronic commerce is much more important to the economy in general than its counterpart for consumers, only recently this kind of electronic commerce has gained its desired attention with marketplaces. Unfortunately, marketplaces were very popular but did not solve any real business problem, and as a consequence complicated this matter even further.

Incidentally, another kind of simpler business-to-business electronic commerce – EDI, for Electronic Data Interchange – already exists for more than 30 years in the automotive, retailing and other industries. EDI usually lets one customer send orders and receive invoices from their suppliers, although it can be used with almost any other kind of business document. For example, a large study concluded that only 52% of companies using EDI in the automotive industry actually exchange orders [Fricke, M. et al, 2002] although in the Portuguese retailing industry EDI is used almost exclusively for orders and invoices. Another study in the office supply industry only mentions orders [Beck, R. et al, 2002]. The difference is that the automotive industry uses EDI for “just in time” logistics while the retailing industry uses EDI for procurement.

More recently, large companies realized they could use the Internet as an alternative to more complicated and expensive protocols, and so exchange electronic business documents with their partners at a fraction of the price. The idea was to replace traditional communication protocols (such as X.400) with HTTP and email, while traditional message formats (such as EDIFACT, see below) were replaced by XML.

To their surprise, they found out that using the Internet for EDI was not a huge improvement over traditional EDI as previously anticipated. Since we have participated in several real-world experiences during the last few years with EDI on the Internet, and an enormous number of companies all over the world are about to (try to) use the Internet for EDI, this paper explains the main challenges with Internet EDI and hopes to make a small contribution towards EDI adoption by SME.

2. TECHNICAL CHALLENGES

Unfortunately, most of the focus on EDI is concentrated on the technical details of exchanging messages between two partners, that is, how the large company sends orders to the SME and how the SME sends invoices to the large company. Although this is an important issue for EDI adoption by SME, there are many other technical challenges that are worth discussing, especially if we impose ourselves a cost limit for the complete technical solution.

2.1 Message Format

Until recently, EDI messages were based mostly on a standard promoted by the United Nations called EDIFACT [UN/EDIFACT] or its American counterpart X12 [ASCX12]. Although in some vertical markets, such as the automotive industry, there are other popular formats like VDA and ODETTE [Fricke, M. et al, 2002] EDIFACT remains the most widely used format in Europe [Westarp 1999] and represents well any other traditional format. Recently, just before XML appeared on the scene and changed their plans, EDIFACT and ASC X12 were trying to converge in order to create (finally!) a unique global standard for electronic documents.

Today XML is the standard language to format documents because its simplicity (as well as other advantages, such as the availability of manipulation libraries for free) turned this language extremely popular amongst programmers in only 3 years. Today it seems quite obvious to format electronic documents in XML, especially if there is already a DTD or schema. (The paper assumes the reader has a minimum knowledge of XML.) If there is no DTD or schema, no problem, anyone can create new ones because designing new document types in XML is extremely easy.

Here they start the problems. There is no such thing as a “standard XML order” just like we were used to with EDIFACT. There are dozens, maybe hundreds, of document types in XML that can be used to format an order. The same with invoices and all other kinds of documents. In fact, there are formats for everyone: simple or complex, for a specific industry, for a given country, even for a certain company.

This problem has been noted in the research community already, but we believe most people cannot understand how serious the problem is becoming. Currently, only a fraction of all companies that will exchange documents on the Internet are already using XML. In the next few years, the number of companies using XML will be multiplied by 10 or 100, turning this lack of message standardization into perhaps the greatest difficulty for Internet EDI. Now, it is just a nuisance, although a growing one.

2.2 Communication Protocols

The same situation that happens with message standards also appears, although not so vehemently, with communication standards. Some companies prefer to send orders by email, others use HTTP or FTP, still others use proprietary protocols invented by ingenious IT suppliers to lock in their customers. Each protocol has advantages and disadvantages, and (just like message formats) some protocols may be more appropriate to certain situations than others, so there is no such thing as “the best” protocol.

For example, most SME still connect to the Internet using a dial-up (analog or digital) telephone line. So any synchronous protocol (such as HTTP or FTP) is quite inappropriate for exchanging documents with them, although this kind of protocols are usually better for other reasons explained below.

Recognizing this fact, we have seen large companies receiving invoices by (synchronous) HTTP but sending orders by (asynchronous) email with their smaller suppliers. This is a pragmatic approach (having the benefits when it is possible) but turns communication more complex – and thus more expensive – since each protocol has its own model, metadata (also called envelope) and security mechanisms.

The choice of protocol is made more complex when we take into account the subtle differences in each protocol. For example, email can be used to transfer a message either in the body of the mail or attached as a MIME annex. HTTP can be used to transfer a message either using the GET or POST method. And so on.

Currently, there is no solution to this challenge but we hope that new higher-levels standards – such as SOAP [Graham, S. et al , 2002] and ebXML [Gibb, B. and Damodaran, S., 2002] – will turn this challenge into a minor technical decision.

2.3 Metadata

In order to exchange electronic documents between two partners on the Internet it is necessary to send “data about the data” (also called metadata, headers or envelope) alongside the message. This metadata seems easy to solve but, in practice, it is a tricky technical detail because sometimes it can be considered as part of the message and sometimes it cannot be. This means there is no clear solution to implement metadata, and as a result a number of conflicting solutions have emerged.

For example, we participated in a project called PapiNet [PapiNet] that was set-up in 1999 to facilitate the exchange of business documents on the Internet for the forest, paper and wood industries. On that project, we opted for sending the messages by email or HTTP as XML documents, but the metadata was sent using a proprietary format. We later found out that metadata is perhaps even more important than the documents itself, and the XML documents were extended to include metadata. Even later on, the SOAP standard [Graham, S. et al, 2002] proposed to completely separate metadata from documents.

Today (beginning of 2003) any new project on Internet EDI will not hesitate to use SOAP as the envelope standard to transfer metadata. (Actually, SOAP is just an envelope standard to format metadata.) However, it remains a mystery why SOAP did not address the two other technical challenges we have already discussed (message format and communication protocol) not to mention the reliability and security mechanisms that are discussed below.

We can then expect lots of problems in the coming years coming out from (trying to) solving these challenges in completely different ways, even though all using the SOAP standard.

2.4 Reliability and Security

With traditional EDI partners exchange messages peer-to-peer, although this communication takes place indirectly via an intermediary called a Value Added Network – or VAN for short.

The VAN is a fundamental concept on traditional EDI in order to support asynchronous communication, otherwise all partners had to be connected all the time to all other partners. A VAN works more or less like an Internet ISP as far as email is concerned. The only major difference is that a VAN is more expensive than an ISP, usually requires the X.400 protocol (instead of the simpler and cheaper Internet email) and connects to its customers via X.25 (not Internet TCP/IP). A VAN also provides some “added value” such as checking the message header and format and offering security, logging, archiving and auditing services.

Of course Internet email is much cheaper than X.400 and there are many ISP vendors. However, the challenge here is how to provide all those VAN services on top of the Internet without requiring too much changes to what is already available. Of primary importance is asynchronous delivery of messages, since SME in general are not supposed to have a reliable, permanent connection to the Internet.

Email is asynchronous but famously unreliable. Email messages “arrive when they arrive” and there is no way to know if they have already arrived at the destination. Many email messages are returned with errors to the sender (sometimes 5 days later!) and some just disappear. In fact, since email messages can arrive many days after being sent, one never knows if the message will arrive one day.

HTTP can also be used to exchange messages, in particular if the POST method is used instead of the more popular GET method. Since HTTP is synchronous, we know if the message has been received. In fact, the receiver can just return an immediate confirmation. Unfortunately, HTTP can only be used if the sender is also connected to the Internet at the same time, firewalls are properly configured, and all goes well on both sides. For example, if the receiver has an error, the message cannot be processed again later on.

Regarding security, each protocol has completely different solutions. In this paper we cannot explain all these challenges, although we plan to write another paper just on this topic.

2.5 Integration with ERP

Although sometimes neglected on the EDI literature, ERP integration is probably the single most important challenge for EDI adoption in general, and SME in particular.

In this paper we use the term “ERP” to include any kind of management software to process those kinds of documents sent and received by the EDI software. In general this is a financial package, but it can also be

a Material Management System [Beck, R. et al, 2002] or a Supply Chain Management package. It can also be a specialized ERP, for example, in a hospital it can be software for managing patients. And so on.

The first reason why ERP integration is important is based on the fact that literally all companies with EDI, or about to invest on EDI, have an ERP. Otherwise it makes little sense to use EDI because they can have access to none of the advantages and benefits of using EDI.

The second reason is that, while there are standards for message formats and communication protocols, there are still no standards for ERP. That means all ERP vary greatly in features and interfaces, and since each ERP can usually be configured substantially, it also means that any two ERP installations are usually quite different. As a result, IT suppliers will have difficulties to transfer any economies of scale to their EDI customers as far as ERP integration is concerned.

The third reason, and perhaps the most important but usually less discussed, is that ERP integration is difficult for technical reasons. To be effective, integration should not mean simply converting the message to some other format understood by the ERP, it means inserting the message inside the ERP. Each ERP has a completely different interface (API) and, to make things even worse, some ERP only work with Microsoft COM and others with Java.

Even converting the message is not trivial because there are many small details to deal with. For example, the product code in the message can be the EAN barcode but the ERP only accepts orders with their own internal code. Or a field is needed to create an order in the ERP but the message lacks that field and there is no suitable default value. Or the opposite: the message contains a fundamental field (say, the customer order number) but the ERP has no place to store that field. Last but not the least, the price in the order message does not match the price in the ERP and it refuses to accept the message. And so on, and so on. For each combination of ERP and message type we have seen new little problems that make this integration a very time-consuming activity requiring expert programmers.

3. RELATED WORK

B2B marketplaces were extremely popular between 1998-2000 and they promised to integrate sellers and buyers using the Internet. Unfortunately, at least for them, they provided a Web interface and – except for their biggest buyers – neglected the integration with their customers' ERP. Only recently some surviving marketplaces began to offer this kind of integration, but usually at a price impossible for SME. However, most marketplaces have transformed themselves into service companies renting procurement software so clearly represent a separate market from EDI – where the objective is to exchange electronic documents without providing any business service between the partners.

Recently, some marketplaces have evolved into “message brokers” that are essentially a kind of Internet VAN with some minor differences from traditional VAN. For example, they can convert messages between different formats, support multiple communication protocols or different security mechanisms. This approach is more similar to Internet EDI, although one typically without ERP integration. By the way, that is what we proposed several years ago [Mira da Silva, M. et al, 1998, Mira da Silva, M. and Baptista, N., 1999].

Some companies have also proposed “WebEDI” [Westarp, F.v. et al, 1999, Beck, R. et al, 2002] although they later recognized that WebEDI is not truly EDI because there is definitely no ERP integration on the SME side and, as a consequence, the main benefits of EDI cannot be achieved [Beck, R. et al, 2002].

Finally, in the last year we have seen great enthusiasm for “Web Services” [Graham, S. et al , 2002]. However, if we remove all the marketing, Web Services are just a new form of RPC (Remote Procedure Call) based on XML. They are probably not appropriate for application integration inside the same computer, and will certainly not work between companies, either for renting software or B2B integration.

Last but not the least, ebXML [Gibb, B. and Damodaran, S., 2002] is being sponsored by the UN/CEFACT and OASIS as “a modular suite of specifications that enables enterprises of any size and in any geographical location to conduct business over the Internet.” Moreover, ebXML is also based on XML, designed for B2B integration from the beginning, and can work on top of SOAP that is part of the Web Services standard. If it lives up to the hype, ebXML can well be the future of Internet EDI because ebXML has the support of UN/CEFACT (the same organization behind EDIFACT) and this makes a big difference.

4. CONCLUSION

This paper summarizes our real-world experience in the last four years working on Internet EDI, first implementing software then trying to convince SME to invest on the new technology. In the process we have learnt a lot, so this paper is an effort to share this experience with the research community.

The main lesson is that Internet EDI has basically the same set of challenges as those of traditional EDI, so technology by itself will not be enough to convince SME to invest on EDI. For example, XML is easier than EDIFACT, but integrating the EDI software with ERP packages remains a time-consuming (so expensive) task. We need to lower the costs even further and/or increase the benefits much more in order to make it worth investing on this technology.

As a contribution to this effort, we are working on several topics in the EDI theme. For example, we are building an ebXML pilot to evaluate not only the technology by itself but how it works in the real-world. Another project is investigating Vendor Managed Inventory (VMI) to add even more value to EDI. Yet another project is addressing integration between companies from a process management point of view, hoping that a better integration with EDI into the overall IT strategy will further increase EDI benefits. As a long term objective, we do expect that EDI will reach one day – hopefully, sooner rather than later – its own “Tipping Point” [Gladwell, M., 2000] and suddenly be adopted by most companies, including SME.

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IMAGE DATA MINING – CONCEPTUAL OVERVIEW OF IMPLEMENTATION AND METHODOLOGY CHALLENGES

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ABSTRACT

Data mining is a class of analytical techniques that examine a large amount of data to discover new and valuable information. Data mining applications have proved highly effective in addressing many important business problems. Intelligent access to rich archive of image data in different fields makes the image data mining applications of particular interest. This paper delivers a conceptual overview of implementation and methodology challenges in image data mining. Different applications are discussed as well as the challenges specific to the nature of image processing and data mining.

KEYWORDS

Multimedia data mining, Knowledge discovery

1. INTRODUCTION

Several trends in the Information technology and business demands have called for development and implementation of more complex analytical techniques which go beyond the classical statistical analytical approaches. In the current information age there is an explosive expansion of digital data generated and stored in computer databases. Identifying potentially useful knowledge from such databases is not a trivial task and is resulting in the growing interest in data mining by researchers and practitioners. Another trend is the increasing pressure in companies to keep competitive advantage by construction and deployment of data-driven analysis. Data mining is a class of analytical techniques that examine a large amount of data to discover new and valuable information. It is a semi-automatic technique which can discover patterns, association rules, anomalies, and statistically significant structures in data. It has been increasingly recognized as a key tool for extracting meaningful information from the flood of digital data collected by businesses, government, and scientific agencies. Gartner Group, MIT Technology Review for 2001, and Palo Alto Management Group have identified the data mining segment as one of the fastest growing in the Business Intelligence market and as a top ten emerging technology.

Data mining applications have proved highly effective in addressing many important business problems. Continuing construction and deployment of data mining for crucial business decision support systems has taken place. It has delivered measurable benefits: reduced cost, improved profitability, enhanced quality of service. Industries in which data mining became a necessary tool include insurance, direct-mail marketing, customer relationship management, fraud protection, network intrusion, telecommunications, retail, healthcare, science. The predictive modeling is often an integrated part of high-level of practical data mining.

This paper examines the specificity of image data mining, its challenges, and implementation model.

2. IMAGE MINING AREAS

There are several business channels for which the development of robust, scalable, and reliable image mining applications is critical: government surveillance and criminal investigation; science, including biomedical imaging and astrophysics images from telescopes and spectra data; health care and medical fields; art, design, and photographic art, and last, but not least, web mining for images. For example, the vast store of medical images leads naturally to using data mining techniques to discover interesting patterns and associations not previously known to physicians.

A comprehensive review of emerging scientific applications in data mining is given in [4]. The authors identify several scientific fields where a substantial growth of data mining is needed for further scientific advances. Biomedical engineering is in the midst of revolution with an unprecedented flood of data and images forcing biologists to rethink their approaches to scientific discoveries. Microscopic images of DNA, small molecular structures, gene representation in a population of cells – the availability of this data requires biologists to take opportunity with the automated learning abilities of data mining.

Geospatial data is another area where the scope and volume of digital geographic data sets acquired from satellites, high resolution remote sensing, and other monitoring devices easily overwhelm traditional spatial analysis techniques. Despite some prominent research and data mining algorithms developed in this area, geospatial data mining is in its infancy [9]. Climate and oceanographic data and Earth's ecosystem has in the recent years acquired copious amount of data through satellite images, terrestrial observations, and computer modeling. Periodical global snapshots, typically in a monthly basis provide a voluminous, large scale data that presents a major candidate for automatic rules and patterns extraction through image data mining, this complimenting textual data mining and traditional statistical techniques. Important results from effective data mining can be applied to identifying mineral, oil, and water resources, agriculture and forestry, land mapping, marine research, etc.

Data mining the large archives of digitized medical images of hospitals, healthcare institutions, and physicians' offices provides unique opportunity for advances in medicine and health care. MRI, PET scans, mammograms, ultrasound images, protein crystallography – all these image categories are excellent candidates for image mining [10]. Through image-content database query techniques, data mining can discover common and indicative patterns leading to early and automated discovery of abnormal organ tissues, lesions, cancer, and others. Moreover, it is also possible to use image-content data mining as a clinical tool for new cancer screenings as well as to provide clues to deeper understanding of the nature of different sicknesses and their correlation with environmental and genetic factors as derived from patient records.

Astronomy and Astrophysical Sciences also benefit tremendously from imaging and textual data mining applications. Hubble telescope and ground-base optical and radio telescopes supply astrophysicists with sky data tens of times more voluminous than any of the traditional image analysis and statistical techniques can handle. Lawrence Livermore National Laboratory in California, USA, is a leading provider of image mining applications tailored towards the tedious and arduous process of finding a handful of precious images of rare astrophysical objects or patterns by mining trillions bytes of image data. For example, their SAPHIRE project (lead by Kamath, [6]) provided efficient search for a rare category of quasars among 22,000 sky images amounting to 100 gigabytes of image data.

One of the most urgent areas for applying advanced imaging data mining is the security and surveillance. The new government regulations, following September 11 terrorist attack, the national strategy of Homeland security and the new security regulations call for applying cutting edge imaging techniques including data mining. Human face recognition, signature recognition, automated target recognition and identification, X-ray image mining (for airports and facility security), and fingerprint/retinal recognition are estimated to be the fastest growing image mining application to respond to the heightened need of securing the population against criminal and terrorist acts.

3. IMAGE MINING PROCESSING MODEL AND CHALLENGES

Image mining is the discovery of patterns from a collection of images [7]. The image mining is highly specific because the image databases are predominantly non-relational. In addition, many image attributes are

not directly visible to the user. The size of each data item is large which imposes severe requirements not only on storage, but on data delivery (the query process, browsing results, etc.). The data mining implementation model proposed by [3] and verified in a case study by [5] is viewed as a framework of how data mining should be conducted. Several common stages in imaging mining can be identified [6]: Data Preprocessing, Pattern Recognition, and Knowledge discovery stage. These stages are iterative and highly interactive in nature. The whole process repeats until the useful knowledge is extracted.

3.1 Image Preprocessing

The image data is highly non-trivial. Preprocessing and postprocessing of image data are often the most critical, time consuming phase which determines the effectiveness of the data mining application. Data preprocessing is more influential and time consuming. In addition, it is domain specific which impedes the preprocessing automation. It is a well known argument in data mining that data and human issues are the bigger success or failure factor in data mining than the algorithmic and model issues. Some researchers report that data preparation phase is the most resource intensive stage – around 60% to 70% of the total effort in the data mining project is dedicated to preparation [3]. The Preprocessing stage includes De-noising of the images, Object identification, and Dimension reduction.

The sources of noisy data can be typographical errors, missing values, incorrect information, duplicate data, etc. In addition many images are not in a form suitable and have to be transformed to more meaningful attributes. To overcome the problem of noisy data, frequently a whole data cleaning system has to be implemented that reconciles the format differences by allowing the users to specify the mapping between attributes in different format styles and encoding schemes [1]. Some categories of data are more prone to noise than others. It depends on how controlled the environment can be at the time the image acquisition. For example, medical images, photographs taken in controlled conditions are much less noisy than telescope and remote sensing images where the data acquisition process is highly dependent on atmospheric disturbances. Various de-noising techniques include spatial filters, simple and wavelet thresholding, and other traditional image processing techniques for noise reduction.

The object identification is non-trivial. Among the greatest challenges is the tremendous variety of object shapes, hues, and contrasts, its image quality and boundaries. There is no universally accepted measure of quality of the object, in time sequence measures the object can change shape or move, split, or merge with another object. Among traditional image processing techniques, widely used are thresholding of the image histogram, segmentation techniques, and edge detection by using filters. Along with the object's identification, its features (distance parameters, angles, areas, etc.) are also extracted.

The Dimension reduction is made to facilitate the computational algorithms and shorten the time for pattern extraction. Classical methods of dimension reduction are applied, such as exploratory data analysis, principal and/or independent component analysis, etc.

3.2 Pattern Recognition

Traditional algorithms are employed at that stage. These include classification, clustering (segmentation), association/sequential pattern discovery, regression algorithms. A thorough review of the algorithms is beyond the scope of this article. However, some studies report successful usage of specific algorithms in different application areas. For example, [8] used the fast Nearest Neighbor Search algorithm which can have broader applications in photo journalism and web image mining as well. ("*Find shapes similar to this*"). The reported techniques achieve classification based on shape and degree of change in shape over time (for tumors), by providing Time Evolution analysis and detecting correlation among shapes, diagnoses, and symptoms. More sophisticated image mining application incorporate numerical signatures of image features such as color, texture, size, and shape and temporal changes. Successful brain image mining was reported by using nonparametric regression [11].

Once patterns are discovered, it is difficult to distinguish the spurious from the significant ones. While the traditional statistical approaches offer the estimate of significance level, it is not possible to apply these approaches directly due to spatial and temporal autocorrelations.

3.3 Knowledge Discovery

Therefore, when genuine patterns are identified, domain-specific knowledge is essential so the patterns of no interest and/or relevance are filtered. Filtering the large volume of rules discovered needs a design of a separate pruning algorithm to remove insignificant rules. This algorithm has to be domain specific and reflect the common and relevant knowledge in the corresponding domain.

For a given image database we propose the following algorithm for knowledge discovery. Initially we construct a database with records containing the following structure: (imageID, $C_1, C_2, \dots, C_n, T_1, T_2, \dots, T_m, S_1, S_2, \dots, S_k, F_1, F_2, \dots, F_j$), where imageID is a unique identification of the image; C_1, C_2, \dots, C_n are the values of the color characteristics; T_1, T_2, \dots, T_m are the values of texture characteristics; S_1, S_2, \dots, S_k are the values of shape characteristics; F_1, F_2, \dots, F_j are the high level semantic features, given by an expert in the field. The mining process is defined into two steps. First we find the frequent multidimensional value combinations and find the corresponding frequent features in the database. The combination of attribute values that occurs two or more times is called multidimensional pattern. For mining such pattern a modified BUC algorithm [2] is used. The second step includes mining the frequent features for each multidimensional pattern. They constitute the obtain rule base set for the high semantic features.

One of the most important aspects in this stage is the visualization, filtration, and validation of the newly discovered patterns and rules. This stage is highly domain and knowledge specific, and during the mining method validation it requires close interaction between the domain expert and the data mining researcher. The extent to which the knowledge discovery presentation is user-friendly and does not require additional training determines the success of the data mining application. Many end users' primary activities are not to analyze the outcome of decision support systems – for example physicians, astronomers, artists, photographers, etc. Therefore they cannot take the time to sort through large number of rules. It is therefore important to present the discovered rules in a visualized, easy to understand form. The data mining application should be able to assist the user in analyzing knowledge discovery quickly and easily.

4. CONCLUSIONS AND FUTURE RESEARCH

This overview of image data mining focuses on fundamental questions of image data mining implementation, usability and challenges. In addition to providing a discussion of usability in different business channels, implementation specificity and implementation model stages, the paper gives an overview of methodology used in the different phases of image data mining. Future research objective is to test and provide comparison of different data mining modeling techniques on astrophysical images provided from computer simulations of supernova explosions, as well as actual images obtained from telescopes. We intend to use about 500 images to extract and validate relevant rules and patterns by using the methodology described above. Additional area of interest are the privacy issues related to image data mining in health care and security and surveillance applications, as well as individual's vulnerabilities associated with the Internet availability of such image data.

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KNOWLEDGE MANAGEMENT SYSTEMS AND BEST PRACTICES. CORPORATE MANAGEMENT'S WAY TO BUSINESS EXCELLENCE: "THE INTEGRATED BUSINESS EXCELLENCE NAVIGATOR (IBEN)"

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ABSTRACT

The effective development, distribution and use of personal and company-related organisational knowledge is one sustainable criteria for long-term competitive advantages on the way to business excellence. First companies need to develop a consciousness regarding knowledge and knowledge management for a strategic positioning of knowledge management in company targets, the documentation of relevant knowledge and the use of business process oriented information- and communication systems. On the way to business excellence an integrated approach on the basis of knowledge management helps to evaluate and control business processes and strategic targets to meet the competition. The "Integrated Business Excellence Navigator" is developed as one tool to picture and diagnose these circumstances in a holistic way.

KEYWORDS

Management for Knowledge, Best Practices, Corporate Management, IBEN

1. BEST-PRACTICES OF KNOWLEDGE-ORIENTED CORPORATE MANAGEMENT

Management of knowledge concentrates primarily on explicit knowledge, which can be seen as one of the slightest parts of knowledge inside an organisation. Through these circumstances the efficiency and actual practicality of knowledge management attempts of this kind can be evaluated as rather superficial. On the contrary the creation of the context for promotional, organisational, general conditions (constraints) is the basis for the generation, transfer, actualisation and usability of knowledge itself. Thus refers to the **principle of management for knowledge!**

The principle of management for knowledge follows the thesis of system- and structure-theoretical basis, which says that the (re)producing self-developed order in the deep structure of the organisation continuously manages the dealing with knowledge rather invisible through monitoring, interpretation, combination, giving of meaning and handling (Neumann, R. 2000). The organisational order of knowledge takes over the main function of a pre-anticipated management system, because it determines what kinds of data develop to

information, what kind of knowledge will be generated, integrated, distributed, used or refused. Furthermore it establishes the knowledge-based acting inside the organisation. This order is based on knowledge that is embedded in structures, routines, competences, technologies etc. and on which the acting is currently implicit referred to.

Organisations are exclusively oriented on their own criteria and for this reason develop their own knowledge for the solution of problems. They generate their own codes and languages; shortly, they develop obstinacies of an interior logic on which they arrange their acting. The epistemology of an organisation particularly determines, what kind of knowledge-generating questions will be directed towards the own organisation and the environment. This refers to the internal and external events and what kind of meaning they draw on. The pre-anticipated character of the epistemology of the organisation determines, what kind of knowledge becomes system-internally operative and furthermore be transferred to competence, through the process of integration in existing structures and the combination with existing resources. This organisational order of knowledge arranges and accordingly manages to all intents and purposes in dealing with knowledge and organises the ability to govern learning- and knowledge-intensive processes.

The kind of knowledge organisation is precisely traced in the specific acting, deciding and the communication of the organisation. The sub-surface-structure shows the result of the organisational knowledge basis and the knowledge performance which deals with the ability to realise organisationally specific knowledge in the form of intelligent and innovative products and/or services (Figure 1).

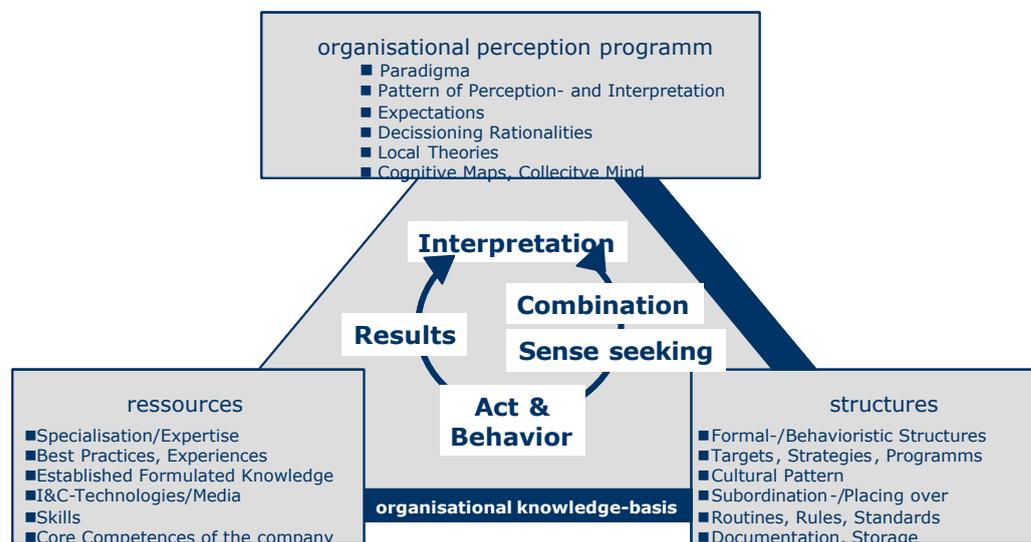


Figure 1. Order of organisational knowledge (Neumann, 2000)

Under the consideration and acceptance of self-referential characters of the "order of organisational knowledge" it can most only be dealt with contextual interventions in terms of the contextual control. This means that desired circumstances are not only produced in a deterministic way but also inconsistencies are detected questioned. Aspects and accordingly action alternatives are integratively developed. Thus leads to the definition of indirect forms of control in the way of targets, rules, routines, standards and systems. Furthermore this can be referred to information, communication, creation of incentives and the establishment of strategy and control.

From the just now described principle of **management for knowledge** following guidelines and accordingly relevant criteria for success are transferred (Figure 2):

- Strategic relevance of the topic of knowledge for the organisation (target-/system of value)!
- Procedure in the context of a unified and integrative conception (design)!
- Commitment from **top-decider** !
- Gain employee **acceptance**!
- **Knowledge-oriented organisational-diagnostic**, Identification and structuring of relevant company knowledge !
- Constitution of **knowledge-oriented organisational culture** ! (trust, communication, cooperation, failure behaviour, reflection, learning) !

- Development of **promoting contexts** (incentive system, structures etc.)!
- Continuous **development of competences** at management- and employee level !
- Construction of **infrastructure** (technologies and media for knowledge transfer, -saving, -retrieval) and integration of existing structures and systems !
- Promotion of **integrative processes** through interaction, communication and application!
- Coordination of **planning- and control-processes** ! (indicators-/ measuring system)
- **Knowledge transfer** from the environment into the company
- **Documentation** of „lessons-learned“ and „best practices“
- Acquisition of **the effects** of KM-methods

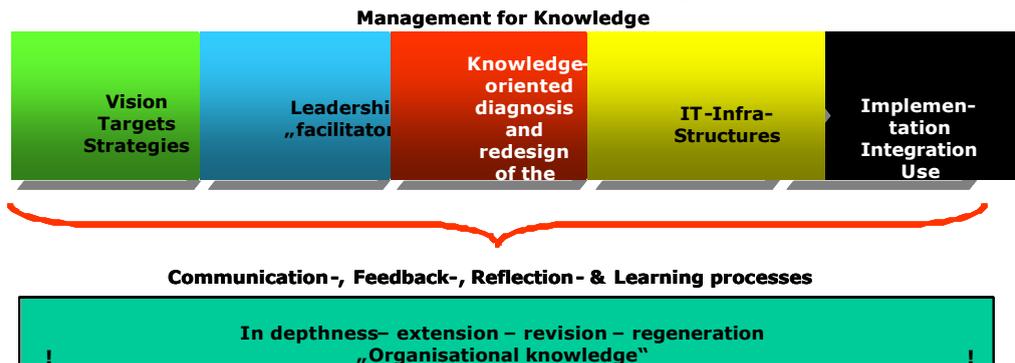


Figure 2. Guidelines of management for knowledge (Neumann, 2001)

Knowledge management boosts the myth about rationality, feasibility and controllability of organisations. However it is requested to display the dialectic of knowledge on the one hand as resources and driving power for the new and on the other hand as element of stability. Processes of a deeper consideration about knowledge, enhancement of knowledge, revision and reformation of knowledge demand not only a high degree of organisational consciousness, but also the diagnostic and rearrangement of an organisational order of knowledge as one of the key elements of knowledge-oriented strategic management, because the implementation of implicit knowledge resources demand promoting contextual circumstances. As a rule these become operative if also changes organise the sub-surface as well as deeper structure of the company.

2. CORPORATE MANAGEMENT’S DIFFICULTY ON THE WAY TO BUSINESS EXCELLENCE: INTRODUCING THE “INTEGRATED BUSINESS EXCELLENCE NAVIGATOR IBEN”

Through globalisation and an ongoing internationalisation of business processes, the quality and a qualitative certification of these business processes comes to the fore. It is deemed to generate a unified, realistic and also applicable system, which can be easily applied to (a way out of the indicator-jungle) and flexibly modified (adaptable for diverse business segments and company operations). This concept provides the possibility of a holistic and integrated application for the whole company (internal processes and specific units) as well as for the relevant environment (market, competition, customers, suppliers, among other things). The term of an integrated holistic corporate management includes not only variance respectively dynamic and flexibility of the company’s strategy but also the reflection of the organisational system as a unit with one- and multidimensional change-processes. To visualize and furthermore control change processes, the analysis and diagnosis of knowledge-intensive company processes is essential. Through the illustration of specific spheres and the interdependencies between the different units a company wide map is designed, which offers the ability of benchmarking on the way to business excellence.

An accentuated visualisation of the diverse segments and their influencing factors is enabled through the splitting of the company processes in their spheres of influence (whereas a multiple classification should be prevented regarding causes concerning handling and complexity). Common tools are limited on a partial,

restricted consideration about the company in a partly isolated environment. Diagnostic gaps and visualisation problems regarding the ongoing use arise for instance from following factors:

- Insufficient figure systems
- No holistic view
- Important user-groups factored out
- Visualisation-Problems
- Problem of internal customer
- Indicator-jungle
- Data-Information flush
- Internal vs. external consideration
- Stakeholder-reflection
- Adaptation regarding strategy, vision, mission
- Dimensions of learning
- Relevance of problems (enter of barriers and handicaps)
- Change and innovation
- General orientation to the dimensions of learning, knowledge and the change as epicentre and origin
- Limited strategic alternative
- No diagnostic tool

A multiplicity of problem areas make a diagnosis and assessment impossible, because major points and segments are disregarded respectively the general orientation is not consistent with the strategic and future-oriented positioning of the company and its guidelines. In this context the problems of internal learning- and knowledge- relevance are of extraordinary importance, also regarding the origin of a dynamic change management and a participative and selective strategic new-orientation.

To avoid these problem areas a structured approach with a specific orientation on integrated diagnostics and planning-application is recommended. In whose front the nine major segments of company processes, application and results lay. In this domain the external as well as the internal components, cross-functional and multi-hierarchical results and the structure and function of specific sub-areas are going to be defined.

The model provides nine specific checkpoint areas:

- Market
- Business Performance
- Corporate Culture
- Organisational design
- Staff
- Management
- Targets/Strategies/Measurement criteria
- Learning/Change/Improvement/Innovation
- Core competences/Resources/Knowledge



Figure 3. "Integrated Business Excellence Navigator" (own illustration)

Each of these areas pictures a specific part of the company and its business processes, whereas the influencing factors and user-groups diverge in the different domains. Highly important and relevant is to elicit the funding agencies and beneficiaries in the different areas. The areas are recorded regarding body, entities and their results and furthermore evaluated. Thereby idle laying potentials are collected und eventual

gaps are defined. The diagnosis is the first output of the concept, on the basis of which change initiatives are designed and attached a planning and design of individual steps follow.

Whereas a special attention is turned on the diagnosis itself as a tool for the identification of weak points and the tracking of the causal symptoms as an essential element of identification for the thereon oriented therapy. Referring to this the diagnostic level should be especially considered and executed in its detailedness and therapeutic relevance.

Ongoing from nine checkpoint-areas it is possible to draw a visualisation of the company and its core competences and resources. Further on specific units are specified and described in detail. Each domain is accompanied with a fitting indicator quartet to establish a clear and measurable diagnostics and analysis platform.

3. CONCLUSION

Management for knowledge tries to unify theoretical and practical approaches through the incorporation of best practices and lessons learned in the system as self-referential, learning and feedback loops. Through an innovative organisational knowledge basis and knowledge performance companies realize intelligent and innovative products/services. The "Integrated Business Excellence Navigator" as a tool for the development/analysis/diagnosis and change of different organisational patterns on the way to business excellence tries to picture the diverse areas of the company's business with a knowledge oriented perspective towards a corporate knowledge management approach.

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A NEW ARCHITECTURE FOR INTEGRATED OLAP/GIS ANALYSIS BASED ON A GEOGRAPHICAL DATA WAREHOUSE

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ABSTRACT

Decision Support Systems (DSS) are currently based on On-Line Analytical Processing (OLAP) applications that typically access a Data Warehouse (DW). But, GIS applications – although mainly used for operational analysis – can also be used for decision support. Unfortunately, these two worlds are still separated and only work together using ad-hoc methods that don't exploit the advantages of integrating spatial, temporal, and business data in a single unified DW. In this paper we propose a new architecture – including a novel GeoDW, a DW extended to the spatial domain – that seamlessly integrates business data with spatial data.

Based on this GeoDW concept we present a complete technical architecture to integrate business and spatial data retrieved from operational databases, and use this integration for spatial-aware OLAP analysis. The GeoDW uses address-location data to extend business data with spatial features on a map. This means the GeoDW can be used not only to extend the traditional OLAP analysis to include GIS functionalities, but also to benefit traditional GIS applications with OLAP functionalities. We are currently building a prototype to validate this architecture.

KEYWORDS

Application integration, DSS, Spatial DSS, OLAP, GIS, Data Warehouse.

1. INTRODUCTION

DSS basically analyze and summarize numeric data to present them to decision makers using high-level applications – such as Balanced Scorecards – in order to monitor the evolution of critical business indicators [Chaudhuri, S. et al, 2001].

But, when decision makers need to analyze business data in a spatial context, a Geographical Information Systems (GIS) tool is needed because conventional DSS cannot process spatial data. This separation between business and spatial data motivated the creation of “Spatial DSS” (SDSS) [Densham P., 1991, Malczewski, J., 1999]. SDSS applications, although increasingly used amongst innovative decision makers, remain a niche market, focused on specific areas, such as geo-marketing, and still without actually integrating the two kinds of data.

Building SDSS using commercial products is an accelerating trend [Tu, S. et al., 2002, Casey, M.J. and Austin, M.A., 2001]. Their research work has a common approach: both are addressing the integration issues between business and spatial data. Specifically, they present methodologies to integrate the two worlds (spatial and business data) using also commercial products to provide users with harmonious views for various workflows, via Web or through the interoperability of heterogeneous GIS.

Tu et al. propose an adapter to improve accessing time to consolidate file-based raster images. Casey and Austin propose semantic Web methodologies to enable distributed heterogeneous agents to utilize spatial data and services in an open, interoperable environment for SDSS. They also exemplify the aggregation, reasoning, and desegregation capabilities of agents in the context of spatial navigation and decision support.

But, they still consider working with two separate databases, one for business data and one for spatial data. Besides that, the focus is on operational issues, and our work focus on spatial analysis. Our research also considers the evolution over time of features and business arguments.

In this paper we propose to collect and integrate business data with spatial data on the back-end – in the GeoDW – before being accessed by any OLAP or GIS tool. In order to explain the GeoDW proposal and its architecture, the paper is organized as follows. Section 2 presents basic concepts of GIS technology, namely GIS standards, important to explain the GeoDW. In Section 3 we propose and explain the GeoDW architecture as a novel architecture for building SDSS applications. Finally, Section 4 focus on related work, summarizes the main contributions of the paper, and presents our planned future work.

2. GIS AND DECISION SUPPORT

Traditionally, GIS tools were focused on displaying, managing, and analyzing spatial data, without any concern to integrate its own data with other applications or databases – leading to inconsistent data and time-consuming integration efforts. As a result, a new requirement emerged: how to exchange spatial data between applications in order to incorporate GIS functionalities inside the overall IT architecture.

The Open GIS Consortium (OGC) and ISO have tried to solve this integration problem by defining standards for spatial data [Open GIS, 1999, Ostensen, O. et. al., 2002]. The OGC was also launched with the specific mission of improving the interoperability of GIS tools amongst themselves and with other tools. The major challenge was to find a standard for structuring topological features, in particular for relational databases [Open GIS, 1999]. The idea was to store spatial data alongside ordinary business data, and stop considering them as Binary Large Objects (BLOB) without any possibility of being searched or analyzed using only SQL.

GIS tools can operate with features on one or more themes (also called layers), and support operations for spatial analysis, such as boundary, difference, buffer, distance, convex hull, union, and intersection. For example, a view containing two themes, a street map, and a demographic lifestyle map, could be used to map potential new store locations based upon business data such as in-store surveys, credit card receipt, and population density with lifestyle profile similar to good customers.

This geographical approach is much better than simply analyzing the data as records in a table, where patterns are much more difficult to be detected by decision makers. However, analyzing business data with GIS tools cannot offer decision makers the same analysis power that existing OLAP tools commonly support. On the other hand, OLAP tools are not appropriate to deal with spatial data [Densham P., 1991].

Although the SDSS were presented as the answer to these limitations, it is still inadequate for integrated business/spatial analysis [Densham, P., 1991]. It restricts both the integration with other types of data and the interoperability with other tools and systems.

To solve the problem, we propose that business and spatial data should be collected, integrated, organized and stored in the GeoDW. By “integration” we mean not only to store these two kinds of data in the same format and/or database, but also to link business data with their spatial features.

3. GEO-DATA WAREHOUSE (GEODW)

The architecture we propose (see Figure 1) is based on the new GeoDW concept. The GeoDW is basically a traditional centralized multidimensional repository extended with geo-coded fact tables and geographic dimensions.

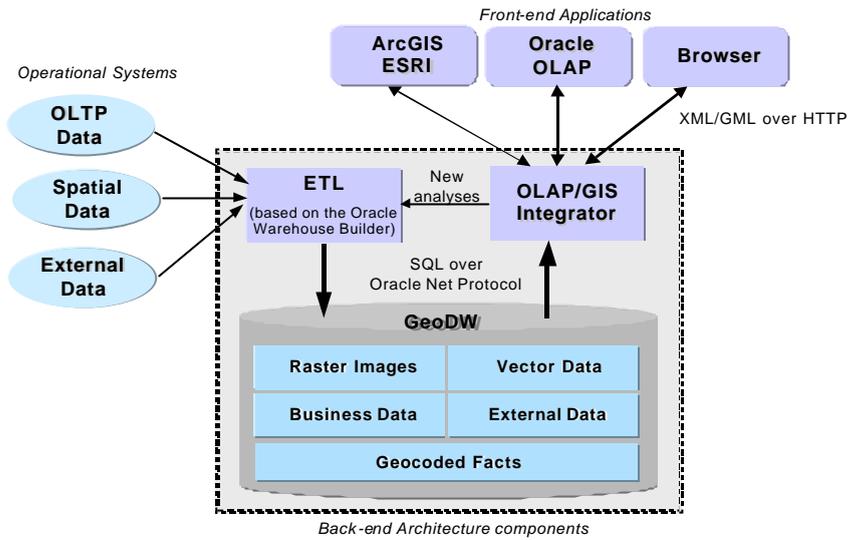


Figure 1. Proposed Architecture (including the GeoDW).

The figure shows, the three back-end core components of the architecture, respectively the GeoDW, the ETL Process, and the OLAP/GIS Integrator.

As any DW, the GeoDW has a multidimensional structure with facts and dimensions. The difference is that the “fact” (e.g. sales) can now be, not only, referenced to traditional business dimensions, but also geo-referenced (and topologically related) to geographic dimensions. In a geographic dimension each record describes the state and geometry of a spatial feature in one specific moment or period of time.

Beside geometric and features attributes, the geographic dimensions also store all cartographic parameters needed to characterize the features in spatial terms. Figure 2 below uses an example (postal address uniformity) to illustrate how business data – collected from the company operational databases – can be integrated with spatial data, keeping referential as well as topological integrity.

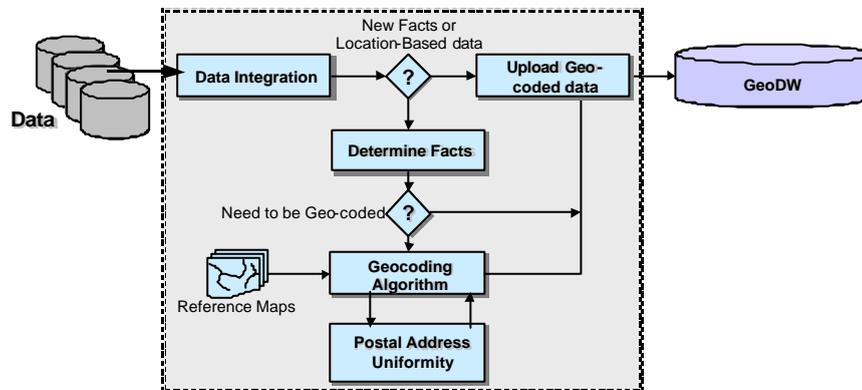


Figure 2. ETL process: integration between business and spatial.

At the transformation (or cleaning) phase the ETL process analyzes the standard tables *Geometry_Columns* and *Spatial_Reference_Systems* and loads the corresponding metadata, geometry and reference system attributes into geographic dimension.

The ETL process also checks each fact. If the fact is already geo-referenced, it is directly inserted into the GeoDW; if not, the ETL process activates the geo-coding algorithm to determine the geographical coordinates for that fact, based on a reference map [ESRI, 2003, Dangermond, J., 2003]. Facts that are not possible to geo-code (e.g. with invalid postal codes) are passed to another process that deals only with abnormal events.

Facts have to be geo-coded in order to be used for spatial analysis, and are represented as a point on a theme. When the user clicks on a point that geo-references a fact on a map, its feature attributes are retrieved. This relationship corresponds to a foreign key from the fact to the geographic dimension that describes the place (point) where the fact occurred.

The front-end applications access the OLAP/GIS Integrator via an API that uses XML over HTTP, also called Web Services [Graham, S. et al, 2002]. In the particular case of GIS tools, there is an XML schema to exchange (and store) geographic information called Geographic XML (GML) [Open GIS, 2003].

The OLAP/GIS Integrator provides an XML-based API to the OLAP and GIS front-end applications that can be used over the Internet. Optimising the GeoDW data accesses at the back-end and interact with the ETL process to automatically create new aggregated structures to improve query performances.

Since the OLAP/GIS Integrator exports XML, it should be possible without much effort – e.g. using a J2EE application server – to provide a direct Web interface to the basic GeoDW functionalities. .

4. CONCLUSION

The architecture we propose solves data inconsistencies and lack of integrity caused by data fragments. This is achieved with a GeoDW that can be used as a repository for DSS in the entire organization. The architecture offers XML-based API to facilitate interoperability between applications.

The main objective is to expand existing DSS capabilities and improve system performance analyses by directly accessing data at the back-end.

The three core components of the proposed architecture work together for the functional workflow that starts with collecting data from existing Operational Systems and ends with the front-end applications. The **OLAP/GIS Integrator** separates the front-end tools from the SQL implementation, optimizing GeoDW data accesses, and interacts with the ETL process to automate the creation of new multidimensional structures. The **GeoDW**, a spatial-enabled multidimensional database with basic functionalities for spatial analysis supported by the extended SQL, stores the data at the back-end. The **spatial ETL process** to automate the creation of multidimensional structures in order to better answer spatial-enabled queries,

In order to validate this architecture, we are building a prototype based on Oracle and ESRI products.

The ultimate objective is to build an architectural framework for analytical customer relationship management, where any spatio-temporal data change would be stored. In particular, we would like to experiment with information about real-time location of customers using mobile phones, together with statistic information about their daily itineraries, to provide highly personalized services to increase the so-called Average Revenue Per User (ARPU).

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E-GOVERNMENT IN THE ARABIAN GULF: A VISION TOWARD REALITY

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ABSTRACT

This paper presents a review of the e-government initiatives in the Arabian Gulf countries that form the Gulf Cooperation Council, GCC. Throughout the region, extensive efforts are being made to capitalize on the cyber technologies and enhance the government to citizen service. The described cases are from Kuwait, Bahrain, Saudi Arabia, Qatar, the United Arab Emirates and Oman. While the efforts vary in size and intensity, what appears to be common is the top level support the e-government initiatives are receiving, which offers them visibility and hopefully warrants their eventual success. The collective message delivered by the examined cases is that e-government is becoming an integral part of the respective countries life with a byproduct being an increase in society's cyber-literacy.

KEYWORDS

Arabian Gulf, GCC, e-government, Kuwait, Bahrain, Saudi Arabia, Qatar, United Arab Emirates, UAE, Oman

1. INTRODUCTION

The *Digital Age* has revolutionized the marketplace, as well as the business-to-consumer and business-to-business relations. Now, the same force is transforming the model and protocol of interaction in extra-government and intra-government communications. The result of this transformation has been a new relationship in *government-to-citizen*, G2C, *government-to-business*, G2B, and most important in *government-inter-agency*, G2G, communications that is now Web based.

Considering that governments are mainly information producers, rather than information receivers, the Internet presents itself as the ideal intermediary becoming the 24/365 passive call center for government-citizen interaction. Of course, nothing prevents it from being an interactive call center, as well, and this is where the ultimate challenge is. Governments, around the world, and especially in the Gulf, responding to the society's continuously increasing cyber skills and wanting to capitalize on the Internet technologies, are funding numerous e-government projects aiming at enhancing their own productivity as well as that of their constituencies – citizenry and business alike. Most projects are Web based, while others are high-tech telecommunications based.

Government administrations have recognized that an e-government portal – serving as the gateway to a National Web Depository - can simultaneously meet two important objectives, a national one and an international one. The national objective is operational and dual. On one hand, it is to serve as a Depository of Documents and a one-stop information center - and on the other, to be a fully interactive service provider with call center capabilities functioning as the government's Transaction Processing System offering tactical automation.

The international objective is strategic and also dual. On one hand, it is to serve as a worldwide showcase, and on the other, a permanent promoter of that country's political, cultural and business aims. In that respect, the Arabian Gulf States, rather lead in e-government initiatives and in services delivery. Over the past two years, country after country, has initiated programs attempting to Web-enable the government-to-citizen and government-to-business interaction, also making it impersonal. This is significant governance transformation that will only have a positive impact on the path toward a transparent G2C relationship. In the

area of education, the information and communication technology has become a cornerstone, and it is identified as "...the one and only international language..." [1].

As a result, similarly to the digital firm, more and more government agencies are moving employees from the front office to the back office of government service. Ultimately, the front office of government will be the Web, kiosks strategically located in areas of high foot traffic, as well as the SMS capabilities of the omnipresent mobile phones. While in most countries around the globe e-government is treated as a necessary evil, in the Gulf, the e-government vision has been placed on the top of the government priorities and with very impressive results; often serving as a G2C interaction showcase.

What is of special interest is that many e-government projects are remarkable strategic innovations, rather than merely online replicas of offline government services. Yet, in most cases, e-payments over e-governments portals still remains a goal to be attained.

Table 1. Objectives of an e-government portal

e-Government Portal				
Objectives				
National			International	
Documents Depository & Information Provider	Transaction Processing Center with Live Interaction		Worldwide Showcase of Natural and Cultural Wealth	Permanent Promoter of Political, Cultural and Economic Aims
Passive	24/7		Multilingual	

2. OBSERVATIONS AND CONCERNS

Despite the numerous advances in e-government, all across the Arabian Gulf - from Kuwait to Oman with exceptional vision displayed in Dubai - there is a widespread fear that the *digital divide* will make the fruits of e-government inaccessible to the majority of the society due to lack of *cyber literacy*.

Beyond the *digital divide*, an additional concern is also being expressed about another *divide*, namely the "... *speed divide*..." [2], where the haves will have broadband access to the Internet (10Mb/s), while the have-nots will have a mere telephone modem connection (56Kb/s). Consequently, the accessed content will be, respectively, *rich* and *poor*, at least when it comes to multimedia. "*Unless these infrastructure deficiencies are eliminated, the surge in Internet users ... will definitely cause problems.*" [3]. The general fear is that the Internet access facilitators - the backbone access providers and the Internet service providers - in order to maximize their return on investment will not meet the access demand. As a result, the growth rate in Internet utilization will decline.

Another concern is the way e-government projects are being reviewed and funded. Such projects in the Gulf appear to be "...*budget-based projects rather than being in project-based budgets*..." [4], and "*to move from vision to reality, such a transformation needs a committed leadership, a sound strategy, a seamless cross-coordination between various agencies and organizations as well as the know-how.*" [3].

Despite the various concerns, there is a very positive outlook toward e-government in the Gulf, with several believing that the e-government initiatives not only will show that the "... *government is too rigid*..." [5], but will also serve as an agent for change. As a result, there is a high expectation for government processes streamlining, modernization and reforms. The implementation of the e-government projects requires skilled human resources that not available within the governments themselves. Consequently, consultants and local partners are being contracted for assistance and most important for *technology transfer*.

3. SELECTED e-GOVERNMENT CASES

3.1 Kuwait

The Emirate of Kuwait has been very active in e-government with a variety of projects and activities, such as,

- a. The development of a Judiciary Information Database, with the support of the United Nations Development Programme [6].
- b. Organization of Kuwait's first e-Government Conference sponsored by the Al-Faris Group "...to create awareness among business and IT executive ... to deploy latest web technologies...". [7].
- c. The sponsorship of a large e-Government conference in Kuwait, in April 22-24, 2002, with the support of Microsoft [8].
- d. The participation of a wide range of consultants including the Al-Bared Group, which "...has committed itself to finding a workable solution for the implementation of an e-government infrastructure in the State of Kuwait. [9].
- e. "In collaboration with the Kuwaiti government, FAPCO is in the advanced stages of setting up the infrastructure of E-Government services and solutions for the State of Kuwait". This project can be best defined as the first electronic public library in the Gulf, and will include more than 800 pages translated into six different languages. The website is an official source for all sort of information, public data, geography, history, photos, and references about the State of Kuwait. [10].

Kuwait having realized the need for a comprehensive and strategic plan for addressing the issue of developing and maintaining an e-government service "...created the Secretariat for the Central Technical System..." within the Ministry of Planning. In Spring of 2002, Kuwait launched an international tender for proposals - based on detailed e-Government Project "Product Specifications" – seeking responses from e-government experienced companies [11].

3.2 Bahrain

The Kingdom of Bahrain has been the first to introduce e-voting. During February 14-15, 2001, the 200,000 Bahraini voters participated in referendum where they had the opportunity to express their position in a variety of national issues. As a voter's registration identification card, their CPR card was used (Central Population Registration Card) was used. The card has a significant amount of information on it that is optically encoded in a two-dimensional bar-code scheme. "The 2D barcodes on the card contain securely encrypted data to guarantee consistency of the personal information and the eligibility of the voter in a matter of seconds." [12]. The scheme is based on a technology developed by Symbol Technologies, Inc. [13].

3.3 Saudi Arabia

The Kingdom of Saudi Arabia makes extensive use of the Web as a bulletin board, with the most visible e-government effort being the creation of a special website serving the informational needs of the Umra pilgrims. Initially designed as an extranet for use between the Saudi Ministry of Hajj and the travel agent and tour operators, it is eventually growing into a major portal for all related services, such as visas, and travel and accommodations reservations. The site's mission is "... to fully exploit the emerged driving force of the Internet technology ..." for the logistical support of the Umra pilgrimage [14].

3.4 Qatar

The Emirate of Qatar has launched a thirty month e-government effort designed to e-enable all government. The starting point is a pilot program addressing the renewal of the resident permits. The project was implemented within two months, opening the way for similar initiatives in other operations, such as passports and other permits. The Qatari vision goes beyond the Web replication of the G2C and the G2B operations aiming at "... e-knowledge ..." delivery [15].

The Qatari government already has a large database with a single view of the individual. This is, an

individual's file that contains all aspects of the G2C relationship. The objective is to extend access to such files to all government agencies, and to have all government agencies make relevant data contributions to that master database. The vision includes the use of additional front end delivery channels, beyond the Internet, such as kiosks and SMS via mobile phones. While there is budget and determination to realize numerous e-government projects, *"There is a curve involved ... (and) more experience ... (to be gained before) ... rolling these systems out."* [16].

3.5 United Arab Emirates

The United Arab Emirates, especially the Emirate of Dubai, stand as the undisputed leader in e-government, where the *"... the crown prince has launched his own web site, <http://www.sheikhmohammed.co.ae>, as a platform for Internet technology and digital medium for facilitating contact between the leader and his people."* In Dubai, among the numerous initiatives, one of the most ingenious ones is the use of the Internet for the completion of tourist visa applications, where the application when printed displays a computer readable two-dimensional bar code that represents the entered information. As a result the associated staff was reduced to half, while the application processing time decreased from days to hours. *"In the high season this can run at over 3,000 visas per day"* [17].

In Dubai, a program has been implemented where citizens can subscribe with the police department and receive *"... up-to-the-minute traffic reports ..."* and other information via SMS (Short Message Services). Another high tech service is the department's WAP site. Here, citizens can scroll through it, viewed on their cell phone, and find information needed on the road, such as the nearest police station. The department also has in its website link to the stolen cars database, kiosks located in shopping malls where motorists may find out if they have any outstanding speeding tickets entered by the radar cameras [18]. Dubai has also introduced an e-wallet called *m-Dirham*, after the name of the country's currency. In this scheme the citizen deposits money in a third party financial institution from where transfers can be electronically made to pay permit fees, fines and the like [19]. In an effort to integrate the woman in the mainstream of employment, several IT training programs are being implemented in the Arabian Gulf, including one in Dubai in cooperation with UNESCO, addressed to women. Indeed, *"Technology presents immense opportunities for women to make productive use of their talents without breaking the conventions of society."* [20].

The above is only a sample of the long list of currently operational e-government projects undertaken by the Dubai police department. It is apparent that the Dubai e-government initiative is one of the most citizen-centric regional efforts serving as an example not only in the Arabian Gulf region but worldwide.

3.6 OMAN

The Sultanate of Oman is currently implementing a *holistic* approach to the *e-Xxxxx* moving *"... towards (an) e-Oman (strategy), which consists of e-government, e-commerce, e-learning and other e-services,..."*. After having realized the breadth and the depth of the needed technological and change-managerial skills, the Omani government formed an ad hoc taskforce which has sought the services of international consulting houses to lead them through the maze of e-gov design. In an effort to learn from the mistakes of others, rather than from their own, the taskforce is studying e-government implementation applied elsewhere, places like UK, Dubai, Virginia. The taskforce wants to *"... remove the stupid rules and regulations and put the whole process on the Internet."* and to serve as the e-Oman "godfather" [21].

Addressing the issue of *cyber illiteracy* and *digital divide*, Oman has initiated numerous programs on computer and Internet literacy, especially for the Omani women, hoping to at least partially bridge the gap.

4. CONCLUSION

In researching e-government in the Arabian Gulf, the main issues appeared to be:

Change Management. How the old bureaucracies will give place to the e-technocracies? How the old rules and regulations that provided importance and job security to the mandarins of the ministries will be declared irrelevant in today's globalization?

Cadre Creation. The realization of any e-government requires a hard core of *techies* to design and develop the e-government and an army of IT savvy civil service to use the e-government machinery. Where will the former come from and how will the latter acquire that IT savvy?

Public's Cyber Literacy. When a government builds a superhighway, soon after its completion the motorists flood it; it is because they have a car and know how to drive. On the other hand, when a government builds its e-gov superhighway will the citizens use it?

In closing, in the Arabian Gulf, the e-government vision is slowly, but surely and steadily, becoming a reality creating a trilateral *win-win-win* situation for all – the government, the business and the citizen. Giving the credit where it belongs, it must be stated that the Dubai e-government is the asymptote model all others try to reach. But, how can an asymptote be reached when it continuously attains higher and higher levels?

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http://www.symbol.com/news/pressreleases/pr_releases_inter_dubai.html
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TO BE, OR NOT TO BE CONNECTED

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ABSTRACT

In the debate of today concerning the Internet, e-democracy, e-governance and the private use of ICTs, Information and Communication Tools, a note of warning is often struck for 'the digital divide', 'the digital gap' or 'the digital borderline'. Whatever the expression, the intention is to pronounce the differences in access to ICTs. A main reason to pay attention to this question is the endeavour from both the public and the private sector to transform services to digital ones. The question of access to public services and information is a crucial factor both to succeed with this transformation and to fulfil the democratic values. When access to ICTs is talked about, the focus is mostly put on a physical or technical level. Conclusions concerning the use are often based on official statistics regarding the number of computers or Internet connections in a country. The problems with these conclusions, which are used to legitimise the implementation of public systems, are that they do not consider other factors among the potential users like attitude or confidence. These issues, related to the individual, are necessary to take into account in the decision process. This short paper starts from Clement and Shade's "Access Rainbow" (Clement & Shade, 2000) and suggests a direction for a study concerning driving forces and barriers related to the individual's experience of access to ICTs.

KEYWORDS

ICT, access, digital divide

1. INTRODUCTION

Since a couple of years there is a feverish activity going on in the USA and in the EU, among other countries, to make more and more services and information accessible via sites on the Internet. This activity could be found in both the public sector and in the private one. Sweden is one of the countries where the government has expressed the ambition to create the 'information society for all'. To reach there it is necessary to bridge 'the digital divide', 'the digital gap' or 'the digital borderline'. The term could vary but the meaning is the same. Cullen (2001) writes "the 'digital divide' has become a convenient metaphor to describe the perceived disadvantage of those who either are unable or do not choose to make use of these technologies in their daily life." A short definition of the 'digital divide' could be the differences in access to the digital technology.

2. THE ACCESS CONCEPT

The access to ICTs has more or less the status of a civil or/and democratic right in Sweden and in other highly computerised countries. The Swedish Government writes in a bill "if not all citizens have access to the new technology, or are capable to use it, it is hard to talk about a satisfactory democracy. ...There is a risk for an increased segregation and for a growing permanent information underclass." (2000, author's translation).

The question of the ‘digital divide’ deals with differences in access to the technology. The content of the concept is dependent on the context, which implies that the picture varies with the perspective of the observer. The focus in the debate is often on the physical access or what is provided, which of course are necessary ingredients but far from the only ones. The official statistics concerning the ICT use in different countries show, primarily the number of Internet connections and personal computers. How, by whom and why they are used could be a very different thing. Hague and Loader (1999) claim that “providing physical access to ICTs is one thing; giving citizens good reasons to want to make use of them is quite another.”

2.1 A treasure at the end of the ‘Access Rainbow’?

Clement and Shade (2000) states that it is difficult to define access, and raises three main questions to address: a) Access for what purposes? b) Access for whom? and c) Access to what? They present ‘The Access Rainbow’, a 7-level conceptual model of access to the ICI, information/communication infrastructure. The model provides a basis for a definition of ‘universal access’, and points out how to reach there. In the figure below, the ‘Access Rainbow’ covers the environmental level that includes the aspects of how to provide access. The individual level deals with how the provided access are accepted and experienced by the individual.

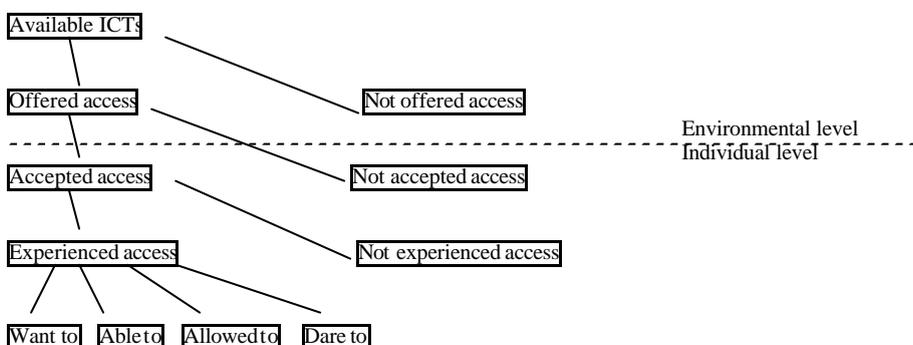


Figure 1. Elements influencing experienced access

The most commonly used pair of notions to describe the differences in access is “*haves*” and “*have-nots*” (e.g. Boyd, 2002; Carveth & Kretchmer, 2002). The problem, or the shortcoming, with this dichotomy is that it just describes the possible physical access to ICTs. More seldom, even if they are at least as important, do the dichotomies “*want to/not want to*”, “*be able to/not be able to*”, “*be allowed to/not be allowed to*” and finally “*dare /not dare*”, occur. That it is important to be aware of the latter dichotomies is underpinned by reports that show that physical access is not the same as the factual use (e.g. Selg, 2002). In the same way that it is not enough to have a car in the garage, to know how to, want to, being allowed to, or to dare to drive it, an Internet-connected computer at home says nothing about the use of it. It is possible to study each of these dichotomies separately, but such a study will not be meaningful because of the interrelations between them. A study of one dichotomy at a time may give an answer to the question *How many?* but not to the necessary question *Why?*

In order to *want to* use it, you must in one way or another be convinced of the benefits or the necessity of the use. This conviction could be based on knowledge or belief. The benefits could be economic or something else that makes your life easier or better. Efring (1999) introduces the concept of useworthiness, which is “the individual user’s assessment of the extent to which the technology meets the user’s high-priority needs.” No one else than the user can determine what is worth using for him or her. Aspden and Katz (1997) claim “[a]s to reasons for using the Internet, socio-personal development appears to be the key driver, while nonusers have a decidedly different set of beliefs about the value of the Internet”. Selg (2002) argues that conclusive for the decision to use or not to use the Internet is the medium surplus in relation to alternative courses of action. The will may be dependent of the knowledge, but could also be influenced on

by attitudes. Some people make a conscious choice not to use the technology despite the fact they have the physical access and are able to use the technology.

To be able demands at first that you have the physical abilities or the means of assistance that is required to handle the computer. Further, you need the knowledge: both how to handle the equipment and also how to find the information or the service you are looking for. In a report from the ICT commission, (Selg, 2002) the author states that the totally dominating obstacle for using Internet at home could be found in technical deficiencies. Knowledge how to use the information or the service is also necessary. Harris (1996) names this "the information capability", i.e. the capability to get and use information for your own needs. He argues that it requires more than access to the information: you also need to be conscious about its existence, how to get it, and how to use it. *To be able* also includes the economic aspect: you must be able to pay for the access in some way.

To may, or to be allowed to use the technology, describes the fact that there is nothing that limits the use, i.e. laws, rules or other constrains. *To be allowed to* also include unwritten constrains: e.g. that parents are free to use the computer placed in the children's room, that every member of the family has the same right to use it, or that public access points are not occupied all the time. Social, political, religious or cultural constrains could also restrict the feeling of being allowed to access. According to Rogers, (1995) the acceptance and the use of new technology are largely influenced by social factors. Even if the innovations are excellence or have high quality, they will not get the wanted acceptance if they interfere with the dominating norm system.

To dare to use the technology addresses the fact that many people feel uncomfortable or have a fear of using unfamiliar technology or in some ways also familiar ones. In a study including 1056 respondents, made in 1998 by SCB by order of Telia AB, 51% stated that they sometimes felt a fear of using new technology (Norlin, 1998)

3. CONCLUSION

I will argue that it is not risky to state that the ICTs are here to stay. Used in an appropriate way the technology could provide many advantages for both the society and the individual. This will raise the two questions how to use it, and how to make sure that everyone who wants experience that he or she has the possibility to use it. This paper addresses the latter question, or the experience of access.

To have access to public service and information is a civil right in a democratic society. The way the access is given or offered varies a lot depending on the type of service or information. The focus here is on the access to Internet-based public services and information. As shown above the concept of access to ICTs is a broad issue that requires a careful consideration of many aspects. One thing is clear: the official statistics regarding the number of computers or Internet connections in a country will not give us a true picture of the actual use or the level of access. For a public service, this question not only crucial in reference to democratic values, but also for economical reasons. It is not meaningful, or justifiable to spend public resources on something that will not be used. The question of having access or not is dependent on the context but also on the individual's own view. Disregarding the technical aspects, personal aspects like e.g. attitude, unwritten rules and confidence with the technology play an important part if we experience that we have access or not. Nevertheless even if we take all the factors mentioned above into consideration, it is only the individual himself or herself who can conclude if he or she has the access to the tool, the information or the service.

This raises a new question concerning how to measure or estimate the level of access in a presumptive target group? It is not the intention to answer that question here, but two notions will introduced that could be useful to the continuance of this work. These notions will be used a forthcoming study, which hopefully will confirm the usability of these concepts.

The first one is *accepted access*. This will refer to those who have an Internet-connected computer at home, or those who have a user account at work, at school or in a public place. The notion includes everyone who has furnished oneself with a PC and an Internet connection, or an Internet account. The accepted access will not say anything about the actual use, only that the person has acted in some way to get the Internet access.

The second one is *experienced access*, which refers to the individual's sense of being an Internet user. The access could be both provided and accepted but for some reasons not experienced. These reasons are grounded in circumstances referring to the individual's own situation and in his or her frame of reference. To find and understand these factors are probably a valuable brick in the bridge over the 'digital gap'. It could also contribute to point out the direction for the efforts intended to increase the participation in the information society. Maybe this is the 'pot of gold' at the end of the 'access rainbow'.

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AN INVESTIGATION INTO PREDICTIVE METHODS FOR HANDOVER IN A CELLULAR IP NETWORK

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ABSTRACT

The next generation of access technology will ensure wireless connectivity to any one at almost any location using wireless access technology. While Mobile IP is an established technology and is a macro mobility technology, Cellular IP is a sub-division of this and is known as a micro mobility technology. With device portability the communication device moves, with or without the user. Many mechanisms in the network and inside the device have to make sure that communication is still possible while it is moving. Apart from signaling across the wired network, resources have to be employed to accurately track the mobile user. This tracking of the user is inefficient in terms of bandwidth and power consumption. A number of movement prediction methods to alleviate this problem have been proposed for cellular networks. In this paper we will examine three of these and compare them in relation to their application to Cellular IP users.

1. INTRODUCTION

Although Mobile IP is a powerful Internet mobility protocol that scales reasonably with the number of users in a network, it presents some weaknesses for frequently migrating hosts. Specifically, after each host migration, a local temporary address must be obtained and communicated to a possibly distant home agent. This significantly disturbs TCP connections while causing network-signaling overload. The simplest way to alleviate this weakness is to introduce hierarchies into the IP mobility infrastructure. A hierarchical IP mobility management scheme specifies that host mobility should be handled where it originates, namely in the access network. Recent initiatives in the IETF focus on standardizing some micro-mobility protocols that will support IP mobility in an access network, while inter-working with Mobile IP in a hierarchical way in order to support wide area mobility. Cellular IP is such an approach, which combines the efficiency and scalability of IP with inherent features found in cellular networks, such as seamless handoff support, passive connectivity and paging as proposed by Valko et al (1999). There are many approaches when it comes to solving the handover issue in traditional cellular networks. One method is to predict potential future cells to reserve resources and forward data to the right base station (BS) prior to the arrival of a Mobile Host. Although predictive approaches have been used for ATM wireless networks for a long time only recently has this method been considered for cellular networks of the 2nd as well as 3rd Generation. This paper aims to provide an overview of three of these suggested approaches and their adoption to Cellular IP networks.

2. PREDICTIVE METHODS FOR MOBILE MOVEMENT

The frequently used assumptions described by many papers on movement predictions focus on the physical movements of users as outlined by Bauer et al (2002). These do not really pay attention to user mobility from the perspective of a wireless network. What is required in a wireless system is for the mobility prediction scheme to predict the network access point through which the mobile user will connect to the network, i.e. the cell/base station to which the user will next connect. In an ideal environment the handover would be to

the closest base station. However base station overloading and anomalous propagation effects frequently result in handovers to base stations other than those adjacent to the current cell. Handover methods adopting predictive approaches is mostly based on forecasting potential future BSs using mobility patterns and probabilistic predictions. They rely on the majority of users following movement patterns that can be predicted with reasonable accuracy. In order to perform this task the system requires information on the cells individual MHs have visited in the past. However this information has to be collected over a sufficiently long period of time to reflect user behaviour. The following section briefly outlines three predictive methods for handover.

2.1 Adaptive User Mobility Prediction Algorithm

This algorithm proposed by Chan et al (1999) proposes to limit the reservation and configuration procedure to a subset of cells around the user. The viability and effectiveness of the proposed scheme is then demonstrated through a simulation based on measured data. If the movement of a user is known, the reservation and configuration procedure can be limited to the regions of a network a user is likely to visit. To determine a user's movement patterns in wireless mobile networks, the base station ID that a mobile user was connected to was logged as a user drove between the central business district of a city to one of its outer suburbs. All inbound and outbound trips followed the same highway and were repeated during office hours for five days. Most mobility modeling schemes in the literature would consider this to be a one-dimensional handover issue. That is, the movement traces of this user should indicate either a track or circle pattern with high tendency of re-occurrence during each trip.

2.1.1 Differences between Actual Call Traces and Conventional Mobility Models

It was shown that large proportion (30% - 95%) of handover events have excessive variance compared to the ideal forward-backward model. By comparing the inbound and outbound movement traces separately, it was found that most "random components" of the traces came from the Ping-Pong effect between adjacent base stations or some temporary handovers to other base stations relatively far apart (i.e. not neighbouring base stations). The authors believe that the above effects are caused as a result of a combination of signal fluctuations, constraints of the surroundings, congested cells, and moving obstacles. A simple example of the differences between the user mobility patterns and the user behavioral patterns are illustrated in Figure 1.

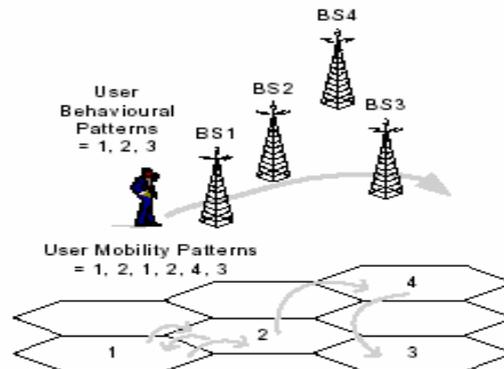


Figure 1. Differences between user behavior patterns and user mobility patterns.

The use of conventional prediction algorithms were found to be inaccurate when traffic patterns such as outlined above was presented. The adaptive user mobility prediction algorithm is defined as follows: A prediction is derived from a probability distribution of all possible next moves. If the first predicted cell does not contain a probability higher than the Prediction Confidence Ratio (PCR), one or more extra cells will be added to the group of cells in which resources will be reserved in advance and services will be pre-configured. This process will continue until the sum of their probabilities exceeds the PCR. Applying various PCR values to the prediction of cellular call traces, a high prediction accuracy rate has been obtained.

2.2 Predictive Channel Reservation Scheme

The PCR scheme proposed by Chiu et al (2000) is motivated by the GPS/GSM-based real-time positioning technology, which has progressed rapidly and is expected to achieve great success and popularity in the near future. In the original PCR approach, we assume such positioning technology is deployed so that current position and orientation of each active MS can be measured and sent to current BS. The BS then uses the position/orientation information to calculate the projected future path of the MS. Based on the projected path, the predicted next cell, which the mobile is heading to, is determined. When the MS is within a certain distance from the next cell, the current BS sends a reservation request to the new BS to reserve a free channel for the expected handoff call. A request to cancel the reservation must be sent to the new BS, in case that a reservation becomes invalid at a later time, which is called false reservation. There are two types of cancellation as explained below. Motion Cancellation: This type of cancellation occurs when an MS deviates from its predicted path and starts heading to a new next cell rather than the original one, which has successfully reserved a channel for the MS. Termination Cancellation: This type of cancellation occurs when the ongoing call, which has successfully reserved a channel in the new BS, terminates before the mobile reaches the boundary of the next cell.

The predictive channel reservation scheme in general pre-allocates only one channel as a result of the prediction. This is a major advantage since channel availability is not degraded. The computational overhead involved in the prediction part of the scheme is minimal, due to the fact that a simple dead reckoning algorithm is employed to carry out the extrapolation. According to the author this algorithm is not computationally intensive, and should therefore not be regarded as a drawback of the scheme. This is especially true when it is considered that the computations are carried out by the more powerful base stations rather than MHs. The PCR method represents a simple scheme that maps a reserved channel to the MH that made the reservation request. Since this incorporates a rather rigid concept, Chiu et al. suggested different modifications to the original scheme to improve the performance properties. These modifications improved the performance properties but need to be investigated in more detail.

2.3 Movement Prediction using Multi-layer Neural Networks

This scheme as proposed by Kumar et al (2002) is designed to predict future movement of a mobile host using a Multilayer Neural Network (MNN) model. The MNNs are trained with respect to the data obtained from the movement pattern of a mobile host for making predictions. The performance of the method has been verified for prediction accuracy by considering different movement patterns of a mobile host. The simulation has achieved an average of 93% prediction accuracy for uniform movement, 40% to 70% for regular movement and 2% to 30% for random movement patterns of an MH. The proposed method for mobile movement prediction (MMP) is based on the mobile host history of movement patterns, which has been recorded for a certain time duration. Multilayer neural networks are used to process the mobile movement pattern for accurate prediction of mobile movements. Before discussing the method, we present some of the definitions used in this paper and the neural network training procedure which has been implemented for MMP.

Training data set is the set of sub patterns obtained from the movement pattern pn by partitioning it into $n - k$ sub patterns, where $k + 1$ is the size of each sub pattern ($k \ll n$). The sub pattern is a training data pair with mobile movements for k time intervals as input and the movement for the next time interval as a desired output. For example, the first training sub pattern is $p1, p2, ..pk$ as input and $pk+1$ as the desired output. The parameter k is the prediction order or time window, which is chosen based on the movement characteristics of a mobile host and the size of the recorded movement pattern. Table I below shows the training data set obtained from the movement pattern of $p10$ and $k=4$.

Table I. Training data set

Subpattern	Input ₁	Input ₂	Input ₃	Input ₄	Desired Output
1	p_1	p_2	p_3	p_4	p_5
2	p_2	p_3	p_4	p_5	p_6
3	p_3	p_4	p_5	p_6	p_7
4	p_4	p_5	p_6	p_7	p_8
5	p_5	p_6	p_7	p_8	p_9
6	p_6	p_7	p_8	p_9	p_{10}

The multilayer neural network devised for mobile movement prediction is based on the back propagation learning algorithm by Haykin, (1995). Here, the neural networks are trained with respect to movement pattern for learning optimized functions for predictions. The role of the neural networks in this application is to capture the unknown relation between the past and the future values of the movement pattern. This helps in predicting the future location of a mobile host for location management.

3. CONCLUSION

There are many problems with existing methods with a lack of accuracy in the prediction of future movement. Some of the more complex algorithms suffer from an excessive processing overhead, which renders them untenable as practical solutions. Such schemes lack the combination of simplicity and effectiveness needed to support future mobile developments, such as Cellular IP. The first algorithm examined, as proposed by Chan et al (1999), shows clearly that there is a large discrepancy between the user mobility models that have been reported in the literature and actual system movements. The second scheme examined as proposed by Chiu et al (2000) is a simple scheme that does not require large computational overhead. However its prediction accuracy has not been proven and it will require modifications to improve its performance. The search for efficient paradigms for prediction is an ongoing one, for which the use of adaptive learning methodologies based on neural adaptive learning as proposed by Kumar et al (2002) in the third scheme examined, offers a possible development path for Cellular IP movement prediction. The advantages of such an approach are obvious – the long term nature of cellular networks lends itself to adaptive learning, neural methods will allow very rapid calculation of predicted routing; and the group mobility of users can provide a realistic data set on which to calculate predicted paths. With Cellular IP, the issue of rapidity of handover is about to assume critical importance for the successful deployment of such systems within the user space. My investigations into user movement prediction in relation to micro-mobility technology is being carried out using the well established Network Simulator 2 (NS2) , a tool that produces a movement pattern using the random way-point algorithm [ns]. From this I can examine the various algorithms for path prediction as outlined above. This work is ongoing and is reflected in the content of this paper which has looked briefly at just three such movement prediction schemes.

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CONTEXT DEPENDENT SERVICES IN AN M-LEARNING ENVIRONMENT: THE PRINTING CASE

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ABSTRACT

We study a context-dependent problem that arises in an m-learning environment: how to print a document when being in a generic place. We implement a working solution, and argue about the general value of our approach. We examine the printing problem because it has a practical value, and at the same time it turns out to be a prototype for a class of other problems that can be encountered when moving from e-learning to m-learning.

KEYWORDS

m-learning, printing, location-dependent services

1. INTRODUCTION

“m-learning” is one of the successful buzzwords of the beginning of the millennium. It combines the promises of two very promising fields: e-learning and mobile computing. E-learning is growing at a very fast rate: nowadays most universities have at least some degree of support for e-learning, companies are investing in the field, and the need for continuous education pushes for e-learning solutions. On the other hand it is likely that mobile telecommunication will continue to grow and to add new services. Competing and complementary wireless technologies like wireless LAN, Bluetooth, GPRS and UMTS will multiply potential handheld applications. IDC forecasts that 63 millions handhelds will be sold by 2004, and that approximately 38% of them will be smart phones, integrating PDA functionality with features for communication. Most mobile clients will support Java (J2ME) making it easier and less costly to develop portable applications. Given such scenario, forecasting the success of m-learning seems to be an easy bet. It is more difficult to understand in detail how m-learning will help reaching the goals of a better learning, and how it will be different from the rest of e-learning. According to the literature [Zobel 2001, Steinberger 2002] successful m-learning will be characterized by the following properties:

5 minute value: the ability to use small fragments of time (e.g. waiting time) for learning (e.g. doing quizzes, using a discussion forum, communicating, reading material);

Simplicity: the limited display and input capabilities of the mobile devices make it difficult to use rich (e.g. complex and multimedial) documents using a PDA-like interface: it is therefore not useful or practical to transpose a power-point presentation on a PDA;

Context dependent information: the dependency can be relative to:

- location context; i.e. the system knows the location where the learner resides and adjusts to it;
- temporal context; i.e. the system is aware of time dependent data;
- behavioral context; i.e. the system monitors the activities performed by the learner and responds to them adjusting its behavior;
- interest specific context: i.e. the system modifies its behavior according to the user's preferences.

Examples of context-dependent systems (although not related to m-learning) are:

- o Tourist information systems, like GUIDE [Cheverst 2000] and CYBERGUIDE [Abowd 1997]: these systems offer information to tourists, taking into account their current location.

- o Context-aware messaging systems that trigger actions according to a specific context, like the ComMotion system [Marmasse 2000] which links personal information to locations and generates events (e.g. sound or message boxes), when a user moves to a certain location. Other such system are CyberMinder [Dey 2000] and Icron [Heidmann 2000]: they allow the user to define more complex conditions, like time-and-location dependent conditions.

- o General utilities, like “Friend finder”, “GeoNotes”, “BusLocator” [Nord 2002]

We experiment with such requirements, addressing a simple task that is often necessary in all e-learning environments, and that is in general taken for granted: the ability to print a document. This quick, simple task (if performed in a non-mobile environment) becomes less trivial when performed from a mobile device, like a palmtop/laptop equipped with a wireless-LAN card. We show that this apparently trivial task contains elements that constitute a template for other problems that can be experienced when approaching e-learning from the mobile side.

2. THE PROBLEM AND POSSIBLE SOLUTIONS

“Printing on the nearest suitable printer” contains elements that can be found in many other mobility-related problems. Let’s first examine the traditional printing process: printing happens from any application, and uses services that are provided by the (local) operating system (OS). The user typically interacts with the OS through some API to choose his/her favorite printer. In general, a default printer is chosen once, and kept until some special need arise. If the printer is on a network, the OS is in charge of managing the network interface so as to be able to talk to the printer and pass the task to it.

If the computer is mobile, then we need to adapt to the location and to other conditions: such adaptation needs to be based on some space-time-dependent data, and might be performed on a local basis, or on an external resource (a server). So we add at least two functional elements: the discovery of time and location, and the decision of what to do on the base of the contextual data, possibly accessing also the user’s preferences. Although such process might also involve behavioral data, we will not discuss in great detail this aspect.

Let’s state the problem in some more detail. When a user wants to print from her mobile device, the system needs to find which is the most convenient accessible printer, inform the user about the choice, optionally allow her to modify this choice, and finally print the document, optionally allowing the user to monitor the status of the printer queue. (Note that by changing the words “print” with “use a service”, and “printer” with “service provider” one maps this problem to a general one, and therefore this problem is prototypical for a class of other location-dependent problems).

“Finding the most convenient accessible printer” means performing two steps. The first is to gather information about location, time, behavior and preferences. The second is to choose the resource that best suites to needs.

Location is important because one needs to find the nearby printers. Time might limit the availability of some printers (some room might be locked at night or during week-ends). Behavior, i.e. knowing what the user is currently doing, might require a black and white printer if the user is reading a text-only document, or a color printer if the user is looking at pictures. Preferences might involve opting by default for cheaper services at expenses of print quality, or vice versa, etc.

Once this info is available, one needs to use it to find the resource. Therefore, the characteristics of all printers must be known, and matched against the requirements posed by the context. In principle, all the info about the printers might be kept on the mobile device, at least if mobility is limited, and if data are not so massive that they endanger the availability of the device’s precious memory. One might also imagine that when moving to a different environment (e.g. to another building) the mobile device could discard all the info regarding the previous environment, and download the info relative to the present surroundings. However, such approach might miss real time info, like the current load on a printer, producing poor choices (it is probably better to walk a few more steps to an empty printer, that quickly reaching a busy one). A second possibility is hence that info about the printers is kept on some server: the mobile client could contact

the server passing its own context info, and getting back the indication of the chosen printer. The main drawback of having a centralized server is the scalability of the solution, in terms of performance (the central server becomes a bottleneck), reliability (the server becomes a critical single point of failure) and geographic scale (it makes no sense of thinking of a central server that knows about all printers in town). One can overcome these weaknesses in a standard way, i.e. by having a federation of servers (each being responsible for a sub-region, and being able to forward requests to other servers) with some degree of replication.

Another issue has to be considered. In order to be able to perform a print, the mobile device needs to know about the printer, i.e. it must have a driver for it. This makes life complex, because we need to foresee in advance which printers will be used, that again is not practical. One could think of downloading on demand the needed drivers, but sometimes installing a driver requires rebooting the machine, so also this solution is not sensible. To avoid the problem, we might ask the server to print on our behalf. After all, this is what is typically done in a multi-user OS, where printers are never directly accessible by the users (to stay away from nasty concurrency problems), and has the advantage of enabling accounting and permission checking.

Asking the server to print can take two roads: either we pass to the server the current version of the document, and the information about the application that is using the document, or we pass a printable device-independent version of the document (such as a postscript file). The first option is again not convenient, since it requires the server to carry all possible programs, and to start them when necessary (further limiting the usability of servers running OS A (e.g. Linux) from machines using OS B (e.g. WindowsCE). The second is feasible: for instance it is possible to print Postscript files also on non-Postscript printers, e.g. using (on the server) the Ghostscript program that is available for different operating systems. All that is needed on the mobile side is a printer driver that produces a Postscript file: a requirement is easy to comply with.

At this point, what we call “printing” on the mobile device actually means “1-print the document to a postscript file”, “2-pass to the server the context information and the generated file”, “3-have the server choose the printer, send the postscript file to it, and pass back the info about the chosen printer”. One last problem remains open: all this should happen when the user chooses the “print” menu item. This means that one should write a (pseudo) printer driver that, when invoked, performs all these actions. This is certainly possible, although it requires digging in OS-dependent technical details.

A less convenient but more straightforward solution is to explicitly perform the above sequence in two steps: first one prints to a postscript file, and then one explicitly asks the server to print it. A way to do it is through web pages: the mobile client contacts the server via HTTP through a browser. The server provides a form in which the user specifies the name of the postscript file. The form then triggers an active component (e.g. a servlet) that opens a socket to the client to retrieve the context-dependent info and the file, and after choosing the best printer prints the document and reports the choice in an HTML page that is returned to the mobile user. Of course, we have here implied that the mobile system is able to provide a service via socket to pass the context-dependent info. As an alternative, one could pass all this info through HTTP.

We implemented and tested this last solution, and we are working at the implementation of the most complete and convenient option, namely the one that is completely transparent to the user and that is based on the pseudo-printer driver.

As far as the positioning systems is concerned, we note that many possible solutions were provided in literature. Due to space constraint, we cannot discuss them here: we only note that we believe that the most convenient systems are the ones that do not require additional hardware or infrastructure. We therefore experimented with a system [Battiti 2002] based on the strength of the IEEE811b signal coming from different antennas, that uses available hardware and infrastructure, and therefore requires only adding a software layer. In a conceivably wireless networked city, such method would work indoors and outdoors.

3. GENERALIZATION

We have seen that the printing problem can be mapped on a more general one, where the focus is on providing some context-dependent service, while using basic services provided by the infrastructure (e.g. by the OS, or by a Learning Management System).

The idea is to insert a software layer between the service requestor and the service provider. As we discussed, such software layer should in general refer to an external server for at least two reasons: the mobile component cannot be aware of all possible settings that are available in different places, and the optimal choice might depend by factors that could be dynamic, and therefore unknown by the mobile component. The external server must obtain context data from the requestor. At this point two choices are possible: either the server fully provides the customized service, or it provides a “meta-service”, i.e. it only identifies the best option and then passes this information back to the requestor. The requestor then performs the actual customized service. In some cases (like in the printing problem) this last solution might be highly unpractical; in other cases however it might be a viable solution, and might even be preferable since it diminishes the workload on the server. As we have seen, implementing this middleware in a seamless way can require digging into technical details of the infrastructure (e.g. of the OS). In the particular case of the printing, it required writing (or at least modifying) a device driver, that is not a trivial task. In other cases, like for instance in the case of a service provided by a Learning Management System, it might mean entering in the (possibly proprietary) code of the infrastructure providing the service: a possibly prohibitive task. In such cases one can fall back to a less convenient, two step process: through the notion of a stub one would then use a local instance of the needed service (i.e. one might have an actor on the server that asks for a local service on behalf of a remote, mobile user).

4. CONCLUSION

We implemented a working solution to a context-dependent problem that arises in an m-learning environment: how to print a document from a mobile device when being in a generic location. Of course, this particular problem is non *specific* of the m-learning domain. However, besides having a practical value also in this particular domain, we believe it is relevant as being a *prototype* for a class of other problems that can be encountered when moving from a traditional environment to a mobile setting. We believe that the logical organization of the solution we propose can therefore also be transposed in such cases.

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PRESENCE IN COMPUTER-MEDIATED ENVIRONMENTS: A SHORT REVIEW OF THE MAIN CONCEPTS, THEORIES, AND TRENDS

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ABSTRACT

Computer mediated environments present nowadays one of the key areas to the application and use of technology in work, leisure and education. It offers a number of opportunities to redesign the way we work, how we produce knowledge and collaborate with others. It also has some degree of influence in the way we manage information and perceive information generated by others. A number of e-applications that we must built need to be informed by a number of requirements that we can summarise as cognitive ones. Among these is the notion of presence.

This paper presents an overview of the concept of Presence. This concept was proposed around the 90s to describe “the sensation of being there” in computer-mediated environments. It offers one of the many opportunities to explain how engaged people are with the use of technology.

The authors introduce the notion of presence in order to address their impact on applications and the way it can be found and be identified. This work was performed as a part of the European project Presence: Measurement, Effects and Conditions (IST-2001-37661), whose partners are Hannover University of Music and Drama (Germany), Ludwig-Maximilians-Universitaet Muenchen (Germany), Helsinki School of Economics (Finland), University of Zurich (Switzerland), and University Fernando Pessoa (Portugal).

KEYWORDS

Presence, presence theory, computer-mediated environments

1. INTRODUCTION

From the early 90s, many authors have tried to elaborate a consistent theory about presence. During all these years there have been several attempts to define the concept and there have been made many advances with some measurement proposals; however nowadays yet a long path must still be worked on. The fact that researchers from multiple areas are involved is enriching but it carries certain difficulties as well, especially when trying to join perspectives and find a common language. Despite different points of view are checked, a review of the literature produced until now shows us already certain consistencies. Thereby, many researches start off from the attempt to create a definition of presence. The link point between them all is an attempt to create a solid theory about presence which includes a definition accepted by all and suitable means of measurement.

2. PRESENCE FROM THE CONCEPT

Most of authors agree with the definition of presence as “the sense of being there” especially when it is related with virtual reality. Even that, when the purpose is to explain what means “being there” or which variables provoke this subjective sensation, agreement is not so general. Then, most of the authors begin to assert the existence of some specific dimensions.

Heeter (1992) considers that the concept of presence includes a personal dimension of more perceptual nature, another social one based on the existence of others and the interaction with them, and another environmental one referred to the capacity of interaction and modification of the environment. Biocca (1997) also emphasizes three means or dimensions, the first two being coincident with the dimensions pointed out by Heeter, but not the third. For Biocca, beyond the physical (perceptual) and social dimension, there also exists a dimension of self-consciousness that he names *Is this body really me?* The inclusion of this third dimension is understood because Biocca is mainly focused on the use of virtual reality. He assumes that the sense of presence will come ruled by the capacity of creating *avatars* that perfectly simulate our body. About the social dimension of presence, Biocca et al. (submitted) present a point of view much wider than other authors'. They report that the sense of social presence is not only a question of knowing that other persons exist (sense of being together) and that I can interact with them (in virtual environments). For them, it is also a question of psychological involvement, that is, the sensation of having access to other's intelligence, the sensation that the others are intelligent “objects”.

An interesting question that is settled about the dimension of the self-consciousness is the fact that there exist people with injured brain areas, mainly caused by traffic accidents or apoplexy, who remains with half of their body paralysed and who loose the sensation of ownership of those body parts. This provokes that adult and intelligent persons suddenly answer negatively to the question *is this body really me?*

Others, on the contrary, feel (on the wider sense of the term) the existence of parts of their body that were cut off (for a detailed and fascinating reading of these and other cases see Ramachandran & Blakeslee, 1998; Sacks, 1985, among others).

Understanding how it affects their self-consciousness and the perception of their own self in the physic reality could teach us a lot about the physical, social and self-consciousness dimensions of the sense of presence in virtual worlds.

In her work of 1992, Heeter wonders which of the three dimensions will have a stronger effect on the sense of presence. This is, without doubt, an interesting question that even now has no answer.

In their review of the literature, Ijsselsteijn et al (2000) point out only two dimensions: one physical and another social, and they consider the *immediacy of interaction* as the link point of both dimensions. In reference to the link point asserted by these authors, it would be explanatory to try to analyse what other link points exist. The base of this analysis is that our physical (sensorial) and social experiences are, on most cases, inseparable, so more link points should exist.

From a conceptual perspective too, Lombard and Ditton (1997) make a brilliant and explanatory review of the literature in which they emphasize six different conceptualisations of presence:

Presence as social richness (Short et al, 1976; Rice, 1992): the sense of Presence is determined by the fact that the medium is sensed as sociable, warm, sensitive, etc. Here, the key concepts are intimacy and immediacy. Some questions could be taken into account: What happens with autistic and sociopath people

when they interact with the real world? Do they feel it as intimate and immediate? Do they feel it sociable, warm and sensitive? Do they feel themselves present in it?

Presence as realism (Neuman, 1990): the sense of presence depends on whether the representation of objects and persons in the medium is conceptually realistic and socially plausible. Again, we could ask: What happens with people who have some sensorial areas of their brain harmed? Do they stop feeling presence in non-mediate environments?

Presence as transportation (Reeves, 1991; Lanier & Biocca, 1992; Slater & Usoh, 1993; Kim, 1996): in this sense, *transportation* is understood as “you are there”; “you are here” and “we are together”. The sense of presence will depend on the intensity of this transportation. Are there objective means of checking this transportation? Do cognitive correlates exist or will it be just an illusion?

Presence as immersion (Biocca & Delany, 1995; Biocca & Levy, 1995): this immersion is not only perceptual (the virtual environment involves all senses of the user) but also psychological (it implies that the user feels being absorbed). By the fact of this definition including the psychological aspects, this conceptualisation succeeds in embracing many others as *transportation* and realism.

Presence as a social actor without medium (Lemish, 1982; Lombard, 1995): this definition implies that the medium disappears and the user sees himself as a real social actor in a non-mediate environment.

Presence as medium as a social actor (Nass et al, 1994, 1995, 1996): in this case, the concept of Presence implies that the user responds to the medium as if this was a social actor *per se*.

After this review, Lombard and Ditton (1997) emphasize that in all these conceptions there is a main idea that they propose as the new definition of presence: **the perceptual illusion of non-mediation**. This illusion can be produced by means of the disappearance of the medium or its transformation into a social entity. The fact that it is considered an illusion implies that the user is all the time conscious of being using a medium (Lombard & Ditton, 1997). This happens precisely because the definitions elaborated until now mainly affect the purely perceptive questions and they forget the psychological ones. In this sense, which work line will be followed in the future? Will we continue trying to create technologies that simulate better each time our real world or will we also pretend to attain that the individuals do not feel only that “they are there” but also THINK that they are there? Is it possible to cheat the brain, not only its perceptions but also its consciousness?

The authors assume that the experience of presence is not (or there is no reason why to be) a continuous experience. They also assume that it is a sense that varies from one to another individual and through time. Also Ijsselsteijn et al (2000) wonder about this, asserting that one of the objectives of the future investigation is to determine in a precise way if the sense of presence is an “everything or nothing” sensation or, on the contrary, it is a gradual sensation.

Lombard and Ditton even emphasize which are the variables that are influencing the sense of presence depending on the consideration of the medium as invisible or as transformed into a social entity, making differences among these variables as being formal or technological, content variables or individual variables. But the question that remains without answer is: which of these sets of variables are sufficient and/or necessary to create a minimum sense of presence? Or as Ijsselsteijn et al (2000) question, which is preferable: a sensation of maximum presence or a sensation of optimum presence? Which is the minimum level of information needed to reproduce the real world in virtual means? (Ijsselsteijn & Harper, 2001).

3. FINAL REMARKS

At the same time that the authors try to design a definition of presence, most of them are also pointing out those mediator factors of this sense. It is important to emphasize to which extent dimensions and mediator factors can be related. Thereby, Steuer (1992) points out three basic factors: combination of sensorial stimuli, capacity of the participants to interact with the ambient (corresponding to Heeter’s (1992) environmental dimension) and individual characteristics.

Lombard and Ditton (1997) differentiate between formal features (technological), of content and individual ones. Biocca (1997) points out sensory engagement, motor engagement and coordination between both as factors of great influence on the sense of presence. Ijsselsteijn et al (2000) defend four determiners: extent and fidelity of the sensory information, the match between sensors and sensory exposition, content factors and user characteristics.

After that we could remark the need to at more studies should be done in order to provide a clear presence

theory framework. This will result on a more structured use of ongoing research to inform how better computer-mediated environment can be developed and assessed. This paper provides a brief introduction concerning those efforts to provide Presence main concepts, theories, and trends.

The existence of several lines of investigation (we only comment here the most conceptual ones) show a number of issues regarding how systems may produce a presence feeling to the user. It seems that such presence research may provide informed insight into how computer-based mediated system should be developed and what requirements they must provide in order to achieve higher degrees of user satisfaction and digital information transfer. Such research also provides an important perspective on how further studies need to be conducted in order to turn computer-mediated environments much more as human systems than just sophisticated technological devices.

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THE ROLE OF INFORMATION TECHNOLOGY IN THE DEVELOPMENT OF CORPORATE GOVERNANCE

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ABSTRACT

The recent and high profile collapses of corporate giants Enron and Worldcom have highlighted the need for robust corporate governance structures as part of any regulatory regime for companies. This paper looks at two key elements of any corporate governance regime, namely, the disclosure of information by companies and the conduct of shareholder meetings and considers whether, in a United Kingdom context, the use of information technology could assist in the development of more effective corporate governance.

KEYWORDS

Corporate governance; Information technology.

1. INTRODUCTION

Corporate governance as a concept has been described as being not concerned with the running of the business of a company but with giving overall direction, controlling the executive actions of management and satisfying the legitimate expectations of accountability and regulation. While in different jurisdictions different answers may be given to the question 'in whose interests is a company run?', corporate governance regimes seek to ensure that whatever the answer companies are run in a manner which takes account of the interests of those stakeholders. In most corporate governance regimes individuals associated with a company in differing capacities have differing roles to play in ensuring good governance. Directors have various obligations imposed upon them and shareholders act in a scrutinizing role. Whatever the role played by participants in a corporate regime their effectiveness in so doing is dependent upon the information they have in relation to the company and how debate and decision making takes place on the basis of the available information. The effective use of information technology has the potential to enhance the effectiveness of corporate governance regimes and it is now arguable that the use of such technology should in itself be an inherent feature of corporate governance regimes.

2. DISCLOSURE OF INFORMATION

In the United Kingdom and in many other jurisdictions the classical analysis of the need for disclosure of information by companies is that this is an appropriate price to be paid for the grant by the state of the privilege of limited liability status. In the United Kingdom companies are bound to disclose a wide range of information and the recent proposals from government for the reform of company law simply reinforce this position. The principal obligation under the Companies Act 1985 is to disclose financial information. Again, following the basic theory that disclosure is a price paid in exchange for a privilege the financial information which is disclosed is aimed at enabling shareholders to scrutinize and monitor the policies and activities of the directors of the company and to ensure that they are pursuing the specified goals of the enterprise. But

the range of information which companies must disclose, the use to which such information may be put and by whom, now goes far beyond the simple paradigm just outlined. Companies must disclose information on issues such as their environmental policies, employee participation, political and charitable donations and their practices in relation to the employment of disabled and ethnic minority workers. Companies listed on the Stock Exchange have further disclosure obligations imposed upon them by the Stock Exchange's own listing rules and these extend to a statement on the company's compliance with corporate governance rules. Not only do shareholders make use of the information made available by companies but creditors, potential purchasers, trade partners and a whole range of other organizations make use of the information flow from companies to meet (or attempt to meet) their own particular requirements. Two particular issues arise in connection with this flow of information.

Firstly, many companies (public companies in particular) have historically restricted their flow of information to shareholders to an annual report, press releases issued with quarterly accounts and a set-piece presentation at the company's annual general meeting. Secondly, there is no one mechanism or channel for the disclosure and dissemination of corporate information.

Some developments have taken place in respect of the first issue. The significance of institutional investors, particularly to public companies, is now widely recognized and the approach to the provision of information to such shareholders is now highly developed. Analysts and representatives of institutional shareholders are now regularly invited to briefings organized by companies with the express intention of ensuring that their so-called 'information liquidity' with such groups is high. While such mechanisms may be useful they do not meet the needs of smaller shareholders or loosely linked groups of shareholders. It is for such shareholders, particularly in the absence of a single source of information, that the use of information technology offers benefits.

Much of the information that companies are required to disclose has hitherto been made available via paper based systems. Shareholders still receive an envelope each year with a copy of the company's accounts and an invitation to attend the company's annual general meeting. The internet in particular offers a mechanism for information dissemination which would be both more comprehensive and economical. With the main emphasis being on financial information two obvious benefits would be firstly, the posting of more current information and secondly, the opportunity for shareholders to use new and intelligent analytical software to provide the types of analysis hitherto only available to specialist analysts. The emphasis on provision of financial information has largely been in relation to historic information, but companies have much more current financial information available to them and the clear route by which this should be made available is via the Internet. The crucial question is whether companies will opt to make such information available. Again a number of issues arise. The legislative approach in the United Kingdom is clearly not to compel companies to make information electronically. It is a permissive approach. The Electronic Communications Act 2000 and associated orders allow companies to use electronic means of communication but does not compel their use. Companies would therefore need to see some form of benefit or advantage to the use of electronic means of information dissemination before there is likely to be a large scale take up. There are other issues of concern. It has been argued that releasing information this way may make the company more vulnerable to competition, might attract more attention from regulatory bodies or might give rise to unwanted publicity. It has also been argued that by releasing information too quickly and regularly the risk increases that errors might also increase with an associated increase in potential liability where such information is relied upon. In fact a directly contradictory argument can be made in respect of each of these issues. That is to the effect that if in fact these issues are of concern to a company contemplating the use of the internet as a means of information dissemination then they already have governance issues that they need to address. If, for example, they need to improve their accounting mechanisms to 'weed out' any potential errors prior to posting monthly accounts on their web site then the very process of contemplating the use of information technology will have contributed towards the improvement of their own internal procedures and ultimately their standards of corporate governance. This is the type of analytical process which companies will go through in assessing whether or not to make more extensive use of the internet in the dissemination of information. The costs and benefits will be weighed and a view taken as to the most appropriate course of action to be taken. If it can be shown that a 'corporate governance audit' in relation to the potential use of the internet for information dissemination is likely to improve the quality and robustness of the information generated by the company then that as much as anything is likely to convince management of the benefits of using information technology. Until companies are compelled to use electronic means to disseminate

information it is likely that this cost/benefit analysis will be the motivating factor which will drive companies to use technology and thus in turn provide some form of benefit for shareholders.

3. SHAREHOLDER AND OTHER MEETINGS

While the internet offers possibilities in respect of the dissemination of information, the use of information technology generally offers possibilities in relation to the conduct of shareholder meetings. One of the stated aims of the United Kingdom's Electronic Communications Act 2000 was to promote and encourage electronic commercial transactions. The largely passive approach of the Act allows for the passing of orders in respect of areas of the law which need to be amended to reflect electronic practice. Such an order has been made in respect of company law. The intention of this order appears to be to allow companies to choose whatever means of communication they think fit for their companies. At a simple level this would allow companies to give notice of a meeting to shareholders by e-mail rather than by post. But this is a less than ambitious approach. A combination of existing company law and the Electronic Communications Act clearly allow for what might be referred to as the 'cyber company'.

Since the case of *Byng v London Life Association* [1990]Ch 170 it has been accepted in the United Kingdom that the fundamental aim of a company meeting, namely to allow members to debate and vote on issues affecting a company, can be achieved without the company's members meeting face to face in the same room. In that case the technology being questioned was audio technology in two different rooms. With modern video conferencing, web cam technology and possibly even 3G telephones the ability to conduct a meeting without requiring everyone to be physically present is dramatically enhanced. The whole question of a meeting can be taken even further. In the situation just considered a hybrid approach is adopted whereby a physical location, date and time for a meeting are still chosen but the means of participation may be by physical or electronic means. A more radical approach might be to consider the use of a 'virtual' meeting. In this situation there would be no chosen physical location but discussion would take place through an electronic bulletin board, perhaps in response to materials and presentations already placed on a dedicated page of a web site. This more radical approach raises more difficult issues than the earlier hybrid approach. Firstly, it assumes that all shareholders will have access to the necessary technology. Secondly, is such an approach the most appropriate way to deal with difficult and controversial issues such as, perhaps, the removal of directors? There will also be the classic problem of managing the discussion on the bulletin board.

In addition to calling and conducting meetings electronically mechanisms would also be required for voting to take place. Yet again existing company law and the new provisions under the Electronic Communications Act can be used to construct an electronic voting regime. Technology has been developed for use in local and national elections and there are no longer strong technical arguments against the use of electronic voting. It is therefore entirely possible to contemplate a 'cyber' company which conducts all its formal business with shareholders in electronic form. It seems unlikely that many companies will opt for a total conversion to this approach but will opt for a hybrid approach which employs conventional and electronic techniques at the same time. Indeed there is no reason why the use of technology in respect of meetings should not be extended. The practice of briefings for institutional shareholders has already been referred to. There is no technical reason why such a face to face briefing should not be made available contemporaneously to all shareholders.

The use of information technology in respect of meetings and formal proceedings has attractions for both the company and the shareholders involved. For many companies it will be far more economical to communicate electronically. For many shareholders it will prove possible to participate in a meeting which might otherwise have been inaccessible. Again, however, the company will have to scrutinize all the information technology mechanisms it intends to employ and satisfy itself that these are at least as efficient, secure and robust as the conventional mechanisms it already employs. If the new devices are even more effective then the standards applicable to the conventional mechanisms need to be raised.

4. CONCLUSION

The use of information technology by companies in areas such as the dissemination of information and conduct of meetings has clear advantages which will contribute towards good governance within such companies. What is equally clear is that the very process of evaluating what types of technology to use and how will cause companies to evaluate key processes which contribute towards good corporate governance. This process is therefore of itself of value to a company. Given that this is the case it is arguable that rules relating to corporate governance should require companies to review how they use information technology in respect of certain key activities such as information dissemination and shareholder communication. This approach would embed the use of information technology within the field of corporate governance.

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OPEN SDRM – AN OPEN AND SECURE DIGITAL RIGHTS MANAGEMENT SOLUTION

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ABSTRACT

Multimedia content e-commerce is one of the hottest topics in today's Internet. Since the MP3 format appeared, back in early 90's, digital music popularity has never stopped growing, increasing the number of the so-called P2P services for exchanging digital music and raising several issues in terms of Intellectual Propriety protection arising from the promiscuity of the music usage. Security measures can be applied to content, both in terms of encryption and watermarking, however these security measures aren't effective without an appropriate management of rights that can only be achieved through the use of Digital Rights Management solutions.

This paper describes and discusses one of these solutions, which is being developed from scratch in the scope of the MOSES EC R&D program, named Open SDRM, which is based on open-source components and on the distribution of information and functionalities through several Web Services.

KEYWORDS

Open-source, DRM, content, multimedia, security, rights

1. INTRODUCTION

Today's networks provide the opportunity for media content to be downloaded and distributed without difficulties. While this has meant that access for legitimate users has increased, it has also lead to a rise in the number of illegal users, who use and abuse content without any concern about its copyright. Protection and management of digital owner's rights are important in ensuring the preservation of value associated with content. Undoubtedly, digital rights management poses one of the greatest challenges for content communities in this digital age [1, 2]. With the rising demand for digital content rights protection and security that enables effective on-line trading of all types of multimedia items and, at the same time, for global interoperability of customer devices and traded material, can only be assured by a good mix of open architectures and proprietary technologies [2]. While authors and creators can see the benefits in making their

material available online, they are and will be reluctant to release their content without an acceptable protection. DRM is the chain of hardware and software services and technologies governing the authorized use of digital content and managing any consequences of that use throughout the entire life cycle of the content. DRM technology has been developed to protect the commerce, intellectual property ownership, and privacy rights of digital content creators and owners as the content travels through the value chain from producer to distributor to consumer, and, even farther, from consumer to other consumers (by consumer, we mean any recipient of the content) [7, 9, 3, 8]. DRM provides three benefits: 1) persistent protection of content through encryption, 2) expression and association of usage rules with content, and 3) enforcement of the usage rules [2, 9]. DRM technology plays an important role in the context of content rights protection and management. The DRM solution presented here is based on open-source and standard technology, called Open SDRM – Open and Secure Digital Rights Management, and is being developed in the scope of the EC RTD project called MOSES (MPEG Open Security for Embedded Systems).

2. OPEN SDRM ARCHITECTURE

The Open SDRM architecture is adaptive [10], since it can be configured for use with several business models and different types of content. Open SDRM deploys a traditional DRM solution for content rights protection and can be applied for publishing and trading of digital multimedia content. Additionally, the security architecture proposed started from the OPIMA international specifications [6], MPEG-4 IPMP Extensions [5, 13] and the emerging MPEG-21 IPMP architecture [12, 13] as well as with some of the proposals for JPEG2000 standard Part 8 – JPSEC – JPEG2000 security [10]. Open SDRM is being developed primarily in the scope of the MOSES project. MOSES is an EC project joining some companies over Europe that is implementing the new MPEG IPMP Extensions framework and at the same time developing business models and applications for secure content exchange between embedded devices [13]. This DRM solution is composed of several optional elements covering the content distribution value chain, from content production to content usage. It covers several major aspects of the content distribution and trading: content production, preparation and registration, content, interactive content distribution, content negotiation and acquisition, strong actors and user's authentication and conditional visualization/playback [10]. Even though the MOSES project refers explicitly to MPEG-4 file format as the content format, this infrastructure was designed with the concern to be adaptable and applicable to all types of content and business models (both for download, streaming or even broadcasting).

2.1 External Components & Interfaces

This part will present in detail the components and actors that interact externally with the Open SDRM architecture: User, IPMP Tools Provider, Content Provider, Payment Infrastructure and Certification Authority.

- **User** represents a person who wishes to operate a way of enjoying some piece of content (this content may or may not be protected, however the way to access and display such content may require the use of protected devices, software and licenses). The user will make requests to Open SDRM in order to: identify him, download licenses and play multimedia (using a web browser, EPG, Media Player). In a final analysis the User interaction with Open SDRM will always result in one of two things: either the user can play/render the content and enjoy it or he can't; being then informed of the reason for this prevention.
- **IPMP Tools Provider** is any organization that produces tools for encryption, scrambling, watermarking and others that can be applied to content protection. These tools will be made available to Open SDRM for use in content rights protection. These tools will need to comply with some guidelines. These guidelines and a subscription translates into a business relation that must exist between a given Content Provider and the IPMP Tools Provider, since mostly, a given producer and/or distributor of content may want to choose which type of protection the content will have and which tools can be applied to the content and from which supplier.
- **Content Provider** is any multimedia content supplier that feeds Open SDRM with content and/or metadata. The content can be complex multimedia content that is ready for distribution, or simple

content, for example JPEG images, that can be edited and combined with other content. Currently, in the MOSES project we will be addressing MPEG-4 content.

- **Payment Infrastructure** facilitates Open SDRM e-commerce features by providing services for handling electronic payments. The interface between Open SDRM and the Payment Infrastructure would be generic and independent of the payment method, allowing therefore a multiplicity of payment systems.
- **Certification Authority** is responsible for receiving requests for and issuing credentials to, entities. These credentials will be used by entities to authenticate themselves to each other, allowing the establishment of secure and authenticated communication channels between them. All the components in the Open SDRM architecture communicate using the channel security provided by the SSL/TLS protocol. This Certification Authority may be internal to Open SDRM, and therefore entirely managed by some entity, or it may be an external commercial Certification.

2.2 Internal Components & Interfaces

In this part, the internal components of the Open SDRM platform and the corresponding interfaces are presented. These components include: Media Application, Media Delivery Server, Commerce Server, Authentication Server, License Server, IPMP Tools Server, Registration Server, Content Preparation Server and the Payment Gateway.

- **Content Preparation server** this server component is responsible for the content preparation. It receives raw content from a specified source or sources and encodes it on a specified format, adds metadata and protects it. Currently, and under the MOSES project, content will be encoded in MPEG-4 format, according to some pre-established templates. These templates will allow the creation of MPEG-4 files containing music files in MP3 or AAC format together with some JPEG images about the album and artist.
- **Commerce server** is a server component responsible for trading the content with the users. Normally, content is chosen via web browser, some very generic metadata might be consulted, information about the price is also available, and especially the content usage conditions might be established.
- **Media Delivery server** is a server component responsible for exchanging pieces of content with the client. This Media Delivery server will implement a specific protocol (download (FTP, HTTP, or other), streaming (RTSP, other), broadcast) to exchange protected content with the client application.
- **Registration server** is a server component whose role is to assign unique identifiers to content and to register metadata information for that specific content. This architecture will be as close as possible to standards and therefore for this unique ID, it follows the MPEG-21 directives about Digital Item Identification (DII), using a reduced version of the MPEG-21 DII Digital Object Identifiers (DOI) [14].
- **Authentication server** is responsible for authenticating all the entities, internal and external to the DRM system. It validates the access rights of all the entities and components in the system working as a SSO point, registering and managing components and users on the system. It uses cryptographic XML credentials to authenticate both components and users in order to authenticate the transactions exchanged between them (XML Encryption and XML Signatures).
- **License server** is a server component responsible for house-keeping the rules associating a user, the content and his/her corresponding access rights. This component will accept connections from authenticated client Media Players for downloading of licenses, which will be applied to the protected content through an appropriate IPMP tool. The licenses are XML formatted using Open Digital Rights Language (ODRL/OMA) [4], and, in the future, they will migrate to the Rights Expression Language (REL) [15], currently being developed by MPEG-21.
- **IPMP tools server** is the server component responsible for registering new IPMP tools and for receiving authenticated client Media Player requests for the downloading of a specific IPMP tool. It is also responsible for making IPMP tools available to the Content Preparation Server to allow the protection of content.

- **Media Application** This component represents the software that will be used to render the content. This is a generic component with the particularity of being able to display/playback the appropriate content for which the necessary audio/video codec is available (if this codec is not available it may be downloaded from a remote secure server). This player may work with one or several IPMP tools in order to control how the content is accessed by a particular user. This component works on the client side of the general architecture; however it plays an important role in the DRM functions.

3. CONCLUSIONS

Open SDRM opens a new world of perspectives in the DRM field, through the introduction of the open-source paradigm and a set of adaptive and standardized components which will allow content producers and providers to create their most appropriate business model at a attractive price.

The presented model/architecture is being developed in the framework of the MOSES EC RTD project, which is also being developed an implementation of the standard MPEG-4 IPMP Extensions (IPMPX). IPMPX will use some of the features being deployed by the Open SDRM architecture (such as content production, content registration and the creation and obtaining rules). Also this architecture is being proposed as standard security technology for the recently created JPEG2000 digital imaging standard in Part 8, more specifically in the security infrastructure where it will be performed a core experiment.

The development of Open SDRM will closely follow the outcomes of the MPEG-21 standardization group and to become the first open implementation of a DRM platform based on MPEG-21.

In a world where content is king, but with the appropriate measures, this king can be at check. Current DRM schemes base their security on its obscurity and in proprietary protection methods. This paper presented a different approach for Digital Rights Management that enforces the importance of open-source technology and standards on an integrated architecture can provide the necessary protective measures for content producers and providers.

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CREATING DIGITAL VIDEO RESOURCES TO ENHANCE TEACHERS' E-LEARNING EXPERIENCES

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ABSTRACT

The emergence and convergence of information technologies offer new opportunities to enhance teachers' e-learning experiences. Digital resources are providing avenues to demonstrate authentic classroom applications of exemplary teaching practices. The Department of Educational Technology in the College of Education at the University of Hawaii (UH) through the Learning Enhancement through Innovations (LEI) Aloha project is showing how teachers from elementary to higher education use technology integration as a means to increase student learning and motivation. The video showcase, companion resources, and website are used for multiple audiences and purposes related to teacher training. This endeavor has been supported by a US Department of Education Preparing Tomorrow's Teachers to Use Technology (PT3) grant.

KEYWORDS

Digital Video, On-line, Teacher Education

1. INTRODUCTION

Across the United States as well as other countries, institutions of higher education have been embracing the possibilities of distance learning. In 2002, the International Data Corporation reported that approximately 85 percent of two- and four-year colleges would offer distance education courses. This rise from the 62 percent reported in 1998 demonstrates the growing expansion of distance education. The reasons cited for the growth of distance learning include large enrollment increases coupled with shrinking public budgets, lack of physical classrooms, and desire to provide educational access to students who find it inconvenient or are unable to attend a traditional institution (American Federation of Teachers, 2001). It is clear that a digital revolution is breaking down the traditional classroom walls one normally associates with advanced learning. In this infancy of distance education, however, the delivery of these university distance education courses are barely breaking away from traditional lecture-style formats that have perpetuated college classrooms for centuries. As the numbers of distance education courses continue to increase, attention focused on understanding how changes in the way distance education courses are delivered are also growing and developing.

As more and more research emerges on distance education, a clearer of understanding of what constitutes good distance education courses is possible. For example, the American Federation of Teachers (AFT) published in 2000, their Distance Education Guidelines for Good Practice which outlines a set of 14 benchmarks for achieving high quality in the distance environment. Such work is trying to move the content away from the bite-size, "point and click," accumulations of facts too often dominating content delivery of

higher education courses offered at a distance. Instead, more reflective, interactive, and less easily measured searches for knowledge are among the activities students in these courses need. Following AFT's Benchmark 3 in order to achieve quality distance education courses, course design should be shaped to the potentials of the medium. But what are these *potentials*? With the rapid changes of technology and new discoveries the defined potentials are always changing. Careful investigation of the potentials of distance education is critical at this juncture due to the proliferation of distance education courses.

The emergence and convergence of information technologies offer new opportunities to prepare future teachers for the digital classroom. From interactive websites to electronic portfolios, digital resources are expanding and enriching the classroom experience of tomorrow's teachers. Digital resources also provide one avenue to demonstrate authentic classroom applications of good teaching practices. In partnership with a US Department of Education Preparing Tomorrow's Teachers to Use Technology (PT3) grant, the Department of Educational Technology (ETEC) in the College of Education at the University of Hawaii (UH) through the Learning Enhancement through Innovations (LEI) Aloha project has created a group of online videos and companion resources that demonstrate innovative practices of teachers integrating technology into their curriculum. These videos spotlight outstanding educators from the community that have incorporated technology into their classroom projects as a means to increase student learning and motivation. The ETEC Connections website (<http://www.hawaii.edu/etec>) includes: the spotlight and full length videos, lesson plans, advice on grants and other funding opportunities, access to a copy-right free picture data-base, information about local educational opportunities, and, equipment and software tips and tutorials. The most recent addition is a growing set of multimedia learning objects that cover current "hot" topics, such as, electronic portfolios. Such resources can be used in multiple ways to influence in the development of teachers' technology integration skills for their student-centered classrooms.

2. BODY OF PAPER

Providing relevant concrete examples of quality technology integration in real classrooms is an important element of the preparing teachers for the digital age. The strategy has been to provide an "overview video" that previews a project in an engaging and informative manner, encouraging viewers to pursue more detailed information. Then, a longer "feature video" provides the details through a teacher explanation of the project design, methodology and application, assessment strategies, community involvement, and the challenges and various elements related to successful implementation. The videos are accompanied with online lesson plans, teacher contact information, student products, as well as the local, national, or international teaching standards that were met. A resource kit is available and includes assessment rubrics, teaching strategies, and links to hardware and software resources related to the project.

For example, the "You Can Take It With You!" video demonstrates the portability of technology in a wide variety of educational environments giving new voice to cultures across the south Pacific. Professor James Skouge works with students, teachers, parents, administrators, curriculum developers, and teacher educators in the Federated States of Micronesia. The Pacific Voices Project promotes the use of technology in the classroom to preserve cultural heritage. Pacific Island peoples are privileged to explore common cultural threads as well as wonderful diversity. The very heart of this project, culture, is shared through the voices of children in their art and song, games, and stories. This work celebrates the beauty and diversity of teachers, children and families of the Pacific, by sharing cultural packages and thematic units that are supported and enhanced by educational technologies - including multimedia, video and telecommunications. The outcomes of their efforts are documented in the printed materials on the website and in an extensive multimedia collection of projects.

From using digital video cameras to preserving culture to virtual fieldtrips, the videos featured on the ETEC Connections website demonstrate a wide range of possibilities for teachers to explore. The goal is to eventually provide a broad spectrum of examples with early childhood (Pre-K) through higher education (community colleges and universities), in numerous subject areas, and exploring a variety of technologies. Due to the breadth of the current videos and their high quality, these resources can be used in various ways to improve the education of teachers.

2.1 Strategies for Implementation

Producing high quality videos is a costly endeavor; therefore, it is essential to ensure that they can be used in many ways for multiple audiences to justify their expense. The videos featured on the ETEC Connections website have been incorporated in several different settings from K-12 to higher education classrooms and have targeted various groups who are all invested in the outcomes of technology in education.

To promote the videos and website, 90-second to two-minute overview videos are being broadcast, in partnership with Hawai'i Public Television KHET, and cable television through Hawaii Department of Education's Teleschool and the University's ITV network. The videos are broadcast over 26 times per week to motivate teachers to incorporate technology and visit the website. These short versions are used much like a commercial to first engage and then entice the viewer to visit the website. This is achieved by a combination of up-tempo music, quick edits and an animated cast of teachers and students excited about sharing their experiences about the project. Then, on the website, a teacher will find all the resources necessary to duplicate the project. A longer feature-length video provides an in-depth explanation by the teacher and students about the project.

The ETEC Connections spotlight videos on public television are reaching an estimated 36,000+ viewers and on educational channels, 1081 teachers and 30,268 students across Hawai'i. The website had an average of 22,000+ hits per month before the KHET broadcasts began and gained an average of 10,000 additional hits a month since the broadcasts began. These numbers based on the 4 months prior to and after the first broadcast release in January 2002. A year later, the number of monthly hits has remained relatively steady since public TV broadcasts began (see Table 1). The average number of hits per month since December 2002 is just over 32,000. A steady increase of hits over the last 4 months coincide with the release of several new feature videos on the website and corresponding broadcasts of the 90-second overview videos over public television.

Table 1. Summary of website hits by month.

Summary by Month										
Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
Mar 2003	1874	1185	436	62	1718	694446	1252	8734	23701	37480
Feb 2003	1161	855	108	53	2173	477794	1491	3050	23943	32532
Jan 2003	1003	770	140	47	1707	416215	1476	4359	23891	31114
Dec 2002	903	672	147	47	1912	494133	1466	4574	20842	28021
Nov 2002	793	606	126	40	680	140363	528	1639	7880	10310
Totals						2222951	6213	22356	100257	139457

These videos are also being used in conjunction with online technology courses for teacher education. Technology Intensive Enhancement Series (TIES), part of the LEI Aloha project, targets teachers who want to become good role models and mentor others who are interested in infusing technology into their curriculum. The courses are web and video-enhanced and meet the International Society for Technology in Education (ISTE) National Educational Technology Standards (NETS) for Teachers. TIES can be taken as a sabbatical program for teachers or by preservice teachers as part of their teacher certification program. The versatility of the program allows for maximum effectiveness and sustainability. The online video resources are incorporated directly into the courses. When learning how to write lesson plans, students can see a number of examples of how to make their lessons technology rich. The addition of digital resources to supplement content guides students to make better connections between the material they learn in their courses and real classroom applications.

The instructors of traditional teacher education courses are using the videos as a means to discuss various teaching practices with their students. The overview and feature videos provide real and complete examples for on-line group or class discussion and evaluation. The resulting interactions create valuable opportunities for brainstorming, problem solving, and stimulation to inspire further exploration. The videos also provide concrete examples of standards-based, project learning and foster dialogue about the advantages and disadvantages of using various technologies to accomplish unique goals for students.

One of the most important benefits of the broadcasts and web presence of the videos is the positive marketing for teachers, schools, and education in general. The teachers and schools featured in the videos are displaying the videos at school assemblies, parent exhibition nights, as well as in class for their own K-12 students. The pride of these teachers encourages them to exhibit the videos giving extra exposure to the school, the technology issues, and subsequently the university-related project. The videos can also be used as part of their own professional portfolio demonstrating their hard work and philosophy in action. The ripple effect on students, parents, other teachers, administrators, and the public in general is building a synergy that will further support educational efforts to maximize the appropriate infusion of technology into curriculum programs.

The next step for LEI Aloha is to explore strategies for increasing the distribution and usability of the videos. The grant project plans to add the videos to its database of learning objects. The videos will be formatted to be compliant with SCORM and IMS specifications. The videos will also be repurposed to serve as case-based “trigger videos,” which provide students with the challenge of finding viable solutions to unanswered or incomplete scenarios. It is important for them to gain real experience in solving problems related to technology integration. The open-ended approach demonstrated by these productions provides students with a context in which to apply their own strategies and debate them with other students. It stimulates creativity and vision for resolving of potential dilemmas that ultimately arise in a complex mix of curriculum objectives, technology, and the individual and team dynamics of a classroom.

3. CONCLUSION

From showcasing exemplary teaching practices to case-based, trigger scenarios, the wealth and impact of videos on learning can be invaluable. Specialized videos are yet another dimension of how digital resources are expanding and enriching the learning process and adding to our community of practice in teacher education. LEI Aloha will continue to broaden the matrix of videos in the database to diversify the spectrum of subjects, grade levels, learners, and learning conditions, and the effectiveness of emerging technologies within a variety of contexts. The distribution of these videos as true learning objects that can be reused in multiple ways is a future goal of this grant project. This increase in usability will open more opportunities for teachers to learn in a dynamic and engaging e-learning environment.

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DATA PROTECTION FROM A COMMUNICATION PERSPECTIVE THE CASE OF STATISTICAL DATA

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ABSTRACT

Privacy is an important rationale for data protection. However, the concept of privacy is not without problems. In this paper, we argue for a new perspective on data protection. This perspective considers data in the context of a communicative setting. This perspective is applied to a specific data protection problem that is not easily dealt with from a privacy perspective, that is, the problem of the dissemination of statistical data by National Statistical Organizations.

KEYWORDS

Privacy, communicative action, statistical data, data mining, geographical information systems

1. INTRODUCTION

In the post 9/11 environment, data surveillance has become a serious discussion item (Gandy, 2002). Already for many years, data protection has found its way in European directives and national laws. In this paper, we argue for a new perspective on data protection. This perspective considers data in the context of a communicative setting. It explores the norms for communicative action and their consequences for data protection. The paper is built on a specific data protection problem that is not easily dealt with from a privacy perspective, that is, the problem of the dissemination of statistical data by National Statistical Organizations. Although these organizations are usually very careful in their handling of data, the data can be refined so that, in combination with other data and with the use of data mining techniques, they allow the construction of quite precise profiles of individuals or small groups.

The aim of this paper is twofold: first, it analyzes extensively the privacy problems associated with statistical data. Secondly, it introduces a communication perspective on privacy, which is applied then to the case.

2. PRIVACY PROTECTION AND STATISTICAL DATA

The section explores the nature of the responsibility of National Statistical Organizations (NSOs) to data subjects as regards dissemination of statistical data. Three main issues will be discussed. The first is how secondary uses of data released by statistical organizations can affect individual privacy. The second is what sort of protection is offered to individuals with regard to secondary uses of statistical data. The third is the extent to which statistical organisations can protect the data they release from particular secondary uses.

2.1 How NSOs Tackle the Problem of Privacy

The approach of National Statistical Organizations to protecting privacy tends to put most emphasis on direct disclosure or the re-identification of a particular individual in the data set. Much work is done on simulating the motivations and actions of 'data intruders' who wish to match a given individual from the population with one in the data set (Elliot, 1996). This could entail identifying a person in the data set that one knows from the population or conversely finding a person in the population after selecting her from the data set. The notion of attribute disclosure is also a concern but tends to be a much more difficult thing to define and protect against. Attribute disclosure can be said to have definitely happened however, where a particular characteristic of an individual can be inferred with a high degree of certainty. An example of this would be that the data set showed all single women of 35 in a given area owned their own home. Upon meeting a 35 year old female from this area it could then be inferred with a good degree of certainty that she was a homeowner. Knowledge Discovery and Data Mining (KDDM) are technologies for analysing data in such a way as to find patterns and relationships between variables. Geographical Information Systems (GIS) rely on relational databases, which integrate different levels of information and provide users with visualisation of the characteristics of areas of interest. The attitude of some users appears to be ambiguous as regards the relationship of privacy to the discriminating abilities of GIS. On the one hand users are keen to point out that there are no direct infringements of privacy because there is no direct identification of individuals or households. On the other hand they are equally keen to point out the proficiency of these systems in accurately discovering the characteristics of those who may or may not buy a product or require a service (Sleight, 1993). Clearly there are differences between being able to discover the identity of individual and being able to infer characteristics with a good degree of certainty. However, if the latter is used as a basis for decision it may be difficult to differentiate between the two types of knowledge in terms of consequences for the individual, at least in the cases where information is correctly inferred.

2.2 Uses of data from NSOs

The data produced by NSOs tends to be released into the public domain in a heavily protected form. However, the fact that data can then be used in combination with other data sources can have implications for individuals despite their not being directly identified. The importance of the data disseminated by NSOs is clearly recognised by marketers in building up a profile of the people living in a given area. In the UK the data for small areas, Small Area Statistics (SAS) is acknowledged as fundamental to the creation of GIS. SAS data also helps to ascertain the homogeneity or heterogeneity of an area. The marketers are eager to point out that they use a probabilistic rather than direct approach to the characteristics of individuals. This remains unproblematic from the perspective of NSOs as it does not aim to re-identify individuals and therefore does not breach direct disclosure pledges. However, direct marketers for example are able to study identified data sets for 'look-alikes' who fit profiles discovered in the non-identified data sets (Sleight, 1993).

2.3 The importance of accuracy

NSOs are concerned to prevent direct disclosure of the identity of individuals or the possibility of accurately inferring attributes about individuals. There are two problems with this approach in terms of their application to the reality of secondary uses of data. First, technologies such as data mining and GIS can allow the incorporation of data of different types from many other sources and analysis that reduces the possible values of data and allows the isolation of smaller groups within the data. Second, the links between variables and the patterns that they constitute are sometimes used to ground decisions as if the links were causal rather than probabilistic. The fact that statistical organizations take care to disguise the data or make it safe against accurate re-identification does not protect individuals against uses of data where accuracy is not seen as of primary importance. Rather the use of data by marketers and other speculative organizations is to improve the odds in their favour (Sleight, 1993). The motivation is to segment to the population in order to make the most efficient use of resources. So while it is likely that such organizations would wish to reduce the margin of error as much as possible for their purposes direct re-identification of a given individual is not always necessary.

2.4 Arguments for statistics

Statistical organizations are usually aware that the work they do will in some cases result in negative outcomes for some part of society. An example is where a statistical enquiry shows one area as having lower crime figures than a neighboring area, which may then result in less policing for that area. However, it is argued by statistical bodies in general that this is not a compelling reason to stop the production and dissemination of statistics. Statistics are used for many things that are considered socially beneficial such as planning public services, political accountability and to target deprived areas for ameliorative programmes. Commonly it is argued that while certain groups may be disadvantaged others will be advantaged. The aggregate benefit to society is said to be the fair distribution of goods and services due to a good level of knowledge about prevailing economic and social conditions. Many may disagree with particular interpretations of the data but this is a separate issue to that of the justification for the existence of statistics. Professional statistical bodies such as the International Statistical Institute (ISI) however, believe that it is part of the duty of statisticians to point out the limits of generalisability and applicability of statistical results. Statisticians are also encouraged to make a risk benefit calculation in terms of overall benefit to society and risk to individual data subjects and groups.

2.5 Legal Protection

The Organization for Economic Cooperation and Development (OECD) published the 'Guidelines Governing the Protection of Privacy and Transborder Flows of Personal Data' in 1980. The guidelines were intended as 'minimum standards' thereby permitting whatever supplementation was thought necessary to protect privacy interests, by national legislators. These guidelines have influenced national data protection legislation in many countries, where the principles as well as the definitions of relevant concepts have been adopted. There are eight principles of which we mention two. The principle of Openness, recommends transparency with regard to the processing of identifying data. This notion includes enabling verification of the type of data that is being processed, the policies, which govern processing, and the purposes of use. The Individual Participation Principle states that individuals "should have the right" (OECD 1980:4) to inspect data relating to themselves that is in the possession of the data processor and to challenge the data and have it erased or rectified. Secondly, the principle of Accountability, recommends that the data controller provide a base of responsibility for compliance with the principles. There are clear problems with applying these principles to the kind of issues discussed here. Although the principles of security and purpose specification are adhered to by NSOs national and European legislation tends to give broad exemptions to statistical data making the other principles partially irrelevant in tackling the problem of unwanted uses of aggregated data.

There are other issues with the legal approach to understanding the nature of the responsibility of data processors to data subjects. The legal approach to fulfilling responsibilities to data subjects such as respecting their privacy and allowing them to consent or not to uses of their data might be only loosely related an ethical approach to the same issues. A distinction can be drawn between what is legally binding and what is morally desirable and this distinction can be described in terms of focus (Faden & Beauchamp, 1986). On the one hand the legal approach tends to concentrate on the liability of the data processor. The ethical approach on the other would be more concerned with whether the notions of privacy and informed consent had been respected in a way that protected the autonomy of the individual data subject. In terms of the liability of the data processor while personal data is not an issue and it can be claimed there are no clearly direct and personal consequences to an individual then the duty of responsibility has been fulfilled. This may explain the concern with disclosure control and ensuring individuals and attributes cannot be accurately determined. However, the use of aggregated data clearly does throw up problems both for privacy and informed consent from a moral perspective.

The situation as regards secondary uses of statistical data does not appear to be one that can be tackled by statistical organizations alone but must be seen as part of a much bigger problem requiring a number of solutions. The disclosure control issue is a real problem as it would be undesirable if data provided to statistical organizations was passed outside of this context in ways that allowed individuals to be easily recognised. After these controls are in place however it is difficult to see what more NSOs could do to combat uses made possible by technology and driven by motives such as profit and efficiency. Unlike NSOs the data processing and interpretation of non-governmental organizations is not likely to be subject to

political scrutiny. It is arguable therefore that while NSOs must be accountable to government and eventually to the electorate who can decide to some extent on the acceptability of government uses of data the same controls are not applied to many non-governmental organizations who make secondary use of statistical data.

3. A COMMUNICATION PERSPECTIVE

Data protection is usually motivated by an appeal to privacy rights. However, privacy is still not a well-understood concept. In its current form, it fails to articulate a compelling rationale for protecting statistical data. In our opinion, many privacy issues can be handled better when we take a communication perspective rather than a perspective focused on isolated individuals. A good starting-point would be the communicative action theory of Habermas (Habermas, 1981; Outhwaite, 1996). In this view, communication is a form of joint action. It is an effective means of coordination because it aims at building a shared understanding of a situation. Since it is oriented at shared understanding, it should allow participants to challenge any claim made. The basic rule is that participants must respect each other as communication subjects. It means that you must be able to give valid reasons for the communicative actions that you perform. For example, when you ask information about the other. This is only a valid action when you are able to give convincing reasons. Sincerity demands that you are accountable for using the information only for these reasons, otherwise, your communication would have been manipulative and manipulation is contrary to the basic principle of communication. The discourse ethics also imply that within the communicative setting one is not using the other as an object. This excludes focused attention on the expressed self without being engaged and being willing to engage in communication.

The communication perspective offers two main reasons why statistical data should be handled with care. One is the issue of communicative respect that excludes focused attention towards expressive information. The other is the issue of respecting the boundaries of discourse spheres. The practical implications are in line with the well-known OECD principles, although we think that more attention should be given to the determination of the boundaries of the discourse spheres (or to what OECD calls “party”), particularly in the area of e-government. Also, the OECD principles fail to recognize the problem of focused attention towards expressive information.

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AN E-GOVERNMENT SOFTWARE REPOSITORY

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ABSTRACT

This paper proposes a solution for a government to make a transition from conventional to Component-Based Software Development (CBSD). A set of logistics components is designed and developed to facilitate the development of government to citizen (G2C) applications, such as provision of government products and services to citizens.

KEYWORDS

Component Repository, Software Development, Government to Citizen.

1. INTRODUCTION

Developing e-government has been one of the focal point in “Digital 21 Strategy”, the HKSAR Government’s blueprint of IT development. For decades, efforts to boost local IT development have been initiated by the government. Seemingly, the government will continue to play this leading role in the foreseeable future. As such, the government’s IT policies, including the choice of software development methodology, will become crucial in fostering IT development culture of the local industry. This, in turn, determines the development costs and service quality delivered to the public.

In recent years, the government has demonstrated a proactive role of tapping in expertise, experience and creativity from outside the government so as to deliver high quality public services to the community. Being the largest IT buyer, the government sub-contracts out more than 80% of new IT project development to the private sector. Size of projects is also broken down for more tenders to encourage participation of smaller IT firms. These IT policies are generally considered beneficial to the industry, but then, bring with potential problems of redundancy in development work.

Looking inward to the government, the recent ITSD’s delegation of IT development plan to departmental level has improved responsiveness to public needs. For instances, individual departments have autonomy to develop independent Internet application services provided for the public. To have a more integrated environment, they are put under the same roof, namely, ESDlife. Government’s Internet services, though distributed in various departments, are required to be more integrated and interactive. This has therefore exerted greater pressure to software developers for creating and revising applications at a timely manner.

The large amount of sub-contracted projects, decentralizing departmental IT development plans, and the rising number of Internet applications suggest that the government needs to introduce new IT development model in order to reduce redundant work, increase efficiency and productivity, and save costs. For that matter, this paper proposes a solution for the government to make a transition from conventional to Component-Based Software Development (CBSD). In order to demonstrate the effectiveness of the architecture, we plan to design and develop a set of logistics components to facilitate the development of government to citizen (G2C) applications, such as provision of government products and services to citizens.

2. COMPONENT-BASED SOFTWARE DEVELOPMENT

Complexity causes confusion and costs. IT applications for government are generally complex. Some of the development works are unavoidably redundant under the conventional development methodology.

CBSD methodology breaks down complex software system into components and encourages the use of reusable components. Such practice allows compose IT applications more flexibly and promptly to the public needs. More importantly, it saves redundant work that can be translated into dollars.

CBSD is based on the concept of reusing components. Reusable components are widely perceived as a software unit. In fact, they could be in any forms, such as documentation, requirements, design, system architectures, testing data, test plans, or even development experience. In a highly tied complex organizational structure, like government, this methodology is comparatively cost-effective, particularly when development works are scattered to numerous internal and external parties.

Components are to be collected and organized into a reuse-library. The library provides sophisticated catalogue system and intelligent search engine to attract software developers locating their desired components easily.

3. PROPOSED ARCHITECTURE & SOLUTIONS

The architecture of CBSD methodology consists of a Component Repository, a Digital Library System, and an interface for software architects. A Component Repository is a database designed to store what IT developers need for new applications or enhancements. A Digital Library system provides library administration, handles component submission mechanism, and facilitates architects to locate their desired components. Demographically, the digital library and component repository are centralized, e.g. could be owned by ITSD, and the software architects would be the individual Bureaus and Departments (B/D).

The advantages of component-based development well match the current situation the government is facing, such as: large amount of sub-contracted projects, decentralizing departmental IT development plans, and rising number of Internet applications. The transition from conventional to component-based development will make the government encounter more than just technical issue. In fact, paradigm shift in software development habit is more a cultural matter. To cultivate new culture in IT development, besides setting up infrastructures to facilitate changes, promotional activities and incentive schemes are also important. To execute, it is no need to start from scratch. The government can leverage on outside expertise and their resources (e.g. available components) to build up a reference model first. This model, tailored to government's needs, will then be enlarged and applied to every part across the governmental network in phases. It is recommended to start off a pilot project initially in smaller scale in order to establish and fine-tune a best-fit reference model. One or several divisions in ITSD (or other departments with significant amount of IT developments) could be chosen for this pilot run. This group of people should be currently working in application areas with greater reuse potential.

The pilot project includes the following elements:

- 1) Design and setup component repository.
- 2) Construct a portal site with component catalogue tool to facilitate the management of component-based development.
- 3) Identify a certain number of functions or existing source codes, say 200, which are most desired among software architects and IT developers. This is to boost the initial usage of the repository.
- 4) Componentize the targeted functions and save onto the repository.
- 5) Collect publicly assessable components and make reference in the library system.
- 6) Design incentive schemes and organize promotional activities to cultivate reuse culture. (e.g. Initiate reuse campaign)
- 7) Define quality assurance procedures to guarantee components quality. For instance, adopt risk-ranking scheme to label components' usage.
- 8) Decide maintenance policies, e.g. submission of document including test plans, and check-list for receiving components.
- 9) Design policy to handle licenses problem, e.g. check legal restriction on the use of components.
- 10) Include advanced features where possible, such as Concurrent Version-Control System (CVS)

and Customer Relationship Management System (CRM) to help find out what component types are most required.

11) Design training programs to arouse reuse awareness.

Government's IT development works involve internal developers from various departments and external sub-contractors. To avoid conflicts of interests, it is recommended that the government appoint a neutral consultant party to take forward this project.

4. CONCLUSION

The success of implementing this methodology largely depends on how willing system architects would like to adopt component-based design architecture, because, this may affect the overall usage of reused components as well as the number of new components submitted to the repository. To implement CSBD model, it requires a concerted effort by the whole government. The following issues need to be well thought through in accordance with the government's current situation:

- 1) How to obtain reusable components:
- 2) How to approve components to be included in the repository: e.g.: assigning a librarian unit to evaluate whether the submitted components have reuse potential. Librarian should also consider legal/license matter.
- 3) How to perform basic quality check before components are put in use: e.g. a checklist for qualifying components.
- 4) How to put components in use: e.g. the procedures to load components into the repository, to file in the appropriate directories, enter administrative data, etc.
- 5) How to perform quality assurance for the existing components in use: e.g. a reporting scheme to reflect the usage level and stability of each component in the repository. For any problem occurs, to whom it should report.
- 6) How to cultivate reuse culture: e.g. a credit redeem scheme prizing for those who earn enough redeem-points by submitting or using components in the repository.
- 7) How to publicize new components
- 8) How to maintain components: e.g. tracking problem reports on components and handling enhancement requests, etc.

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PETRI NET MARKUP LANGUAGES AND FORMATS AS GUIDELINES FOR ONTOLOGY DEVELOPMENT

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ABSTRACT

This paper presents basic guidelines for building Petri net ontology, which should enable using Petri nets on the Semantic Web. Available Petri net model descriptions give format definitions. Their main objective is to provide the syntax for sharing Petri net models between different applications. Some of these applications are software-specific and provide either text-based format definitions (e.g., DaNAMiCS) or XML-based format definitions (e.g., Renew). Another kind of such applications proposes a universal syntax definition for model sharing, for example Abstract Petri Net Notation (BNF definition) and Petri Net Markup Language (XML definition). The main drawback of these solutions is their emphasis on syntax per se, ignoring the fact that syntax represents means for sharing *semantics* of Petri net models. Assuming that syntax is just a medium for model transportation, this paper considers the basic concepts and their relationships in existing Petri net formats. The ontology guidelines we present are based on an analysis of such formats and are represented using UML.

KEYWORDS

Petri net, markup languages, ontology, XML, UML

1. INTRODUCTION

Sharing of Petri nets models is significant improvement for their analysis, and there are two possible solutions for using different softwares for the same Petri net model observation. The first solution implies that a software solution implements as many parsers as the number of softwares to perform the exchange with. The second way is general syntax formulation for Petri net models description by which different softwares solutions would be used to describe their models. The syntax definition should contain a set of elements (tags) which should be predefined by introducing the convention. This convention would define the meaning of each element.

However, Petri net using on the Semantic Web or by Web services does not imply just Petri net model exchange considering only syntax for document writing. This also implies consensus of concept meanings which are exchanged by syntax, whereas the syntax is only a medium for semantic exchange. Therefore, Petri net ontology definition is needed for semantic description of Petri net concepts and their relationships.

Two universal syntaxes for model exchange are taken for the analysis subject: *Abstract Petri Net Notation* (APNN) and *Petri Net Markup Language* (PNML). The APNN is analysed (although it is not used by any software) because it is the first attempt to define Petri net universal syntax which includes different Petri net dialects. Beside other Petri net software specific formats, the following formats are analysed: DaNAMiCS (text format) and Renew (XML format).

The next section is about the short description of APNN, PNML, DaNAMiCS textual format, and Renew XML format. The third section contains the comparative review of analysed formats for Petri net model

description as well as basic guidelines for Petri net ontology in the form of UML model. The last section contains final conclusions.

2. REVIEW OF ANALYZED FORMATS

Abstract Petri Net Notation is presented in the paper (Bause et al 1995). It can describe different Petri net dialects. To increase the readability of this notation, the key words are similar to LATEX commands. This notation should satisfy the following requests: net descriptions could be easily exchanged in electronic form, *extensibility* (it can be used by different Petri net dialects. Simple Petri net dialects can be extended in order to describe high-level dialects), *modularity and hierarchy* (the Petri net description in the file should be such that it can be reused), *readability* (text notation should be such that it can simply be transformed into the human-readable format as well as suitable for printing). This notation does not save information of Petri net graphical elements (place position, transition, place name, etc.). Abstract notation for each Petri net class is defined in Backus Naur Form Notation (BNF).

For model record DaNAMiCS (DaNAMiCS 2002) software tool uses a file format with the *bim* extension. Format with the *bim* extension has many internal marks whose documentation is not available for the authors of this paper. The second file format which DaNAMiCS uses has the *wam* extension and these files are used for model import (menu *File*, option *Import net*). The authors are not familiar if this format has the available documentation of its description. However, this format is textual with an evident structure that corresponds to certain Petri net object. This format has been analysed and compared with the models obtained by importing files of this format into the DaNAMiCS and the meaning of every format element has been obtained as well.

In order to overcome the problem of model exchange with other Petri net software solutions, Renew uses XML. The XML document model description is defined by *Document Type Definition* (DTD) (Kummer et al 2001). The assumptions, which are included in the formulation of this DTD, are the same as the PNML assumptions since there are the same elements for the description of: net (XML tag *net*), place (*place*), transition (*transition*) and arc (*arc*). These elements in these two formats also have similar content model. Each element in the Renew's XML format can have graphical information and arbitrary number of annotations. The graphics information is a set of information comprising the following elements: size (*size*), text size (*textsize*), relative position (*offset*), object fill color (*fillcolor*), color of object outline (*pencolor*), text color (*textcolor*), absolute position (*point*), arbitrary data (*data*).

The PNML (Weber & Kindler 2002) is defined by the XML. The PNML is not *de jure* standard, but it is generally accepted by the Petri net society being constantly in progress. The proposed basic language structure for the Petri nets universal markup consists of two parts: a general one (which is independent of specific Petri net dialects) and a specific one. The general part is called Petri Net Markup Language (PNML) and the specific one is Petri Net Type Definition (PNTD). To obtain the universal format of Petri nets markup it is necessary that the general part – the PNML, consists of most Petri nets bases whereas the PNTD defines additional features which are not included in the PNML. Extension of the general part by using object oriented principles is suggested for the PNML definition. Consequently, the PNML definition is given by using Tree Regular Expressions for the XML (TREX) and the XML.

Two softwares have been analysed in order to illustrate the current state of PNML appliance. The first software solution is Petri Net Kernel (PNK) in whose context the PNML has been developed. The second software is P3 (Gasevic 2002), which has been developed by authors in order to explore the applicable capability of the existing PNML definition.

3. SUGGESTIONS AND GUIDELINES FOR BUILDING PETRI NET ONTOLOGY

Petri net formats and markup languages, which have been analysed in previous sections, put syntax for Petri net description in the first place. However, in order to obtain these grammar definitions, it was necessary to make certain conceptual assumptions as their base. This mostly refers to the universal exchange syntax: the

APNN and PNML whereas internal formats of analysed softwares deal more with syntax. Regardless of these facts, it is possible to distinguish few common concepts, which describe the domain of Petri nets. The review of common concepts is made in table 1. Attributes (normal face font) of particular concepts as well as their related elements (bold face font) for each format are distinguished. This also constitutes basic guidelines for building Petri net ontology.

The authors suggest the use of the PNML as a base for Petri net ontology. The reason is that it represents a language for Petri net markup, which included the following: the fact that there are many Petri net dialects, possibility of the extension of some formats of Petri net dialects with additional features by using object oriented principles, and the fact that it should be a part of Petri net standard. A special advantage of using the PNML is the fact that it contains all concepts founded in each format, which have already been analysed in this paper.

Table 1. Review of Petri net concepts, attributes and content

Concept	APNN	DaNAMiCS	Renew	PNML
<i>Net</i>	Identifier, place, transition, arc	-	Identifier, type, place, transition, arc, annotation	Identifier, type, place, transition, arc, page, reference place and transition
<i>Place</i>	Identifier, name, initial marking, capacity	Name, initial marking, marking, graphical information	Identifier, tip, graphical information, annotation	Identifier, name, initial marking, graphical information
<i>Transition</i>	Identifier, name	Kind (immediate, time), name, graphical information, possibility, time, delay	Identifier, tip, graphical information, annotation	Identifier, graphical information, name, toolspecific
<i>Arc</i>	Identifier, source, target, multiplicity	Source, target, multiplicity, graphical information	Identifier, source, target, type, graphical information, annotation	Identifier, source, target, graphical information, multiplicity
<i>Graphical information</i>	-	Position	Position, size, text size, color, ...	Absolute position, relative position
<i>Initial marking</i>	Init	Contained by place tag	Annotation: type, identifier, text, graphical information	Value, graphical information
<i>Name</i>	Value	Contained by place tag	Annotation: type, identifier, text, graphical information	Value, graphical information

The proposed approach for building ontology is based on the idea that syntax is a medium for semantics. In this case syntax is a guideline for the ontology. In order to obtain the full notion of ontology, the authors suggest the use of the UML (Cranefield 2001). The use of the UML is suitable because it is generally accepted and standardised for analysis and modeling in software engineering. The UML does not have a graphic notation only, but also profiles, global modules, and extension mechanisms (Baclawski 2002). You can directly obtain the Petri net ontology by using the UML, as well as ontology mapping into some target format – based on DTD, XML Schema, Resource Description Framework (RDF), etc. According to this recommendation the UML model of PNML XML Schema definition has been obtained by reverse engineering procedure. For that purposes the *eXtensible Stylesheet Language* (XSL) transformation, which transforms a XML Schema definition document into *XML Metamodel Interchange* (XMI) format, has been developed. An example of a class diagram, which was obtained by this transformation, is given in figure 1 (Gasevic 2002). That diagram shows basic Petri net object of the PNML taxonomy. They are modelled by the UML profile for modeling XML Schema, which is given in (Carlson 2001). The next step to obtain Petri net ontology will imply mapping gained model into the UML profile for ontology modeling and development.

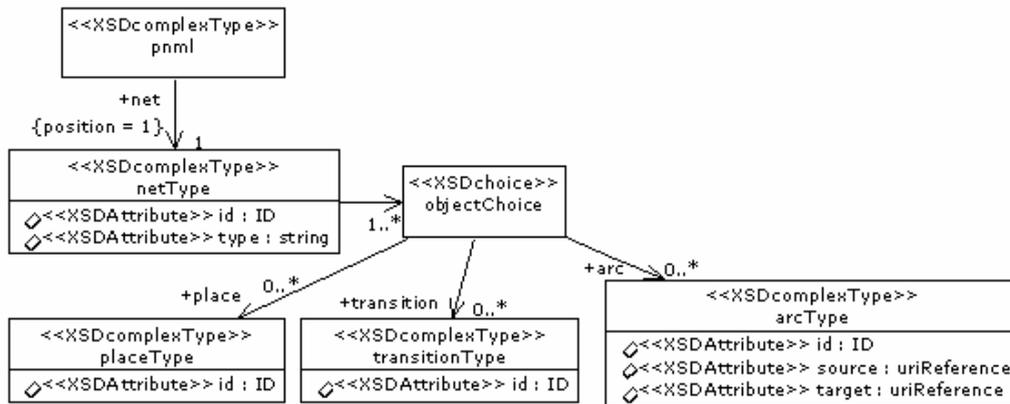


Figure 1. PNML Class Diagram – PNML document content model description

4. CONCLUSION

The review of Petri net formats (DaNAMiCS, Renew) and markup languages (Abstract Petri Net Notation and Petri Net Markup Language) has been made in this paper. According to the fact that the PNML is a language in constant progress which is to become a standard language for Petri net markup, the authors propose its use as an ontology base. It contains all concepts as well as other analysed languages, and it could be extended.

The main contribution of this paper are the guidelines given for Petri net ontology. These guidelines are obtained by analysing the current formats for Petri net model exchange. The originality of the proposed solution is the fact that the ontology building is based on the existing Petri net syntaxes. Furthermore, by defining Petri net ontology it is possible to use them on the Semantic Web and by Web services. This means that the description of some Petri nets can be found in a document which is not necessarily for Petri net softwares use. For instance, those documents can contain natural-language text described in the HTML, provided that they should contain metadata (RDF) of Petri net concepts as well.

The main tendency of the future work means complete defining of the Petri net ontology. This also means translating the PNML’s UML model into the UML profile for development ontologies, as well as additional consideration of relationships between concepts of Petri net ontology, because this paper analysed relationships of the *has a* type (having a property) only, and not relationships of the *is a* type. Special aspect would be consideration and adding mechanisms of structuring to the Petri net ontology.

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THE SEVEN E'S IN eTRANSFORMATION - A STRATEGIC ETRANSFORMATION MODEL

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ABSTRACT

This paper describes the Seven important stages of a successful eTransformation methodology using the 7-E model highlighting the need to commence the E-transforming process by studying the external environment and the forces acting on an organization due to advances in IT and changing business needs. Equal priority is given to the e-readiness of the company and the e-readiness of it's external partners such as the customers, suppliers, financial institutions, the market etc. Many other existing eTransformation models have been studied in order to get an in-depth knowledge of the existing models and their strengths and weaknesses. The proposed Seven E's in eTransformation model is currently being tried and tested with a group of companies in the region of Western Sydney, Australia. The paper also highlights the issues such as importance of analysing the external environment when reengineering the business, business-IT alignment, implementing and managing systems restructuring, issues related to business re-engineering, e-readiness and the eSystems maintenance and policy issues.

KEYWORDS

eTransformation, eBusiness Model, 7E Model, eBusiness Strategy, eTransformation Roadmap

1. INTRODUCTION - THE EMERGING GLOBAL E-ECONOMY

With the evolution of the Internet, eBusiness opens up new possibilities for businesses to carry out the business activities more effectively. The methods of operations of organisations are changing rapidly with paradigm shifts and new IT/business strategies for B2C and B2B being introduced everyday. Enterprises operate in a global scale today with operations occurring in many countries simultaneously. The global village concept has introduced a whole new way of doing business in an ever increasing competitive world. Therefore, the need to introduce and use IT as an effective strategic business tool is crucial to gain the competitive advantage and successfully achieve the company's business goals.

1.1 eTRANSFORMATION - THE KEY TO SUCCESS

Business processes have been changing continuously due to business driven forces and IT driven forces. Business driven forces are market pressures, customer needs and competition. IT driven forces result from advances and merging of Information and Communication technologies (ICT) and the introduction of business communication systems. Exchange of information in a company has changed dramatically with the introduction of facsimile, e-mail, intranets and the internet.

This effects the internal business processes and external business processes in dealing with its' suppliers, buyers, financial institutions, etc. The Internet has tremendously increased the quality of customer service, after-sales service, customer relationship management and supply chain management. Many organizations have web sites providing valuable information and services to thousands of potential customers. The process of transforming in to an innovative and effective IT-enabled organization is eTransformation.

In the CommerceNet 2000 global survey on barriers to Electronic Commerce [9], the top five barriers for SMEs (Small and Medium Enterprises) were found to be as follows which show that there is a great need for an effective e-business model for SMEs. (i) Lack of qualified personnel, (ii) Lack of Business Models, (iii) Fraud and risk of Loss, (iv) Legal Issues and (v) Not sure of benefit

2. IN SEARCH OF A SUCCESSFUL MODEL FOR eTRANSFORMATION

There are many eTransformation models and strategies published in journals, conferences and on the web proposed by many renowned researchers, academics and professionals around the world today. Most of them concentrate on the issue of managing the change in dealing with eBusiness. We have analysed a number of models but, will discuss only a few in detail.

2.1 The Seven Steps to Nirvana

Prof. Mohan Sawhney, has expressed the following ideas in his book "The Seven Steps to Nirvana – Strategic insights in to e-business transformation" [6]. *"What becomes obvious is that the first thing you have to do, before you understand e-business priorities, is to understand business priorities! Which, by the way, makes sense because in the end there is no "e-business". It will all be "business."* " He describes, seven steps in the model which are: *Catalyzing, Diffusing, Motivating, Skilling, Externalizing, Structuring, Staffing.*

This model successfully concentrates on the three key areas vision, strategy and organizational structure. It also addresses the issues in change management, concentrating more on the human factor such as the importance of the CEO leading the project, motivating the management to e-transform, training, incentives, etc. It clearly gives the message that eBusiness is not about technology but, it is about organizational change. The model does not clearly address the issues related to strategy development, E-readiness of the company and it's external partners, the changes in ICT infrastructure, policies, etc.

2.2 The Seven Co-business Strategy Formulation

This model, developed by Pricewaterhouse Coopers consultants in 1999 [5] discusses seven major strategic areas of Ebusiness to be covered in any eBusiness Strategy. They are grouped in to Strategic Positioning, Corporate Strategy and Implementation Strategy:

A. Strategic Positioning - Community & Content B. Corporate Strategy – Collaboration, Competition & Company, C. Implementation Strategy – Computing & Corporate change

This recognizes the key players in the new environment. When formulating an eBusiness strategy, it is important to identify the players and understand the significance and the role each member plays in the game. This model concentrates mainly on the external environment and little is discussed about the internal change management issues.

2.3 The Seven S Model

Many who speak of eTransformation and organisational change have been inspired and guided by one model, the 7S model, developed by consultants in McKinsey & Company over 20 years ago which has gained wide spread acceptance. This model discusses how to achieve organizational excellence by achieving superior fit among seven different dimensions, namely, *Strategy, Structure, Systems, Style, Staff, Skills and Shared Values.*

The Seven S model addresses all possible issues and aspects of organizational change like no other theory has done so far. It provides a very useful check list to drive an organization in to excellence. It is very effective for internal change management, but does not discuss the complexities of linking up with the external world with no geographical boundaries and faster speed of communication.

3. DEVELOPMENT OF THE SEVEN E’S IN eTRANSFORMATION

The key driving forces for Organisational change are the IT and Business driven forces. Both these are external forces such as vanishing geographical boundaries, ICT explosion/ advancement, virtual connectivity, Internet and bargaining power of customers/suppliers, strong competition, market changes, etc. The need to commence the eTransforming process by studying the external environment was highlighted by the above driving forces for organizational change. The team leading the eTransformation process should have a very good idea about the global IT and Business trends as well as the strategic situation of the company. Equal priority should be given to the eReadiness of the company and it’s external partners such as the customers, suppliers, financial institutions, the market etc.

3.1 The Need To Develop A New Model

The big bang approach which is adapted by ERP solution providers, have lead many companies to chaotic situations. The main criterion for the selection of an information system is the best fit with current business procedures but, several studies have shown that configuring and implementing ERP solutions can be costly and may even require reengineering entire business operations[10].This is one cause which lead the ERP systems usage a living nightmare. The 7 E’s in eTransformation deals with seven aspects evolved after carefully analysing the existing eTransformation models & strategies and considering various eTransformation projects the University of Western Sydney has tried and tested in the Western Sydney region.

4. THE MODEL - SEVEN ‘E’S IN eTRANSFORMATION

This model consists of seven very important aspects of eTransformation. Each stage is important in it’s own right and as a part of the whole process. Six steps which could be achieved one after the other are linked to the seventh step ‘Evolution’ which deals with the crucial issues related to change management. After each stage, the organization can go through the changes horizontally to the evolution stage and through that, go to the next stage, which is vertically up or down. The model - 7E’s in eTransformation is described below.

4.1 The 7 E Model

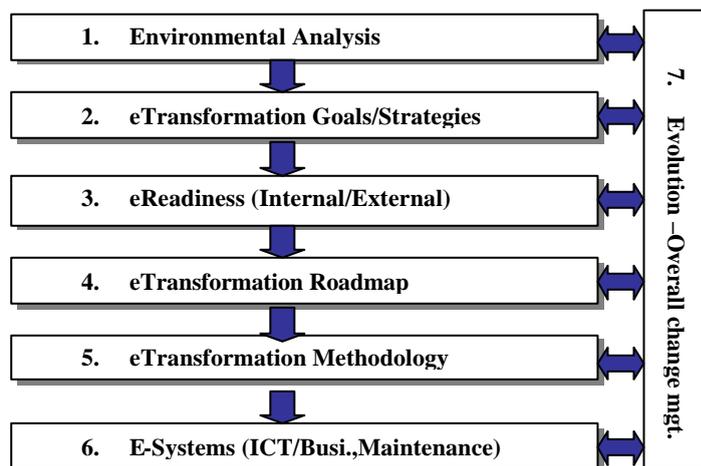


Figure 1. The Seven E’s in E-transformation

4.1.1 Stage1: Environmental Analysis

- **Significance and Outcomes:** To understand the Global IT and Business Trends and the Company's Strategic Situation In the book "E-Business- Roadmap for Success", Dr. Ravi Kalakota [2] explains the major trends driving organisations to changing the way they have been doing business. They are Consumer Trends, Service/Process Trends, Organisational Trends, Enterprise Technology Trends.
- **Methodology used:** The following analysis is proposed to be carried out:
 - Industry Analysis – Michael Porter's Five Forces Model, the forces being Rivalry among existing competitors, Bargaining power of suppliers, Bargaining power of buyers, Threat of new entrants, Threat of substitute products/services
 - Internal/External Strategic Factor Analysis – The SWOT analysis deals with the assessment of external Opportunities and Threats a company will face with it's internal Strengths and Weaknesses.

4.1.2 Stage 2: eTransformation Goals/Strategies

- **Significance and Outcomes:** A corporate strategy/goal has to be arrived at taking in to consideration all the strategic factors looked at so far which will explain the driving force for change. Depending on the status of the organization, the strategy should be adopted for *Survival, Sustainability or Growth*[1].
- **Methodology used:** After determining the type of organization, the organization should decide on it's strategic positioning. According to Michael Porter, Strategic Positioning means performing *different* activities from rivals or performing similar activities in *different ways* [12]. Porter's generic strategies can be used to derive the most effective one of four strategic positions. They are Cost Focus, Cost Leadership, Differentiation Focus, Differentiation.

4.1.3 Stage 3: eReadiness (Internal/External)

- **Significance and Outcomes :** None of the eTransformation models developed so far try to see whether the organization is ready to go through the eTransformation process. It is very important for the CEO to see the implications and check the eReadiness of the company to go through this major transformation.
- **Methodology used :** Seven important aspects are discussed in relation to the e-readiness of the organization. They are Business processes, Applications & Infrastructure, Web presence, Skills, Executive mgt, External connectivity, Future directions.

4.1.4 Stage4: eTransformation Roadmap

- **Significance of this Stage:** The organization is fully aware of it's strategic position and where the competitive advantage is, and it's readiness to eTransform. It now needs a clear path to follow. The road map assesses the current status of the company in the roadmap and shows the direction to proceed.
- **Methodology used:** The eTransformation Roadmap developed by the University of Western Sydney (UWS), Australia is the guideline being used for the successful eTransformation of many enterprises in the region of Western Sydney along with the evolutionary eTransformation methodology[10].

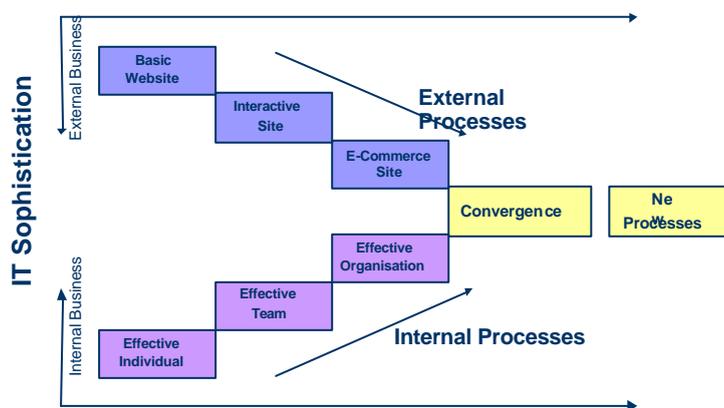


Figure 2. The eTransformation Roadmap [10]

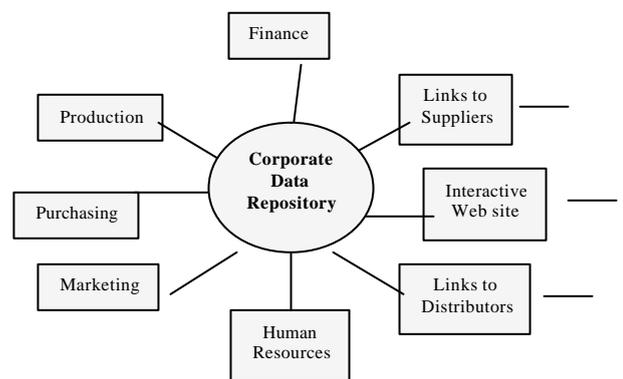


Figure 3. The Convergence Model [10]

4.1.5 Stage 5: eTransformation Methodology

- **Significance and outcomes:** The successful eTransformation is not easy. There are so many techniques used in the world, but some organizations have failed miserably, damaging rather than enhancing their competitiveness. The Evolutionary eTransformation methodology developed by the University of Western Sydney, Australia is a strong believer of the importance of the business aspect of eTransformation. This methodology is being used successfully in e-transforming a number of companies in the region of Western Sydney.
- **The Overall Methodology used:** The following eTransformation Methodology [10] diagram shows the iterative evolutionary process, which enables the enterprise to become more adept in handling the change, which in turn will help to transform itself successfully and relatively quickly.

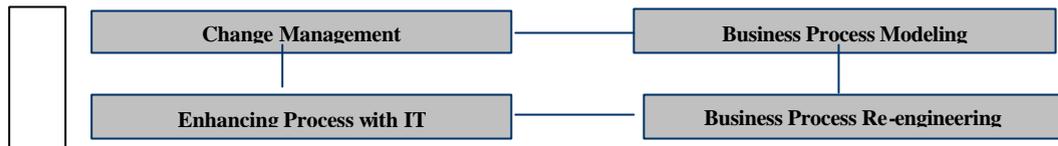


Figure 4. Adapted from the eTransformation Methodology[10].

- **Methodologies used in each step and Outcomes:**
The iterative nature of this stage makes sure that the changes are not drastic and not difficult to cope with. In the business environment, modifications and changes to systems are inevitable. This approach solves that problem by managing each change step by step and revisiting the business goals and strategies to make sure that the company is going in the right direction.
- **Business Process Modeling**
The business processes of the company are studied and divided into 3 categories - Core processes, Support processes and Management processes according to the methodology used by Martyn A. Ould in his article "Business Processes – Modelling and Analysis for Re-engineering and Improvement" [3].
- **Business Process Reengineering**
All organizations are built on three main pillars which are People, Processes and Technology [4]. First, the processes of the firm have to be identified along with the problems faced. Then the technology and the people issues have to be addressed in order to re-engineer a single process or a whole set of interconnected processes in order to add value to the customers.
- **Enhancing Business Processes with IT**
A component based development technique could be used for the implementation, which is cost effective rather than developing software from scratch. Various applications such as invoicing, purchasing, marketing etc can be developed as components and plugged into a Shell. A study carried out with the eTransformation of the Garment Industry in Sri Lanka proved the above point to a great extent [13].
- **Change Management**
The reengineering of business processes triggers changes in *business processes, applications, employee and skills, technology infrastructure, and executive management*. The implementation of the changes are done according to the 7 S Model developed by McKinsey and Company in 1980s. It addresses issues related to Shared Values, Strategy, Systems, Structure, Skills, Staff and Style.

4.1.6 Stage 6: eSystems (ICT/Business Systems Maintenance, Policies/Security, Support)

- **Significance of this Stage:** After Business Process Reengineering, there will be a proposed organization-wide 'Business and IT' integrated system. Along with this, the business thinking, the IT policies and the support systems will also need to be in the proper place for the organisation to successfully sustain in the long run. According to the U.S. Department of Commerce – NIST Handbook [7], the eTransformed organization must apply the appropriate Management controls, Operational controls and Technical controls along with the incorporation of the IT policy in to the corporate policy.
- **Methodology used:** This section deals with the proposed eEnabled systems in the transformed organization, which could be broadly categorised into 4 areas: ICT Infrastructure, Business Systems, IT Policies/ Security Measures and IT Maintenance/support for the Organization

4.1.7 Stage 7: Evolution –Overall Change Management

- **Significance of this Stage:** After going through each of the other stages, there could be internal changes the organization may want to go through, which can be done by going through to this stage and implementing them using the 7 S model. This stage runs across all stages linking them to each other linking and implementing the Strategic, Managerial and operational changes.
- **Methodology used:** The model used to deal with the strategic, operational and other changes is the well accepted 7 S model developed by McKinsey and Company over 20 years ago.

5. CONCLUSION

Information from a European survey of 2400 companies show that the main criterion for the selection of an information system is the best fit with current business procedures but, several studies have shown that configuring and implementing ERP solutions can be costly and may even require reengineering entire business operations [10].

The proposed eTransformation model, takes in to consideration the environmental aspects and the model transforms the organization along the selected business strategy using the roadmap as the guideline. The model addresses the important issues of change management, infrastructure and maintainability.

Michael Hammer and James Champy in their best selling book 'Reengineering the Corporation'[1] have stated the most common errors that lead companies to fail in reengineering. Some of them are

- Trying to fix a process instead of changing it
- Not having a focus on business processes
- Ignoring everything except process redesign
- Neglecting peoples' values and beliefs
- Willing to settle for minor results or quitting too early

The Seven E model addresses all aspects mentioned above ensuring success to the organization in the eTransformation process.

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ASSESSING E-LEARNING IN AN MBA PROGRAM

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ABSTRACT

This paper explores how an online MBA program has designed and implemented a comprehensive assessment strategy to evaluate the program's effectiveness and the extent to which students have acquired the skills and literacy levels needed in today's workplace. The assessment strategy has three main components: the values, outcomes and student competencies linked to program objectives and outcomes; a personal development plan or portfolio completed by each student to identify academic and professional goals and objectives; surveys providing students opportunities to comment on their reactions to course content and format and their learning: At the end of the class to what extent do they believe they are able to successfully perform the tasks specified in the course objectives? Finally, six months after students complete their program, graduates and their employer are asked to assess the extent to which graduates have been able to apply what they've learned in the program to produce business results in their workplaces. Although an assessment plan is essential in any education or training program intent on measuring student learning and content relevance, it is especially critical in an accelerated online program serving a very diverse, worldwide audience. An assessment plan has allowed the MBA program at the University of Maryland University College to demonstrate that student learning actually occurs in an online program and to gather evidence to document, explain, and improve performance.

KEYWORDS

Online assessment, higher education .

1. INTRODUCTION

A recent U.S. Department of Commerce report (1999) emphasized the fact that over 90 million Americans lack the skills and literacy levels that will be needed for the 21st century workplace. With approximately 4,000 public and private institutions serving only 14.5 million students, higher education in the United States and around the world will be challenged to scale up substantially to provide the kinds of educational resources needed in the decades to come. The Internet and related e-learning technologies offer a platform that can help higher education institutions keep pace with the expanding demand for knowledge and learning. At this time over 3,000 higher education institutions in the U.S. and a growing number of colleges and universities outside the U.S. offer a range of online courses and degree programs. This paper explores how an online MBA program in the University of Maryland University College (UMUC) has developed and implemented a comprehensive assessment strategy to evaluate the program's effectiveness and the extent to which students have acquired the skills and literacy levels needed in today's workplace. .

2. ASSESSMENT STRATEGY

2.1 Overview of UMUC's MBA Program

UMUC, an institution that has been serving part-time and mid-career learners for over fifty years, has extended its reach and made its resources available to learners around the world by increasingly offering

more Web-based education courses. To facilitate its online programs, UMUC developed its own Web-based learning management system, WebTycho.

UMUC's MBA program is designed to give students with full-time jobs around the world the opportunity to receive their degree in under three years and requires students to take an active role in their education. The goal of the program is to make students successful independent learners, a skill which will serve them well professionally throughout their careers. In the MBA program students and faculty share the responsibility for creating a rewarding academic experience.

The MBA program consists of a one-credit MBA fundamentals course and seven six-credit interdisciplinary seminars. The material in each course builds upon the material from previous courses while laying a foundation for future seminars. Six major management and organization themes span the curricula of the individual seminars.

The management themes focus on important functions of a manager -- the manager as a decision maker, a critical thinker, and a strategic thinker. The organizational themes include foundations of modern organizations, the organization as a global enterprise, and the future of organizations.

2.2 MBA Assessment Strategy

UMUC has developed an integrated assessment strategy to accomplish several objectives: to link learning objectives and expected learning outcomes; to provide data about student preparation, academic achievement, and development; to ensure that learners and faculty are partners in the learning process; and stimulate improvement of teaching and learning. Although an assessment plan is essential in any education or training program intent on measuring student learning and content relevance, it is especially critical in an accelerated online program with students and faculty located in several countries around the world. The basic purpose of the MBA assessment strategy is to ensure that students will develop skills, knowledge, and abilities to be successful managers in their organizations.

The assessment strategy has three main components. First, the MBA program's values, outcomes and student competencies were identified and linked through a series of assessment matrices, one for each seminar. Each of the matrices match the course objectives to the program outcomes and the seminar assignments to the course objectives. These matrices offer a systematic view of the integration of content in the MBA program across the seminars.

The second component of the assessment strategy is a personal development plan (PDP) that each student completes in the first seminar and then expands in subsequent seminars. The PDP or portfolio is a vehicle to encourage students to become an active partner in their learning process by identifying their own academic and professional goals and objectives and reflecting on their learning experiences in the seminar. Students are encouraged to pursue these objectives through the interaction and assignments in each seminar.

In the first three MBA seminars students use electronic portfolio software provided by an external vendor, Nuventive, to reflect on their learning. Throughout the remaining seminars students have the option of either extending their portfolio accounts on their own or developing their own portfolio files. Yancy (1998) has indicated that reflection, the process that encourages students to think about how they learn, consists of **reviewing** the products they create and produce, **projecting** how they want to control and manage their learning, and **conceptualizing** problems from divergent perspectives. MBA students create portfolios that showcase the skills and knowledge they've acquired in the MBA program and in the workplace; they may create several portfolios customized for a number of prospective employers.

In their portfolios students assess their skills and knowledge in each seminar. They rate themselves on fifteen competencies - each representing important knowledge, skills or abilities that have been identified and tied to seven measurable and observable outcomes that graduates will be expected to demonstrate or accomplish by the end of the program. The individual course objectives in each seminar are linked to one or more of these program outcomes. In turn, the specific assignments in a seminar are matched with one or more of the course objectives. This makes the connection between assignments and program outcomes clearer and student attainment of the competencies more likely.

The final component is a series of pre-program, end-of-seminar and end-of-program program surveys (typically used in all on ground and online courses) that all students complete periodically in the MBA program and 3-6 months after graduation. Figure 1 depicts the linkages between the components of the MBA assessment strategy and the four levels of evaluation addressed in this plan (numbers in boxes):

Level 1. End-of-Seminar Surveys and End-of-Program Surveys assess class participants' reactions to the program and what they plan to do with the material.

Level 2 Grades and End-of-Program Survey assess learning - which skills, knowledge or attitudes have changed and by how much.

Level 3 Alumni complete surveys and/or participate in focus groups 3 or 6 months after graduation to determine whether or not they applied on the job what they learned.

Level 4 Alumni and employers will complete surveys and/or participate in focus groups 3 to 6 months after graduation to determine whether or not on-the-job application produced measurable business results. This level of evaluation is the primary challenge in the assessment plan. Initial focus groups with program graduates have suggested changes to improve student learning - for example, the need for faculty assistants in project management and financial management seminars - that have already been implemented.

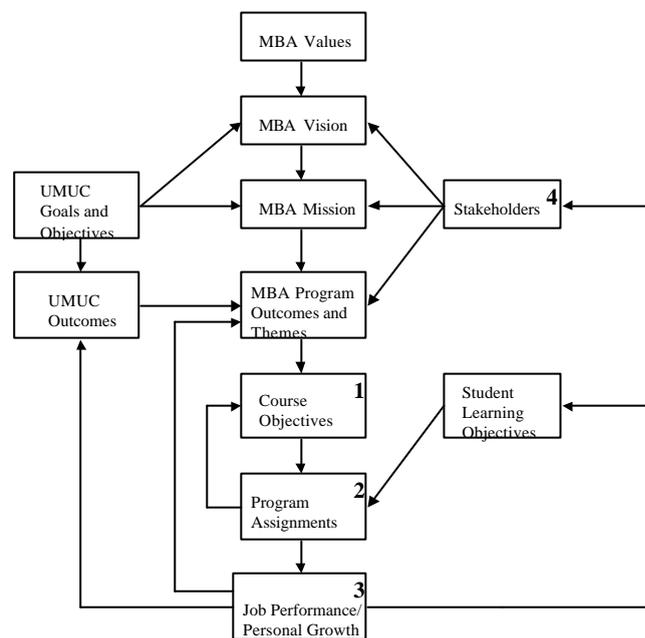


Figure 1. MBA Assessment Strategy

3. CONCLUSION

If an online assessment strategy of online learning is to have any meaning, in the end it should translate into improved student learning and better educational practices at the program, department, or institution level. Furthermore, the plan can become a vehicle for programmatic quality by driving curricular and programmatic reform, such as a systematic emphasis on ethics throughout the program. At UMUC the assessment strategy has begun to serve as an indicator of online program quality to the administration and external stakeholders. As a state institution, UMUC faces challenges in an environment characterized by increasing external scrutiny, accountability, and scarce resources. The ability to demonstrate that student learning actually occurs, an assessment benefit, is becoming more crucial.

Finally, since assessment is an ongoing review of a program and its goals, UMUC's assessment plans include feedback loops that identify problems based on measured results, and the implementation of needed corrections. UMUC's assessment plan is simple, flexible and it's working. Through the assessment strategies

the MBA program has made explicit and public the expectations and standards for quality, systematically gathered evidence on how well performance matches these expectations and standards, and used evidence to document, explain, and improve performance.

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COMMUNICATE WITH STAKEHOLDERS USING THE WEB

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ABSTRACT

In this paper we analysed the use of the web as a communication media with the stakeholders. In fact, being a relatively inexpensive communication media, the web allows some organisations with few resources to spread its message to a wide audience. By using the stakeholder analysis it was possible characterising its audiences. But a question was left, is the web used to reach those stakeholders. In order to answer this question, we performed an analysis of websites of the NGOD (non-governmental organisations for development).

KEYWORDS

World Wide Web, stakeholders' analysis, non-governmental organisations

1. INTRODUCTION

Internet, and specially the web, plays an important role in the communication policy of organisations. Especially organisations with few resources, like some non-profit organisations, have to choose some media to communicate with their stakeholders. The use of the web is a possible solution.

In fact, the web is not just a media of advertising products, not even just a way of supporting the marketing strategy of the firm. The web may support the development all the corporate strategy (Kalakota & Robison, 2001). But, like any other organisation, non-profit organisations have to be managed effectively and efficiently (Druker, 1990). Nowadays, if business organisations may take advantages of the web, why non-profit organisations may not use the technology in order to optimise their resources.

In this paper we analyse in what extent NGODs use the web to communicate with their stakeholders. In the section two the concept of stakeholders is presented, as well as a brief literature review. Then we analyse literature concerning the NGO, non-profit, 'voluntary organisations' and the third sector. In forth section it is discussed the use of the web as way of communication with stakeholders. Then, in the fifth section, we report the survey and finally preliminary conclusions are presented.

2. STAKEHOLDERS' ANALYSIS

Organisations exist because of their ability to create value and acceptable outcomes for various groups of stakeholders. Those stakeholders are people who have an interest, claim, or stake in the organisation, in what it does, and in how well it performs (Freeman & Reed, 1983). In general, stakeholders are motivated to participate in an organisation if the received incentives exceed the value of the contribution they are required to make (March & Simon, 1958).

The origins of stakeholders' analysis started as an approach developed in the business and managerial science fields (Freeman & Reed, 1983, Freeman, 1984). But some researcher (Clarke & Clegg 1998), found that economic theory centred on notions of stakeholder relations goes back to the beginnings of industrialism and is embedded in ideals of 19th century co-operative movement and mutuality. Other researchers (Brugha

	Communication organisation -> stakeholder	Communication Stakeholder -> organisation	Demand of stakeholder	Goals of stakeholder
Users/ consumer	Product/service information	Service and product requirement	Satisfy the need	Get the best product
Contributors	Activity information	Opinions	Effectiveness and efficiency of contributions	Contribute to society improvement through financial contribution, Tax reduction
Volunteers	Activity information, supervision, services	Labour, opinions	Effectiveness and efficiency of work, acceptable working conditions	Contribute to society improvement through work
Employee (or workforce)	Supervision, services	Labour, opinions	Salary, Good working conditions	Higher salary, Enjoy work, Get promotion
Supplier	Orders, Advertise	Services, product information	Clear instructions, money	Get more orders, expand
Government	Ask for permits, Information on activity performed	Legislation, Prescriptions	Meet laws, Have work done	Reduce costs with social activities, Receive tax, employment
European Union	Information on activity performed	Legislation, Prescriptions	Develop activity with effectiveness and efficiency	Improve harmonisation
Society	Activity information	Opinions	Develop activity with effectiveness and efficiency	Improve general welfare

Figure 1. ONG Stakeholders

& Varvasovszky, 2000) suggest that stakeholder theory appears (or reappears) in business and management discussions of the 1930s.

Stakeholders' analysis fits in with a great range of approaches (Burgoyne 1994, Grimble & Wellard 1997). Stakeholders' analysis is currently used in fields ranging from political science to policy development and international relations. The concept and related methodology have made significant inroads into poverty reduction studies and applied research pertaining to issues of sustainable livelihood, community-based natural resource and conflict management (Ramirez, 1999). Dispute resolution practices and the social actor perspective in the social sciences are also related to the stakeholders' analysis (Grimble & Wellard, 1997, Oudman et al., 1998). It is also part of World Bank thinking on participation methodology since about 1993 (MacArthur, 1997).

Stakeholder's analysis is also used in the information systems field, to analyse the impact of the implementation of a system. Stakeholders may be categorised into two groups (Jones, 1998): inside stakeholders, like shareholders, managers or workforce, and outside stakeholders, like customers, suppliers, government, unions, community and general public.

3. THE NGO

The literature concerning non-government organisations (NGO), non-profit organisations, 'voluntary organisation' or third sector analyses a wide range of problems:

- Growth and evolution of NGO roles in development and relief work, with policy issues of NGO relations with states and donors and with community-based action and social change (Drabek, 1987; Farrington et al., 1993; Clark, 1991).
- The 'aid industry' (Clark, 1991; Hulme & Edwards, 1997; Fowler, 1997),
- Development practices (Korten, 1990; Carroll, 1992; Smillie, 1995).
- The potential of NGOs to transform development processes in positive ways (Korten, 1990; Clark, 1991; Edwards & Hulme, 1992).
- Different explanations for the existence of the third sector (Powell, 1987; Anheier, 1995)
- Policy issues such as the growth of contracting (Smith & Lipsky, 1993; Kramer, 1994).
- Service delivery and welfare organisations (Billis, 1993; Salamon, 1994).
- Organisational structure and management issues (Butler & Wilson, 1990; Young, 1992; Billis & Harris, 1996, Fowler, 1989)
- Processes of development alongside the state, local government, foreign donors and private corporations (Farrington et al., 1993; Wuyts et al, 1992; Hulme & Edwards, 1997).

Some authors also distinguish between non-profit and NGO, based in the literature research. While termed 'non-profit' or 'voluntary' organisations focuses on literature related to developed countries

(Salamon, 1994; Smillie, 1995), the concept “non-governmental organisations” is related to work which examines these organisations and their activities in developing countries (Korten, 1990; Clark, 1991; Edwards & Hulme, 1995).

Based in the literature review, the following stakeholders were identified: users/ consumer, contributors, volunteers, employee, supplier, government, European Union and society. There are some stakeholders, whose behaviour towards the organisations is similar. For example, a nurse working as an employee in a public hospital, to a NGO or a private organisation probably will see the organisation just as an employer. A person may get an employment in any organisations and not knowing if it is a private, public or non-profit organisation. But, a nurse may also work as a volunteer, for example in an NGO working in a developing country. The main difference in relation to the stakeholders identified in the last section is the identification of volunteers, a special type of employees, that contributes to the organisation and does not have as main incentives the wages, bonuses, stability in employment or promotions. Users and consumers generally do not pay for the full service. In those organisations, the contributors are those that giving money for “charity” in fact pay the services, or at least a great amount of it. Finally, the role of the Government is different from that presented by Jones (1998) and analysed in the last section.

4. THE WEB

The use of the Web allows the possibility of communicating with a great quantity of people with a relatively low cost. On the other hand, it allows the use of text, images, film and sound.

The web has been used as a way to communicate with clients, obtaining information from clients, supporting the supply chain or procurement. The Web is used to support marketing (Carpenter, 2000). The web may be used in the enterprise resource planning (Perez et. al, 1999). As mentioned by Kalakota & Robison (2001) the web may support, not only the advertisement, but also communication with clients, suppliers (procurement), supporting all the value chain of a business or an industry.

The Web may also be used as a privileged way to communicate with shareholders, investors and government, making available financial information. In what concerns this kind of information, it was found that organisations generally do not supply much information. But the purpose of this paper is not analysing just one stakeholder but having the general picture of the communication between stakeholders and organisations.

5. APPLICATION - NON-GOVERNMENTAL ORGANIZATIONS FOR DEVELOPMENT

We used as field of application the Portuguese NGOs that have websites. Then, we developed a questionnaire including 32 questions related to the organisation, presentation, technology, language and conventions, as well as availability of information to stakeholders. We used a 5 point Likert scale. This questionnaire was then used by a group of four people that evaluated the sites of the Portuguese NGOs. The websites evaluated corresponded to the totality of the Portuguese ONGD with website (n=24).

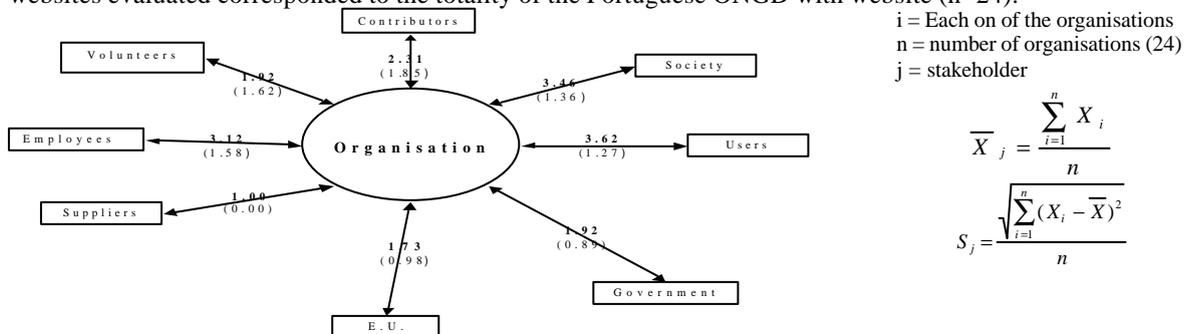


Figure 2. - NGO and stakeholders

The Figure 1 shows the result of the field study. The questions analysed was the following: in what extent the website is useful in the communication with the stakeholders of those organisations. In each arrow average and standard deviation may be seen.

After analysing data, the following conclusions were evidenced:

Technologie/formatss	Document genres
<ul style="list-style-type: none"> • "Downloadable" documents (txt, doc, pdf, ZIP files) • e-mail references • forms and CGI • Text in the page (HTML) • Multimedia (Flash, Quicktime) • Java applets 	<ul style="list-style-type: none"> Mission declaration Service and product information Activity report Budget Direction speech Chat Guest Book Action Plan Meeting verbatim Games Simulations

Figure 3. Technologies and Document Genres

- The number of organisations classified as NGO for development having websites is very small (corresponding to just 26%), as long as 24 have website in a universe of 92 organisations.
- NGOs presented in the web useful information to employees, society and users;
- WebPages have no information (or useful information) to suppliers. In fact, the score given by the group to all websites was 1;
- The information presented to contributors has an "average level" of usefulness (near 2.5);
- In what concerns information to volunteers, there is a great variability, with some organisations presenting useful information and a great number of organisations without useful information, what was reflected in a great standard deviation;
- Information to E.U. and government is reduced but all the organisations have similar data.

A more detailed analysis is still being performed, and results are not yet completely evaluated. This analysis consists of evaluating the technology as well as document genres employed in the websites of the NGO for development. Some of those technologies and document genres are presented in Figure 3.

6. CONCLUSION

In this paper it was analysed the use of the Web by organisations, especially NGO, in the communication with their stakeholders.

We verified that some of the sites are more oriented to stakeholders than others. But it was also observed that Web is not fully explored as a media for communication with its stakeholders. In fact, while some websites are just poor presences not fully developed, other websites are more sophisticated but do not have a clear purpose. On the other hand, some sites are specially used to communicate with some stakeholders, like society, users and employees. A detailed study of each site must be performed, identifying not just the technology employed but specially the document genres presented.

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EVALUTATION OF COLLABORATIVE DOCUMENT CREATION

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ABSTRACT

Modern use of Internet technologies is being used to create unique environments supporting collaborative writing. Wiki sites of the late 1990's and the more recent development of blogging sites indicate a trend toward cooperation in creating objects of information. The authors are beginning a series of research projects to explore several variations of team-based, peer-evaluated co-authoring. The experimental environment consists of a web-conference with the functionality of a deliberative body. Authorized users propose enhancements to a shared document. Members can discuss the proposals via an integrated discussion utility and either approve or disapprove any proposed enhancements. Only those proposals approved by a predefined percent of participants are included in the shared document. This paper describes the environment and the goals of the ongoing research.

KEYWORDS

Learning Communities, Computer-Mediated Communication, Collaborative Authoring

1. INTRODUCTION

When an individual sets out to produce some work (a document, declaration, plan or product), communication patterns tend to be hierarchical. The initiator may delegate aspects of the product to subordinates, production tasks may be assigned to artists or contractors, but these individuals do not participate in determining the content of the product. The expert retains the role of author. The product is completed when the expert declares it to be completed.

Indeed, most popular views of the creative process focus on the talent and genius of the individual. Descriptions of the creative process suggest the product is produced in a nearly spiritual manner. The idea of the product builds in the mind of the creator and then flows, nearly complete, from the mind of the creator into a form that can be viewed and appreciated by an audience. Mozart and Einstein describe such a process in letters to colleagues (Ghiselin 1952, p32-35). The descriptions suggest the product is formed in the wordless space of their intellect and then transcribed into a physical form that is communicable to others.

We argue that the idea of an individual effort is an illusion. Stephen Dobranski published a book exploring patterns of collaboration in John Milton's writings. "Throughout this book, I describe the complex genesis of Milton's writings as a 'collaboration,' by which I mean a co-laboring or working together. Milton benefited from the advice and assistance of acquaintances both during the imaginative creation of his works and during the practical process of putting his writing into print. Rather than accept modern assumptions about authorial control and consistency, we discover a complex process of authorship that enables and contradicts our perception of the poet as a solitary genius. Laboring as an author, Milton produced some of the greatest poetic and prose works in English literary history. He did not, however, labor alone." (Dobranski 1999, p 9-13)

Internet technology has the promise of facilitating the collaborative effort. Easy access and update capability of Internet technologies has already given rise to personal journals. Individuals write their journal online (blogging). These electronic journals are available for review by anyone in the world. Comparisons have been made to the Viennese coffeeshop where artists met for talk, discussion and mutual inspiration.

"There has been a lot written, both on blogs themselves and in the more mainstream media, about the blogging phenomenon. For the most part, the writings have centered on blogging's relationship to existing print media and punditry, which is understandable considering the many similarities. However, I'd like to suggest a different comparison—I think blogging is the modern day equivalent to the old Viennese coffee houses of the early 20th century. Those coffeehouses served as the center for public intellectual discourse. Writers, thinkers, and other intellectuals would gather there, where they would read the papers . . . and discuss the issues of the day. Similarly, here on the Internet, bloggers surf the papers, linking interesting articles and posting thoughts about them." (The Media History Project, 1996)

When a group of people comes together to produce some product, they are creating a resource held in common. This common property starts as an idea and grows into an information object reflecting the effort and talent of the participants. Lawrence Lessig defines the commons.

"In most cases, the commons is a resource to which anyone within the relevant community has a right without obtaining the permission of anyone else. In some cases, permission is needed but is granted in a neutral way." (Lessig, p 19-20)

The rise of Internet writing is a fascinating development, suggesting a trend toward truly collaborative efforts. Current research provides insight into how online teams arrive at agreement and acceptance (Kahai, 1999). There is growing understanding of how online teams form and create cohesive, task oriented groups. (Yoo 2001). There are even convincing voices suggesting that computer mediated communication is an entirely new phenomenon requiring its own set of theory and predictive models (Caplan 2001). But there are many questions still to explore.

2. BODY OF PAPER

Modern technology can be configured to support and encourage collaboration and motivate the collective creative process. If the product is to be produced by collaboration, the communication patterns tend to form a network rather than a hierarchy. The group or assembly interacts to create the product's content. The product is complete when the group arrives at a consensus, or a majority vote, that the product is ready for distribution.

The collaborative model requires that the product, in all its stages of completeness, exist in a communicable form from the beginning. Participants must be able to contribute, modify, alter and augment the work over the time the product is being created. The collaborative process is an iterative effort of proposing enhancements, subjecting them to the considered opinion of others in the group, and refining the document with advantage of critical review. Christopher Alexander discusses a design process of creating good fit. "I should like to recommend that we should always expect to see the process of achieving good fit between two entities as a negative process of neutralizing the incongruities, or irritants, or forces, which cause misfit" (Alexander, p 24).

We are conducting a series of projects to explore how people work in a collaborative environment. The environment we have defined has grown out of our efforts to support online focus group research and collective curriculum development. We have modified the environment to allow us to study groups of individuals as they jointly create a single document. The general flow of the collaborative environment is described below.

Individuals are provided access to a secured site and given the objective of collaboratively creating a document(s). The team communicates asynchronously using a threaded discussion (see figure 1).

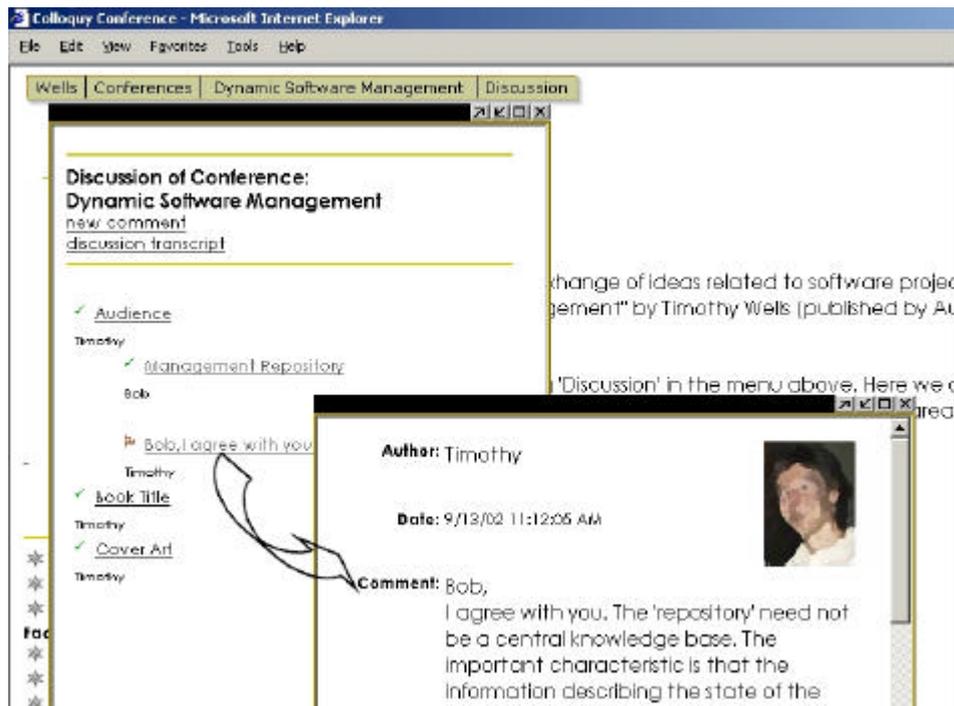


Figure 1. Discussion utility of collaborative writing site

A topic within the conference is declared as a shared document and the moderator configures the document's approval mechanism by declaring the threshold of approval required for inclusion in the document. The threshold can range from zero percent, meaning any change a member proposes is automatically added to the document, to 100 percent, which requires all team members to approve of the proposed change before it is added to the document. The shared document is visible to all team members. The display reflects the current state of the document, that is, all approved enhancements to the document are displayed.

At any time, any team member can propose a change to the document. These changes are in the form of a proposal to the rest of the team that a section be replaced, deleted, or a new section be inserted into the document. Other team members are notified of the proposal by a link appearing on the document display. If the individual team member has yet to vote on the proposal's acceptance, a red flag appears. If the individual has registered his or her vote, the flag is replaced with a green check mark (see figure 2).

To register her or his opinion, the team member follows the proposal link to display the full proposal. Below the proposed change is a ballot allowing the team member to approve or disapprove of the change. If the document threshold is reached, the change becomes part of the document. Proposals can be made to change any section of the document regardless of the number of proposals made over time. The entire document remains dynamic for as long as the team members propose changes.

Issues that need to be explored include:

- What is the effect of high approval thresholds?
- What limits exist on the size of the collaborative team?
- Do larger teams form factions that then exert influence as a block?
- Does the formality of the approval process diminish the individual's creativity?
- What is the effect of asynchrony on the collaboration?
- Do delays in communication have negative/positive effects on feelings about contributing to the effort?

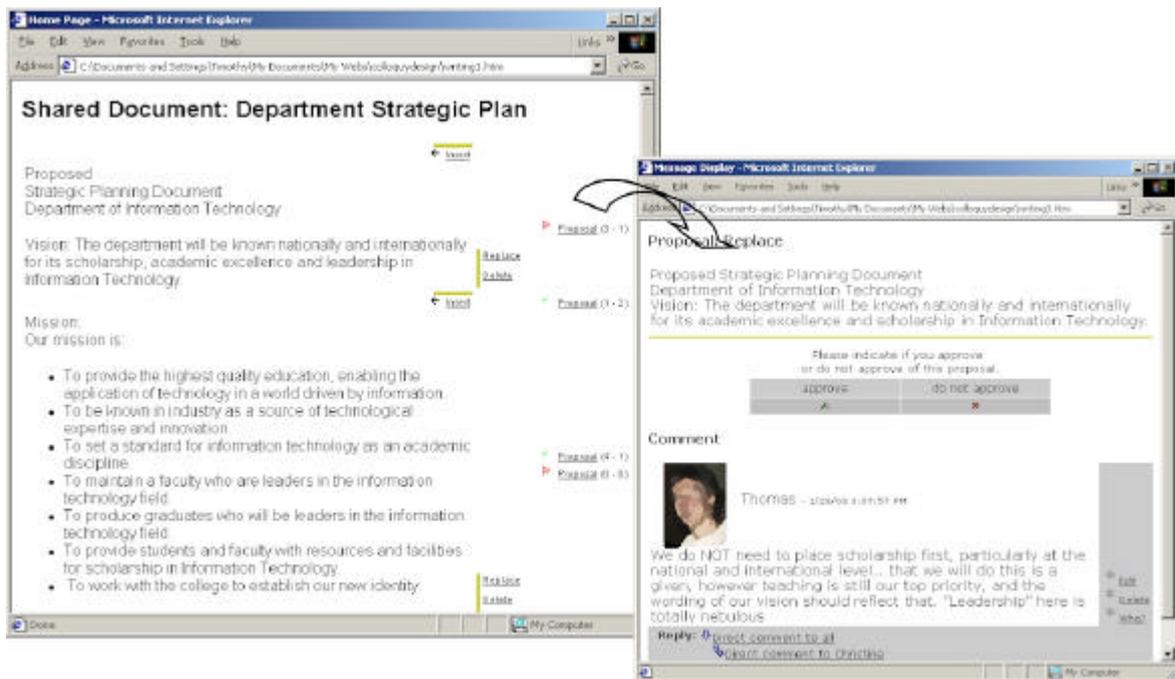


Figure 2. Approval of proposed enhancement in collaborative writing site

3. CONCLUSION

The authors are monitoring the use of collaborative environments and gathering survey data from participants. Content of the collaboration is assessed for quality and compared to similar documents created by qualified individuals. The results of the projects will help define functional characteristics of collaborative writing environments and provide insight into the emotional and behavioral responses of participants of co-authored documents and shared memory.

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SEMANTIC TOOLS FOR ACCESSING LEGAL INFORMATION

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ABSTRACT

The subject of this paper is a description of the *Giur-Wordnet* (Giur-IWN) project, aimed at the development of a semantic net for legal domain, as an extension of the *EuroWordNet* database and of the *Interlingual Index* (ILI) records, that will provide both a content description model for legal information and a tool for accessing multilingual information sources.

KEYWORDS

Right to accessing Legal Information, Legal Standard for content description, Multilingual Retrieval, Ontology-based Information Sharing.

1. INTRODUCTION

The subject of this paper is a description of the *Giur-Wordnet* (Giur-IWN) project, an extension for legal domain of the *EuroWordNet* (EWN) database and of the *Interlingual Index* (ILI) records, aimed at providing both a content description model for legal information and a tool for accessing multilingual information sources.

The starting point was the *Norme in rete* (Law on the Net) project, launched in 1999 as part of the Italian *E-government Plan*. [4]. The portal allows free access to normative information through standard methods of editing, processing, and distributing data, which will lead to a direct, self-updating access, by reaching the sites of law makers (and distributors) themselves.

System design, by now consolidated,[2] consists of classes of XML DTDs for structuring normative ¹texts and of metadata², the most relevant part of which deals with the formal/structural features of each type of source, and with *urns* for the identification of the partitions of texts. Thus, the Giur-IWN terminology database supplies: 1) A source of metadata for semantic tagging of legislative texts at the level of articles-or better, of dispositions. 2) A support tool for information retrieval systems, for facilitating access to heterogeneous and multilingual data. 3) Wordnet could constitute an interface between queries and standard metadata The greatest part of legal thesauri are primarily designed for the "professional" user and not for members of the public: in order to focus on the needs of members of the public who as citizens need access to the information provided by the Legal Sectors, a lexical/semantic tool, as Wordnet is assume to be, can provide the 'missing ring', a valid interface between the 'common language' approach of citizen and the specific codified terminology of legal standard. 4) A conceptual knowledge base, which can be used for information extraction, automatic tagging, knowledge sharing, norm comparison, etc.

¹ A detailed description of DTDs for legislative texts is published at: http://www.normeinrete.it/standard/standard_xml.htm; similar initiatives are: www.lexml.de, <http://www.legalxml.org/>, <http://lri.jur.uva.nl/METALex/>.

² The "Norme in rete" Project also includes the definition of XML DTD for judicial decisions, local regulation, and public contracts, still in progress.

2. METHOD OF DEVELOPMENT OF THE SEMANTIC NETWORK

WordNet is a semantic³ network developed by the linguist George Miller and his colleagues at Princeton University. It consists of a lexicon containing all the most important terms in the English language structured as a “semantic net”; a network, that is, in which the meaning of each lexical unit (term) is represented by its semantic relationships (hyper/hyponymy, synonymy, antonym, etc.)⁴ with the other terms. WordNet, developed a decade ago, is available free of charge on Internet. ILI is the “inter-language” that, from WN, interrelates the lexical/semantic networks developed for the other European languages in the *EuroWordNet* project financed by the European Community. Currently, more than twenty languages share the same methodology and development structure and are linked to each other through the English language. *ItalWordNet* (IWN) is the section of *EuroWordNet* that was created for the Italian language by the “Institute of Computational Linguistic” of the CNR of Pisa⁵; specialised sectors dealing with technical domains, among which *EcoWordNet*⁶, for economic/financial language, and *Euroterm*⁷, have augmented IWN’s capacities. Giur-IWN makes use of the same methodology and tools adopted for the generic resource: network nodes are *synsets* (sets of terms treated as synonyms) that represent the *basic terms* of the domain; they are linked by several semantic and taxonomic relations; the *basic terms* of law are singled out either according a relevance criterion from the legal/institutional viewpoint, or according a frequency criterion; that is, they are the most frequent terms in user queries of the major legal information retrieval systems. We thus used what may be termed a “bottom-up” approach from existing linguistic/terminological resources to select relevant terms, to define primary lemmas, and to build hierarchical trees. Among the available resources, the following were felt to be most appropriate to our research needs. For identification of the relevant terms: the query strings of the Progetto N.I.R. and those of ITALGIURE⁸. For definition of the principal technical concepts: handbooks, dictionaries, legal encyclopaedias, etc.⁹, and the L.L.I. containing historical archive of Italian legislative language [7]. For determination of the syntagms relative to the principal lemmas: the syntagms extrapolated by the ITALGIURE Information Service.

Each group of terms, made up of a basic term and its hyponyms, is further structured from the bottom up and using the hyperonym relation. For example, “*provvedimento*” (ruling) is considered a hyponym of “*atto giuridico*” (juridical act). Where possible, synonym variants were also included. By the end of this phase, the terms collected are about 1500, counting the principal lemmas with their relative syntagms.

As foreseen by EWN, the next phase, still in progress, consists of connecting Giur-IWN with IWN and with the ILI (*Inter-Lingual Index*) in order to integrate the synsets with the networks of the Italian and the other European Wordnets. Because of the real diversity in the points of view between the “common” knowledge codified in the generic Wordnet and the specialist knowledge codified in the terminological Wordnet, we need to use plug-in functions of equal or lower level when the legal meaning does not completely overlap the generic meaning.

3. POLISEMY HANDLING

Polysemy arises in legal terms both in relation to common language and within the specific context. For example, at the legal level the term “*canone*” represents a payment (in money or goods) and according to

³ The semantic classification is based on a representation model that reproduces the human associative memory; through relations that connect a word to other words and relations of sense between the concepts expressed from the terms”. See, Tiscornia D. “*Il Diritto nei modelli dell’Intelligenza artificiale*”, Bologna, 1996, p.27

⁴ The EuroWordNet project, defined 16 various types of relations which as an example: *synonymy*, *hyperonym/hyponym* (logic relation of inclusion between set and sub-set) *meronym* (part-hole relation), *antonym* (opposite meaning as: dead /alive), *relation of causality*, *involvement/role*, *reference*, *derivation*, etc.

⁵ (www.ilc.cnr.it).

⁶ Developed by Institute for the Scientific and Technological Research of Trento (IRST).

⁷ Euroterm is an extension of Eurowordnet with Public Sector Terminology funded by EC in the E-content Program. (www.ceid.upatras.gr/en/index.htm).

⁸ Italgiure/find is the main public legal information system, held by the Italian Supreme Court of Cassazione.

⁹ Enciclopedia giuridica, 1995, Treccani, Roma, I; Enciclopedia del diritto, 1989, Giuffrè, Varese, I; Grande Dizionario enciclopedico del diritto, Fratelli Fabbri Editore, Milano, I; De Mauro T., Il Grande Dizionario italiano dell’uso, UTET, Torino, I; Il Dizionario della lingua Italiana, 2002, Garzanti, Milano, I; Il Nuovo Zingarelli, 2002, Vocabolario della lingua italiana, Zanichelli Ed. Milano, I.

canonical law (canon) a legal norm of universal character (rate). Or again, the term “*alimento*” changes substantially if considered in the singular as “nutriment” or in the plural as a compulsory payment in the field of divorce (alimony). From the legal language viewpoint, the term “*alienazione*”(alienation) represents the legal transfer of title (e.g. ownership) and in current Italian has a quite different meaning (mental illness). The same is basically true for the term “*mora*”(delay), which can represent either an unjustified delay in meeting an obligation or the amount of money owed as sanction for some non-compliance. WordNet permits handling multiple senses in an explicit manner by discriminating the meanings in disjoint synsets and making the word sense classes explicit through semantic and taxonomic relations. Among other things, this approach permits us to establish conceptual correspondences among terms in different languages. It is especially efficacious in the legal domain, where the correspondences are not so much among terms in different languages as between concepts, or often between legal institutions. The problem of multilingual versions of legal texts is crucial in European Community, where a dual approach is taken: the semantic relations established a priori on a conceptual nucleus are integrated with the context comparison on which the Eurodicautom translator is based; for example, the Italian term “*prescrizione*”(prescription) corresponds to at least six English terms: *statute of limitations-requirement-inscription-lapse of time-prescription of claims-periods of limitation*. Distinguishing classes of sense in WordNet makes it possible to specify the correspondences¹⁰ in a more precise manner:

Prescrizione1	Prescrizione 2:	Prescrizione 3:
<i>synonym</i> : norma, regola (norm, rule, prescription)		
<i>has-hyperonym</i> : diritto (law) <i>has-hyponym</i> <i>prescrizione</i> medica	<i>has-hyperonym</i> : fatto giuridico (legal fact) <i>has-hyponym</i> : prescrizione speciale prescrizione ordinaria <i>cause</i> : acquisition	<i>Has-hyperonym</i> : Fatto giuridico (legal fact) <i>has hyponym</i> : prescrizione della pena prescrizione del reato <i>cause</i> : expiration <i>involved</i> : termini di prescrizione
<i>equal to</i> : requirement	<i>equal to</i> : prescription	<i>equal to</i> : prescription of claims limitation of action

In the example above, (tab.1), word sense discrimination takes into account the distinctions among common and technical meanings (between sense no. 1 and nos. 2 and 3) and among legal institutions (between senses nos. 2 and 3), as well as the confusion between cause (*passage of time*) and effect (*extinction/acquisition*) and between *lapse of time* and *final term*. In other words, we need to manage “semantic overlapping” with more sophisticated tools, tools that permit us to make distinctions concerning the ontological nature of the concepts.

4. THE DOMAIN-ONTOLOGY

In line with the “bottom-up” approach, the base of the ontology¹¹ is the higher level of concepts obtained through the conceptualisation of the terminology: from the 1500 synsets structured so far, the higher terms/concepts (about 40) have been organised distinguishing:

- concept as *acceptance* that pertains the common language are linked to hypo-plugin in at the IWN threes and to the top-ontology shared by all the WordNet databases;
- concepts as ‘*license, authorisation, concession*’ that acquire a specific meaning in the legal domain, and that roughly match with (part of) the classical partitions of legal theory, are organised in a *Legal Core Ontology* [1], that takes in account both the new upper levels (foundation ontology) [3], and the proposal in

¹⁰ Clearly, word sense discrimination operates at the level of text marking, while during full-text searching it can only consent broadening the query or substituting the query terms with more specific and unambiguous terms.

¹¹ A foundational Ontology contains a description of kinds of entities and relationships that are assumed to exist in some domain, such as *process, object, time, part, location, representation* etc.; formal Ontologies as DOLCE, provide formal criteria to assign linguistic elements to individuals, concepts and relations.

the field of legal ontologies. [6]. Below the Giur-IWN concepts are classified concepts as entities of the *Core ontology*:

- Social Objects:** *Agentive Social object:* Legal person/Agency/Authority/Government/ Body/Nation/Association.
:Non agentive social objects: Law/Legislation/ Obligation/Right/Duty/Power/Interest
- Mental object:** Intentionality/ Mistake.
- Physical objects:** *Agentive:* Natural person.
Non Agentive: Property, Legal text.
- Quality :** *Physical:* Form.
Non-physical: Requirement.
- Abstract :** *Temporal Region:* Lapse of time(Lapse of time):
- Occurrences:** *Event:* Act (Crime, Amendment)/Legal transaction (Contract)
State: Legal status/Citizenship/Capacity.
Process : Action/ Activity (Performance, Defence)

5. RELATIONS BETWEEN ENTITIES

Below are listed some exemplification of the main relations holding between entities in the core ontology, based on the DOLCE [11] methodology:

Representation: Norms (represent) are *interpretation* text. Norms (represent) are *description* of: others norms (amendments, law-making norms, validity norms/institutional functions (constitutive norms)/institutional powers (power-conferring norms)/behaviours (regulative norms)/incriminating norms.

Dependency: *Legal person* depends on a physical entity,. *Legal subject* depends on norms. *Legal facts* are events depending on norms (only fact relevant for legal systems are legal facts).The subclasses are: *natural fact*; *human facts*, depending on consciousness (but not on will); they are: *institutional facts* (constituted by constitutive rules)/*legal acts* (in a strict sense) depending on will/*legal transactions* depending on intentionality¹²/*crimes* (constituted by incriminating norms).

Constitution: Functional roles are *constituted* by norms; Written form is *constitutive* of some sub-classes of legal acts.

Participation: Legal subjects *are participant* in human facts and in activities.

Inherence: Form is a physical quality *inherent* legal acts.

The GIUR-IWN data base is still under development [5]: we expect to reach a satisfying coverage of the basic legal contents through the definition of about 3000 synsets. The enrichment of the lexical database will probably act as a test of the ontological level, and it will allow refinement and completion of the work done.

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¹² Intentionality is subsumed by will; witch is subsumed by consciousness (on the distinction between will and intentionality depends the distinction between fault and intention (fraud) in crime law).

SAID. SOCIAL ASSISTANCE OVER THE TV

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ABSTRACT

Our seniors deserve better quality of life and more integration into the mainstream of the society. Fulfilling the needs of elderly people is one of the most imperative problems in Western societies that still have no adequate answers from the responsible authorities. Previous efforts aimed at introducing computerized social aid systems at the home of elderly users have failed due to a number of reasons. An innovative approach to home delivered assistance services proposed in the EC funded project SAID is based on two key concepts: innovative interfaces using the TV as the only required terminal and intelligent services oriented to true personalization and permanent user monitoring.

KEYWORDS

TV Services, Multi-agent systems (MAS), Social Assistance, User-adaptability, Personalization, Ontology.

1. INTRODUCTION

The progressive ageing of the population in most Western societies and the need to provide better services to a larger number of users presents an important challenge to the responsible authorities because, in spite of the important increase of resources, they are unable to cope with the exponential increase of the demand. There is general consensus about the fact that the best way to improve this situation is the progressive introduction of technical aids to allow the users to achieve a more independent life by means of remote assistance. However those services still suffer from poor levels of efficiency and quality due to the intensive use of manpower and the low penetration of information technologies.

SAID (*Social Aid Interactive Developments IST 2000-25024*) is a project sponsored by the European Commission whose objective is to develop an innovative social assistance infrastructure, which aims to provide elderly people with more efficient social care, improved services, and the possibility to introduce to the information technologies a sector of the population that has been largely neglected until now. SAID innovates by using the traditional TV, complemented with recent achievements in the interactive TV (ITV) field, as the most suitable vehicle for the delivery of the new services. The essential components of SAID are aimed not only at the end-users but also at the organizations responsible for their care, inside an integrated framework of services. The project involves R&D efforts in three fronts: novel ITV developments based on the emerging MHP standard, research in the area of using Intelligent Agents to implement personalized assistants adapted to specific user's characteristics and new approaches for simplified user interfaces. The Project's development was preceded by a number of end users surveys carried out in the cities of Madrid and The Hague. Survey data was acquired by means of personal interviews with a group of 100 end-users in both cities, complemented with panel discussions, Internet and ITV voting, etc. The remainder of this paper will describe the key components of the system together with the technical approaches followed.

2. THE SAID APPROACH

Elderly users require specially designed interfaces that are: simple to use, affordable, always ready, integrate easily in their living environment and offer a single access point for all services. Previous attempts to introduce aided services in the elderly community (see references) have failed since by involving some sort of computer interface, they did not observe the above requirements. A computer is an element foreign to most users' environment that requires skill, modifies the way of living and has been systematically refused by the users. For that reason, SAID proposes the use of the TV (an already familiar device in the user's environment) as the only required terminal. Some of the key design concepts are: always use a clean direct design; use only a few concepts at a time; if you require more concepts divide the process into more steps; each process must have a natural flow; use big resizable fonts with carefully chosen colours and high contrast (specific for the TV environment); use only a few keys in the remote; always provide written as well as graphic feedback of what is going on; use audio when possible. These concepts, which have proven their value in existing ITV applications, have been extended to include advanced video services and applications specifically designed for the elderly. Furthermore, SAID succeeded in the cooperative integration of assistance services with existing TV contents; something that represents a true innovation in the sector.

However, as system functionality gets more complex it becomes almost impossible to get a balance between simple interfaces and useful services with traditional methods. The answer is introducing intelligence into the system; trying to move, as much as possible, the initiative and decision-making from the user to the system so that interfacing requirements are reduced to a minimum. The combination of simple TV based interfaces with the technology of Intelligent Agents allows the design of "active" applications able to provide the user with personalized information and services while watching his favourite TV program. The final objective would be that any user able to use a TV should be also able to use SAID services.

2.1 Services for the elderly

The objectives addressing the needs of the end user's are: provide assistance (alarms, reminders, home services), fight isolation and loneliness (inter-personal communications, suggestions), permanent user monitoring (24h personal and automatic monitoring) and encourage users to integrate in the society and enter the Information Society (entertainment, tele-education). The catalogue of services implemented include:

1. **Alarms.** Can be automatic (triggered by the system when it detects an abnormal situation) or manual (triggered by the user by means of a radio collar / wristband). Different severity levels are supported.
2. **Reminders.** A reminder is a short message that will appear on the TV of the user at the specified time and date. It can be automatic (issued by the Agents Subsystem) or manually inserted by the Social Assistant. A reminder from the Social Assistant can be used for multiple purposes: to remind the user to take a medicine, greet the user for his birthday, invite the user to an event, etc. A reminder can be programmed for a specific time and date or can be repeated on a periodic basis. Reminders can be temporised (they will disappear if the user does not attend them) or may require an explicit answer from the user. The Social Assistant may also program a degree of tolerance: raise an alarm only after a programmed number of failed answers or after a specified time interval without a correct answer. Since a reminder can be associated with a set of actions (raise an alarm, send an SMS or email) depending on the conditions programmed (not answered, wrong answer), the reminder configuration tool becomes a useful productivity tool for the Social Assistant. The system may also insert automatic reminders by means of the Agent' Software in order to warn the user he needs to do certain activity at a certain time. This service helps mature home users to take care of themselves more easily by providing them advice and automatic reminder of most common activities.
3. **Video-email.** One of the most important shortcomings in the TV environment is the difficulty to use text-based tools. The possibility to post short video messages to other SAID users or users outside the system from your TV is a favourable substitute for traditional communications tools such as email. VideoEmail can be used for personal communications with other users or relatives, to get in contact with social services, etc.
4. **Videoconferencing.** The videoconferencing infrastructure included in the system is aimed at low cost real-time communication from the TV. It implements a simplified user interface where the user will only need to select from a mosaic of photographs the picture of the person he would like to talk to. Videoconferencing can be used for a number of daily tasks: personal communication; communication with

social or health services; remote rehabilitation sessions (requires special equipment); etc. Videoconferencing is also a decisive element while managing emergencies: when an alarm is triggered the system will automatically initiate a videoconferencing session with the Control Post with the objective to provide the Console Operator with visual feedback of the emergency (See Figure 1).

5. Automatic User Monitoring: The system can automatically check whether the user is receptive to system requests, provides correct answers to questions issued by the system (e.g. did you take your medicine?), shows an abnormal behaviour pattern (e.g. have not used the system for a long time), etc.

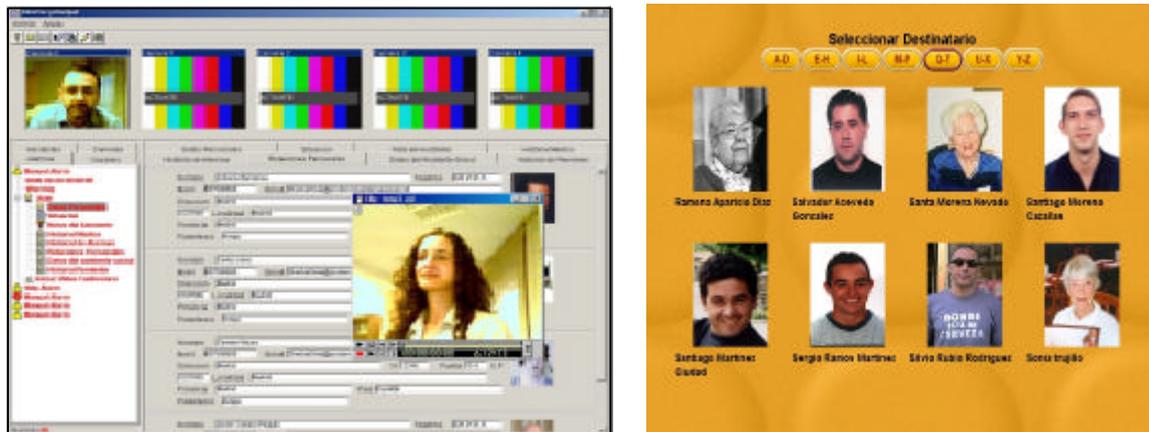


Figure 1. a) The Control Post Interface, b) Address book of the Client Video Services.

6. Suggestions. The SAID “active” information service is implemented via pop-up suggestions appearing on the screen while the user is watching his favourite TV program. The service is “active” because information should come to the user without the need to explicitly request it; instead, it is based on a stored user profile. The Agents Software permanently monitors the Internet for topics of potential interest for the user. When an Agent detects something interesting, a suggestion is sent (e.g. I know you like opera. Would you like information about a play near your home?). A flashing icon alerts the user that the system has something for him. It is his choice to attend the request and watch the pop-up message superimposed over the TV program. Suggestions can have associated questions, which are a powerful method the Agents Software can use to get feedback from the users and refine the profile. Social Assistants may also send suggestions to the users. Great care is taken to assure that suggestions cause little disturbance (not too frequent), are relevant (important for the user, timely delivered) and are issued within the context of the current TV program.

7. Information. The SAID “interactive” information access point uses agent technology to elaborate filtered lists of topics personalised according to each user’s profile. It can be conceived as an intelligent personal assistant, whose mission is to provide improved access to information present in the WWW for people who are reluctant to use computers. The user can navigate through the information tree while the system automatically prunes the search path in order to present to the user only those options that are potentially interesting for him. Each topic is automatically classified according to his personal preferences and a graphical rank mark is presented to aid the user in his selections. At any moment the user may command the system to stop searching and present a suggestion or present the unfiltered list. In addition to the intelligent search procedure the Social Assistant may also manually introduce topics in the system (e.g. municipal information). Some interesting applications such as an intelligent TV program guide or a personalised newspaper have been developed based on this technology.

8. Other Services: Education. Different types of educational courses are available: house care, healthy living, etc. **Entertainment.** Some entertainment titles oriented to the TV are included: photo album, games, etc. Since the system tries to encourage social inclusion rather than isolation only games that require an opponent are supported (e.g. chess). **Household Services.** SAID provides the user with facilities to subscribe to home delivered services: household, home repairs, catering, etc. **Shopping Service. Friends Finder:** enables the user to find friends or relatives who are logged in the system. Chats, videoconference or online games may then be started.

2.2 Services for the Social Organisations

Two groups of services have been implemented for use of Social Organisations (see section 2.1 for details):

1. Social Assistants Services: Reminder configuration; Insertion of information topics; Management of user and Social Assistants data; Intelligent planner (planner aimed at aiding social workers organise round trips to the clients; reminds them of events, etc); Videoconferencing; VideoEmail; Alarm reception. Most services available at the Social Assistance Console are also available under the SAID GPRS Mobile Service.

2. Control Post. A 24h Control Post (figure 1) is included in the SAID system for permanent attention to the users. The Control Post includes functionalities such as: Videoconferencing; Surveillance (one way, multiple camera video surveillance); Alarm management; Alarm redirection (mobile, email); GIS; etc.

3. THE AGENT SOCIETY

Agent technologies are used within SAID for three basic purposes: providing intelligent personalised services; obtaining user personal information (profiling); and automatic detection of abnormal situations. By means of agent technology, we implement a multi-layered network of agents able to carry out a set of specific tasks in an autonomous/distributed fashion. We explored several paths: adaptation to specific needs; learning; efficient information exchange; cooperation between agents; automatic information retrieval; etc (Klusck 1999). The SAID setting is a distributed system where each user has associated personalized agents able to interact with the user and with agents from other users. The agents guide the user to those sources of information that are of most interest, based on the user's personal profile; they provide the user with news, advice, entertainment, companionship (by communicating with other agents associated with other users), etc.

An agent is created to represent a user and his interests as soon as the user logs into the system. The information that this agent contains is essentially a *user profile* – a description of the areas the user is interested in. The agent starts with a limited user profile containing information obtained in a questionnaire. Based upon that, the agents will learn with the user, adapting his profile as more information is gathered and more requests are made using two basic mechanisms: monitoring of the user's activities and direct questions issued to the user by means of the *suggestions* mechanism described above. The adaptive agent will be the polite interface between the user and the technology and will be ready to respond to a user's requests 24 hours a day. The agent will be capable of anticipating common user requests, reminding the user of important daily events, monitoring the user's activity and deciding autonomously to request external help from relevant knowledgeable social workers if it detects something abnormal. The agents act actively, even without an explicit order of the user.

The Agent Subsystem mainly consists of the agent societies representing individual end-users. An agent society comprises a user representative agent for dealing with message exchange to the server, and specific task agents involved in the processes associated with arbitrary problem-solving tasks, e.g. information agents that are closely tied to a source or sources of data. An information agent might be running in the background for long periods of time, gathering information and processing it. On the other hand, the information agents will carry out the extremely important role of adapting their role to users' abilities. In order to accomplish all of these requirements, the Agent Subsystem is hierarchically structured, where communication takes place only between members of the same level or those of the next higher or lower level. All implemented or planned agent societies connect in a centralized mediator agent architecture, which takes care of communication among different agent societies (reducing the knowledge that agents must have about other agents). The mediator agent provides a straightforward and clear communication interface. The convenience of such a software architecture has long been acknowledged by software engineers. If a new agent is added to the system or an agent society, which knows how to get in contact with a single agent, e.g. the mediator-agent or representing agent of an agent society, only the latter agent is required to adapt to this change in order to accommodate this new behaviour/agent. FIPA's agent communication language FIPA-ACL (FIPA 97) is used for the communication between agents.

The information service is intended to be the most innovative part of SAID. It requires searching through textual information on the Web, formatted information (e.g. TV guides), and information in databases. It also requires filtering this information so that only information that is relevant to a user is presented. The

relevance of information is measured by matching that information against the user's stored profile. Searching for relevant information, especially on the Web, is a difficult task. Current technology makes it relatively simple to find a document on the Web that contains certain keywords, but anyone who has used a Web-based search engine will know that keyword matching does not always return relevant information, due to polysemy, multiple matches on common words, and even deliberate attempts by Web site designers to include common keywords in order to gain visibility. People normally deal with these problems based on their knowledge of the context, but for computers, making use of context to disambiguate keywords is difficult. Further problems arise when the text being analyzed is on a Web page rather than being simply text: identifying those parts of the page which are intended to be communicative rather than those which are merely annotations on HTML code; following hyperlinks to collect associated information; understanding a designer's layout; and dealing with imprecision in language. Some of these problems can be solved by working with a limited set of Web pages of known format, but even these must be updated regularly, for it is quite common for Web sites to change their internal structure with minimal visible changes.

The use of information filtering and user profiling in agent-based systems has been surveyed recently (Bohté et al, 2000). They identify a number of technologies for information filtering (calculating keyword vectors, refining this with n-grams, mapping hyperlink structures or using feedback-based filtering), and a number of ways of constructing user profiles; little is said about the content of user profiles, however. Within the SAID project, we use an approach to information filtering based on frequency weightings of keywords that match the contents of the user profile, using XML tags to simplify the process of finding keywords where necessary. An underlying ontology of interest types is used to determine whether certain types of interest are closely related to other types. As for the user profile, the categories will be devised based on the ontology contents and on the types of interests included in consumer surveys. One current implementation provides an information service for European TV programs. Following the idea of cascaded masquerading, messages are sent via the server to a mediator of the agent subsystem (the "gateway"), which forwards the message to the agent society representing the user. This Agent Society also forwards the message to the information agent, which is part of the society. After the Web search, the information agent sends back a message using the same path. Of course, all these actions are hidden to the user.

A simple TV information search scenario could look like this: the client system sends an information request. Based on the user profile, the information agent sends back a list of TV shows that deal with topics the user has shown interest for in the past. The client sends back the user's selection. The information agent searches the Web for more detailed information (channel, broadcast time, description) and sends it back to the client. The user can refine the search, if he wants to have additional information. Additional information may consist of text describing the movie in more detail, other features of the movie (e.g. lead actors), or ratings. The Internet Movie Database (www.imdb.com) is a good source for finding such information.

The user profile, a basic pillar of the system, is implemented using a hierarchy of concepts representing the preferences and interests of the user. Every concept is annotated with a ranking, which indicates the probability that a specific user is interested in information that falls under this concept. If a specific piece of information is found, the profile is tested and a probability is generated indicating how likely the user will show interest in this topic. The decision made by the user effects an adapting of the user profile, e.g. the ranking of the concepts is changed according to the decision. Theoretically, the user profile can be seen as an instance of a simple Bayesian net. For this approach we develop an ontology of typical user interests and/or information relevant to Disabled & Elderly people. The terms from this ontology are used to represent user's interests; and keyword searches based on these ontology terms are performed to serve user requests. This approach is coupled with frequency weightings, with greater weight being given to keywords that appear infrequently in an average text. It allows limited contextual analysis using both the links of the ontology and assigned contextual words; if the user is interested in "banking", for example, the ontology will include contextual words such as "money" and some bank names, which are a subcategory of "financial institutions" having their own context words assigned (e.g. "finance"). This approach also allows the system to be re-used for multiple languages. The ontology will remain largely unchanged but the attached keywords will be in native-language. It is hoped that these words will occur elsewhere in the text of relevant descriptions, and not in descriptions of other forms of banking (e.g. aircraft manoeuvres). If this "contextual analysis" proves insufficient, it may be necessary to include negative contextual keywords (e.g. keywords associated with other forms of banking) and to assign negative weightings to these.

4. SAID ARCHITECTURE

The SAID system is an integrated platform based on ITV infrastructure, composed of distributed clients, using a TV / STB combination as terminal and connected to a Control Post where permanent professional attention is provided. SAID contains the following elements: the main server, the agent's server, a number of Client Nodes, a number of Social Assistants Consoles, the Control Post and the Mobile Nodes. Two types of client nodes are available: OpenTV based (does not support video services) and Java based (oriented to MHP platforms or standalone DSL solutions). The Social Assistant's console is a Web-based application that can be used from any computer with an Internet connection. The mobile nodes use native J2ME applications running on a PDA with a GPRS connection. The system also supports alarm redirection to standard GSM mobiles by means of SMS. The server / client connections are compatible with satellite, cable or DSL (mixed modem / IP architectures for the return channel are supported). A fast LAN interconnects the two servers and the Control Post. The system implements a modular architecture so that it can be scaled according to the number of users with the possibility to add new servers and distributed databases.

5. CONCLUSION

An innovative social assistance service has been presented that intends to overcome current limitations in the introduction of computer-aided systems in the home of elderly users with the aim to offer better services, improved quality of life and reduced costs. SAID proposes an adequate combination of innovative interfaces, intelligent services and "active" applications as the best way to defeat interfacing barriers and get a compromise between simple, easy to use interfaces and the demand for applications that address "real" needs. The SAID pilot implementation successfully passed a pre-testing stage with the municipality of Madrid in Dec. 2002 and will be thoroughly tested under real conditions in the cities of Madrid and The Hague during the spring of 2003. The main features appreciated by the users were: permanent contact with relatives or social services, integration with the TV, always-ready comfortable use of the tools, easy access to personalised information (e.g. Intelligent TV guide), etc. Social services considered SAID a valuable aid to increased productivity, without degrading the quality of the service. In general, the interfacing approaches seem adequate, but more work will be needed to further simplify the interfaces and add more contents. Other lines of work may include: extending SAID services to end-user's mobiles, integrating medical care, etc. Larger-scale prototypes are planned in other Spanish cities before entering into exploitation.

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13 GUIDELINES ON WHY TO USE AN EPSS TO INCREASE PERFORMANCE

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ABSTRACT

Recently, Electronic Performance Support System (EPSS) method is gaining importance as a crucial ingredient in a training and knowledge management. However, its application is not free of criticism, especially in Europe, due to the few research studies on this issue. As a result, this article aims to improve our understanding about the EPSS concept, how this is evolving and which are the appropriate performance problems and issues that helps to decide whether an EPSS should be used. The author think that this information might be useful for three people categories: those who are building e-business applications, web-based training, or any technology-based system to help improve performance in the workplace; novice in EPSS, performance support, performance-centered design, and web-based systems design, and don't know how to get started; and those who have tried one or two projects with limited success and want to know other alternatives witch allows to do it better next time.

KEYWORDS

Performance support, traditional training, EPSS, guidelines.

1. INTRODUCTION

These days, there are a remarkable range of options for supplying training and other performance-support strategies. The choices available today make possible the selection of supplied system that will provide the most effective worker support at an affordable cost and with a reasonable ROI. The challenge is to select the best supplier system intended for using an excellent and objective approach. The cost of mistakes, particularly with EPSS, is far too high to do less.

Decisions on supplying systems must be made following systematic consideration of organizational characteristics, organizational objectives, job or task characteristics, support functions and employees dilemma [Banerji, 1999] from these perspectives: the workers, the number of workers, their location, and skills; the availability of performance-support resources and expertise; the objective and content of the job or task; space, facilities, equipment, and materials; and time and costs.

The EPSS concept was born in USA over the ninety's to address the problems that raising software complexity was creating to employees. Although, it is now a well-established software niche in the USA, with many histories and success stories and a very active research community working on it, in Europe there have only a few implementations of EPSS, and still, the acronym EPSS and the approach, methodologies and technologies it implies are almost unknown. European industry requirements, and cultural and social differences have not encouraged as much as necessary to intensify the small number of existing research studies and projects on this issue. Even so the European approach to performance support merit some insights, as it is not only a late copy of American experiences, but also a new innovative way to develop highly flexible software tools to introduce, support and manage best practices inside organizations.

Considering that an EPSS is on-demand, learner-controlled system that support workers by providing immediate access to information and assistance at the work site, on the workbench, or at a workstation, it can be designed to provide interactive advice on how to perform a task or operation or make decision. However,

there are training and development objectives that are not suitable for EPSS treatment for many reasons: complexity, costly to produce, and existence of more effective strategies for achieving them.

While there are no solid, rapid, and infallible regulations for the selection of suitable issues, this article discusses some existing guidelines based on a new approach, that will assist prevent development endeavor that are likely to fail or become financial disasters.

2. THE EPSS CONCEPT

Gloria Gery [Gery, 1991], the industry guru have introduced in the early 90's the concept EPSS, defining it as any computer software program or component that improves employee performance by: reducing the complexity or number of steps required to perform a task; providing the performance information an employee needs to perform a task; and providing a decision support system that enables an employee to identify the action that is appropriate for a particular set of conditions. The objective is to deliver JIP and JIT training coaching to reduce training costs and improve employee's performance.

With the emergence of the so-called "Knowledge Economy", the late concepts of EPSS have evolved to support the knowledge workers and encourage their shared learning. New concepts are then introduced:

"An EPSS is the electronic infrastructure that captures, stores, and distributes individual and corporate assets throughout an organization, to enable individuals to achieve required levels of performance in the fastest possible time and a minimum of support from other people." [Raybould, 1995]

"An EPSS is a human activity system that is able to manipulate large amounts of task related information in order to provide both a problem solving capability and learning opportunities to augment human performance in a job task by providing information and concepts in either a linear or nonlinear way, as and where they are required by the user" [Barker & Banerji, 1995].

"Dynamic support systems are characterized by the ability to change with experience, the ability to be updated and adjusted by performer, and by augmenting other supports found in the performer's community" [Laffey, 1995].

These definitions conceptualize EPSS:

Not as a single piece of software, but as a collection of all software needed for performance support.

As the integration of knowledge assets into the interface of software tools, rather than add-on components.

As a method for capturing knowledge assets as well as distributing them.

As involved with the management of all assets, whether electronic or not.

By using these new concepts, EPSS gets closer to knowledge Management and learning tools.

3. PERFORMANCE SUPPORT VERSUS TRADITIONAL TRAINING

In addition to the above descriptions of EPSS, it is useful to distinguish between performance support and traditional training.

Traditional training, while beneficial in a number of business circumstances, lacks the dynamic capabilities built into a performance support system. Performance support is significantly more powerful and allows the worker to access the information source at the moment and place of need. In contrast, training usually removes the employee from her/his work environment.

Performance support provides employees with a wealth of information via hypertext to related material such as on-line help, databases, forms, policies and procedures. This information can be accessed in non-linear manner, accommodating individual learning preferences. Performance support can track reoccurring situations for management review and intervention. Some clear examples are monitoring employee progress through a particular process, test results, and common work questions or requests for assistance. Obviously, the transition from the traditional training to the performance support is suitable to embark upon. Bary Raybould [Raybould, 2001] suggests a process for this transition.

4. RATIONALE FOR EPSS

This section pretends to discuss the guidelines for EPSS adoption from a new line of awareness, by grouping the performance issues in two categories: (1) primary decision issues; and (2) conflicting decision issues. The first ones (Table 1.) reflect the situations where EPSS is appropriate, keeping in mind that they exist on a two or more base. The second ones (Table 2.) consider the most common situations where EPSS may be suitable, particularly when equilibrium must collide within contradictory criteria or when disregarding one or more of the primary decision-making issues may avoid an undesirable outcome.

Table 1. Primary decision issues

Issues	Description
Performers have easy (better yet, constant) access computing	First of all, the employees in question must have immediate access to a PC or another suitable network device. Even a short walk to another room may be enough to discourage someone from using the system.
The task/job requires support complex enough to warrant an EPSS	The work must be of a nature that demands performance support. This is particular the case when the sheer volume of new knowledge required will necessitate a long course, with the risk of low retention. The idea is that the EPSS would provide JIT (Just-In-Time) support, particularly for exceptional and complex queries, while a call is in progress. By the other side, if the task is simple, who needs a support system?
Stability of the task/job	If the way that a task is to be performed stays constant over a long period, it might be easier to train it properly tight up front. Unlike, an EPSS may be more appropriate than other approaches that are more difficult to maintain, change, and disseminate.
Critical task stated by high cost of non-compliance or poor performance	Related with critical business issues and specified in terms of work performance. A critical task is a task identified during strategic planning or operational goal setting as something that must be accomplished to assure the continued viability or growth of the organization. Emergency issues such power plant operation, are a good example.
The performers possess the necessary characteristics to use an EPSS in terms of literacy, computer expertise, or motivation	For example, it may be the case that a user must be able to reach any information in just a few clicks.
The logistics of getting people to other approaches are so complicated or expensive that an EPSS is more efficient solution	This occurs particularly when the performance requirements and policies change frequently. Also, when employees are widely distributed geographically, they are likely to find it difficult to get a quick response locally to a query.
When the EPSS will be used for empowerment of performers or to assure that they comply with specific standards of performance	An EPSS must be the most appropriate form of on-job support. It must be the easiest to access, the most accurate and the most cost-efficient. In some jobs, employees require extremely fast response to a query. If cue cards, reference manuals or human support (ask a colleague or supervisor) will be the easier and faster, then why not use them?
Complex decisions are involved in the tasks	When the sheer volume of new knowledge required would necessitate any several-day course, with the risk of low retention. Instead, a blended approach, including a few-day course to put across the major concepts and principles of the new system – supported by a specially-developed system simulation – alongside an EPSS, to deliver the body of procedural knowledge. The idea is that the EPSS would provide just-in-time support, particularly for exceptional and complex queries, while a task is in progress.

Table 2. Contradictory decision issues

Issues	Description
There is time available for support	Some tasks are so time-critical that the notion of consulting an electronic performance support system is ludicrous.
The turnover among potential users of the EPSS is high	The characteristics of the audience are also important. The higher the turnover, the less time spent on formal training and the greater the need for performance support. The only constant in these issues is change. High turnover may often justify an EPSS because an EPSS is often more readily accessible than many forms of training. Also, when employees are widely distributed geographically, they are likely to find difficult to get a quick response locally to a query, so performance support helps here. Logistics
The task is frequently repeated	If the task is performed extremely regularly, it might be easier to memorize for good performance or to train it properly tight up front. If not, an EPSS may be a sound strategy.
When/how the EPSS can be supported/maintained	Anyone considering introducing an EPSS should take the issue of maintenance very seriously. Often all the effort and the budget are put into the development of version 1 of the system, when that is only the start. If users spot just a single inaccuracy in the information, they lose faith in the system as a whole and simply won't use it. So, it will be necessary to dedicate a resource to maintenance, probably full-time.
Cultural shift required in moving to an EPSS	People change more slowly than technology. A person's paper-based notes act as a sort of comfort blanket and it takes time for that person to adapt to an online environment. And for that change to take place, it's important that the support system can sit alongside the application on the screen. It's too disordering to have the support system replace the application – in that case, paper-based notes are much more usable.

5. CONCLUSION

An EPSS is worth considering when tasks are complex, constantly changing or infrequently undertaken. Although it is not a panacea for all training and performance problems, it can be a feasible and cost-effective strategy. Selected wisely and implemented properly, EPSS can improve employee performance, avoid the development of ineffective training strategies, and provide a substantial ROI.

Considering that change is the only constant, EPSS is one of the most promising performance support strategies now available. We are moving on from traditional training practices and conventional models for task support. The emphasis now is on developing effective business processes that can be operated by highly productive and self-sufficient users. Europe and even the rest of the world can't ignore it. The refrain is "add productivity to software".

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THE PROBLEM WITH PRIVACY: A MODEST PROPOSAL

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ABSTRACT

Consumer choice and power is potentially enhanced by the possibilities offered by the Internet, yet simultaneously consumer privacy is threatened. Fears about privacy are well known to be a major source of lack of consumer confidence in on line trading, and thus the problem of privacy is one that needs to be addressed if business-to-consumer e commerce is to thrive in Europe. This paper suggests that conventional means of regulating for privacy – via law, norms or “soft law” are both failing to instil consumer confidence and are in any case impossible to enforce in a global cyberspace, both politically and financially. A technological solution, P3P, is being promoted by some US and academic factions but in fact fails to meet the same criticisms as are levelled at law and “soft law”. This paper instead sets out an initial framework for an alternative proposal, in which the common law institution of “trust” is used to attempt to provide the missing element of trust in B2C e commerce.

KEYWORDS

Consumers and e-commerce in Europe – informational privacy - consumer confidence – law, soft law and data protection – P3P – “code as code” – trust model.

1. INTRODUCTION

Although the Internet has proved an empowering and time saving environment for consumers (one out of every two UK consumers reportedly used the Internet this Christmas (2002) to browse for purchases if not to actually purchase), it has also posed a major threat to consumer privacy (see further, Edwards and Howells, 2003, forthcoming; European Commission, 2000,). Consumers rarely fully appreciate either the extent to which personal information is being collected about them when they shop or browse on line, or the potential value of that data in aggregate, and so are ill prepared either to protect their privacy or to bargain it away. Consumer lack of confidence in the Internet as a secure medium is however clearly shown in survey after survey as one of the major factors inhibiting the growth of e-commerce. The National Consumer Council (NCC, 2000) found in August 2000 that 85% of UK consumers felt safest shopping on the High Street and over a third felt the Internet was the riskiest place to shop. While most surveys show that consumers’ main worries centre around the disclosure or misuse of financial information – especially credit card details – fears also arise in relation to the possibly embarrassing disclosure of other types of personal information, and the possible abuses that may occur where real world information held in databases – such as names, addresses and social security numbers – is connected to information gathered on line such as credit card numbers and shopping habits. The main harms to consumers potentially arising from unauthorised collection and subsequent misuse or insecure retention of data may be classified as

- (a) financial loss arising from fraudulent misuse of financial data;
- (b) unauthorised disclosures to third parties (as in the recent Eli Lilly Prozac list and Microsoft Passport cases reported in *Privacy and Data Protection*, Vol 3, issue 2 at p 12)
- (c) “spam” or electronic junk mail and other types of unwanted direct marketing such as automated cold calling
- (d) the phenomenon of “identity theft”, where data gleaned from various sources is used to impersonate a person for financial and other purposes. Although identity theft has yet to fully impact on the UK, the FBI are now calling it the fastest growing crime in the USA.

The need to find some kind of solution to the problem of consumer data privacy has thus become a pressing concern in recent years for both the EU, and, increasingly, the USA. In the EU, a detailed legal

code relating to data privacy already of course exists in the Data Protection Directive of 1995. Although this Directive was not drafted specifically to deal with the Internet it has recently (controversially) been updated by the Privacy Directive (2002/58/EC) which pays particular attention to control of spam and “cookies”. In the US, by contrast, the historical position has been of industry self-regulation and a *laissez faire* attitude to legal regulation in this area. Although privacy legislation does exist at both a state and federal level, it is piecemeal (eg information collected from children is regulated; as is information collected about video rentals) and not omnibus on the European legislation model.

2. THE EUROPEAN SOLUTION

European data protection (DP) law demands in essence that (with certain exceptions) consent be given to the collection of personal data from data subjects. Furthermore, those who collect personal data (“data controllers”) must name the purposes for which the data is being collected and not then go on to use or disseminate the data as they please. Notification of these purposes must be given to a body independent of state or commerce (in the UK, the Information Commissioner) which is also responsible for ensuring compliance with the entire DP regime. Requirements as to data security and how long data can be retained are also part of the general scheme, as is the right of the data subject to access their personal data, and, if necessary, correct it, from whoever holds it. This scheme is generally regarded as in principle a careful and comprehensive approach to the protection of personal data and on line privacy. But the question must be asked: is DP style legislation really a practical answer to privacy in cyberspace? Two problems arise here: first, the sheer amount of data collected in cyberspace; and secondly, the fact that even if Europe is prepared to devote the resources to enforcing DP laws, will this be of any use in the globalised shopping mall that is the Internet?

2.1 Problems with European model

2.1.1 Enforcement : the size of cyberspace

To give some idea of the problem, the search engine Google currently searches over two and half thousand million web pages. Naturally many of these pages will not collect personal data. However, it is also well known that search engines cover only a small percentage of the sites on the Internet. One recent estimate was that in 2001 there were over 31 million websites world wide. These figures tend to increase exponentially. The task of policing data collection on the web, even if only European or UK sites are looked at, is not for the faint hearted. Yet in general the resources so far devoted to web compliance with data protection laws are puny. The UK Information Commissioner’s Office, for example, employs only about 180 staff of whom by no means all are concerned with website compliance. It has recently been announced that website compliance will be the major focus of the new IC enforcement strategy (see *P&DP*, vol 3, issue 2, p 3), following on the report commissioned last year by the Office on website compliance which showed dismaying performance on many fronts, notably data security and access requests (UMIST, 2002). But it has to be questioned how effective such a focus can be without a huge injection of cash and manpower.

2.1.2 The global nature of the Internet

Even if we momentarily ignore compliance problems, the fact remains that the USA is the hub of the e-commerce world and that most personal information about UK consumers will be collected by US based websites or the subsidiaries in Europe of such. What is the use of having effective DP laws in Europe if information is transferred to, or collected on the Internet by, US based companies? What is the use of Europe regulating spam and cookies when most spam is sent from outside Europe and most cookies are set by US based websites? Even if jurisdictional rules attempt to deal with these problems (see Art 4 of the DP Directive), do the resources and the political will exist to effectively enforce European rules outside Europe? This was, of course, the issue at the heart of the recent long running struggle over the EU/US “safe harbor”. At issue here was Art 25, introduced for the first time in the 1995 Directive, which forbade the export of personal data from the EU to countries which did not have “adequate” data protection - notably, the USA. Although a partial solution was eventually reached in the form of the “safe harbor” compromise, it has

neither satisfied most of its European critics (see Charlesworth, 2000; McKenna, 2001) nor has uptake by US business been conspicuously impressive (currently only around 500 companies have signed up out of many many thousand US businesses). “Safe harbor”’s weakest point is perhaps that compliance with its requirements can be achieved by membership of a self-regulatory scheme such as TrustE – yet recent years have seen repeated scandals relating to misuse of personal data by prominent TrustE members such as Microsoft, Yahoo! and GeoCities. The simple fact is that US industry does not want to take on the financial burden of full data protection compliance, nor does it fit in with the model of data sharing between affiliate companies which has evolved in a competitive and increasingly merger-concentrated market. Both points are made strongly in the recent position paper submitted to the European Commission by the Global Privacy Alliance, a consortium of major US companies. Tellingly, the same points are increasingly echoed in European industry which is already struggling both to survive the IT recession and to catch up with natural advantage the US has had as first nation into the e-commerce market.

3. THE US RESPONSE TO THE PRIVACY CHALLENGE

US industry is of course not immune to the demands of consumers for better privacy protection. To some extent, the growth in popularity of trust seal and kite-mark schemes such as TrustE, and BBBOnline, as well as the ubiquity of privacy policies, has been driven by public and pressure group outcry as much as the need to comply with Art 25 for the purposes of European data exchange. The Federal Trade Commission too has taken an increasingly stern approach in relation to privacy violations since their ground-breaking declaration in 2001 that self-regulation alone was not enough for viable consumer protection on line (FTC, 2001). At one point in 2001 it looked likely that omnibus privacy regulation at a federal level – even if not as comprehensive as Europe might like – might finally arrive in the US. However that hope seems to have receded in the aftermath of 9/11, the change in government and the general fear of recession. Instead emphasis has switched to persuading the consumer that technology can preserve privacy where law and self regulation have failed. Similar arguments after all, have already prevailed in the great Internet pornography debate, where law (eg the Communications Decency Act) has given way to a reliance on filtering software. P3P, the Platform for Privacy Preferences was officially launched in April 2002 and is already incorporated into Internet Explorer version 6 and other major browsers (see further www.w3.org/p3p). It is important to note what P3P is *not*. It is not a “privacy firewall” of any kind - it does not block cookies or anonymise transactions or hide user data. It is not a law or a norm: it does not require a site to meet any particular level of privacy. It is simply a standard or specification developed by the international research consortium the World Wide Web Consortium or W3C. What P3P does is to read the privacy policy a site already has (or may adopt), in a standardised machine readable form. The consumer using the P3P enabled browser can set their own preferences such that sites are accepted or blocked depending on whether the site’s privacy policy matches up to the user’s settings. Future implementations may well allow the user to trade their personal information eg for micro-payment or loyalty points, as well as simply avoid non-conforming sites.

3.1 Problems with P3P /self regulation for consumer privacy

Yet P3P is in no way a satisfactory substitute for European-style DP protection (cf Lessig, 1999). It is simply an automated bargaining mechanism, which makes no allowance for a multitude of problems including the imbalance of power between consumer and website; the general technical ignorance of consumers either as to data collection or how P3P works; the lack of a real marketplace of choices in privacy policies; and most importantly the lack of any kind of enforcement mechanism to make sure that privacy standards as stated in the privacy policy *after* data has been collected (see Art 29 DP Working Party, 2000). We are back at the problem of compliance, of resources, of political will and corporate data-sharing culture.

4. A MODEST PROPOSAL

What seems to be needed is a new approach. European data privacy culture is legally sophisticated, but too resource intensive to police, unsuited to cyberspace, inimical to modern multi-national corporatism, and unacceptable to US industry in general. Yet studies show that industry generally wishes to be compliant both with law and consumer expectations. Is there not some new approach which could be taken to meet US culture halfway, perhaps in tandem with existing data protection in Europe, which might provide a more internationally acceptable model for data privacy protection? If no such approach is found, it is likely that P3P rather than “safe harbor” will become the dominant paradigm, which in terms of consumer protection might well be a disaster. Consumers too might prefer a system where it is easier to understand their rights than is the case with data protection. The emphasis of DP law on consent to data collection as the key to legality is in real life rather formalistic. Consent, a seemingly simple idea, is much less clear when faced in terms of opt-in and opt-out, pre-ticked tick boxes, half-buried links to privacy policies, and incomprehensible legal language (the recent UK Information Commissioner survey of websites found that only 5% of website privacy policies were intelligible to the ordinary consumer.) What consumers seem really to want is the ability to surf the web, making the most of the convenience, choice and competition offered by Internet businesses, without suffering any of the privacy-related harms listed above, and without having to take on the onus of protecting themselves either by struggling to spot privacy tick-boxes or by using sophisticated privacy-enhancing technologies (PETS) which (unlike P3P) *do* work – eg, the EU-endorsed privacy product Freedom (Art 29 DP Working party, 2000). Restricting the collection of personal data also restricts the convenience of Internet shopping which is perhaps its best feature; features such as “shopping carts” and personalised detail disappear without the use of personal information. Is there not a better way of keeping the convenience factor and yet protecting the consumer from harm?

4.1 The trust model

A lateral approach might be to compare data collection on the net to the common law trust. Trust is essentially a kind of protracted gift, an institution whereby property is transferred by the truster(s) (or settlor(s)) to the trustee(s), who have formal ownership of the trust assets, but whose use is restricted by a continuing set of trust purposes, and by the beneficial interest of the beneficiaries. The trustees owe fiduciary duties, including a stringent duty of care set at a far higher standard than the normal negligence standard, to the beneficiaries. In public or charitable trusts, where the truster is often dead or absent, and the beneficiaries may not yet be discerned, an enforcement role to prevent abuse of trust is usually taken by some kind of state body, such as, in England, the Charities Commission (Wilson and Duncan, 1996).

Compare the situation when consumers shop on the Internet. Personal data is given away by the data subject/consumer to the data collector/website, who holds that information and makes money out of it by selling it, sharing it or using it to better market or target their products. What if the data subjects were seen both as the trusters and the beneficiaries of a trust, and the data controller/website as the trustee? That would imply that the trustees owed fiduciary duties to the beneficiaries who would have title to sue for damages and to enforce them. It would mean that the data collected formed the trust property, held subject to the purposes of the trust. It would also mean that the question of “consent” and all its difficult nuances would become irrelevant, as all transfers of personal data would be assumed to be gifts, though not unconditional ones.

If the analogy is continued it might be assumed that the “trust purposes” would be found in the privacy policy of the web-site. But that is obviously unsatisfactory in terms of uniformity, enforcement and avoidance techniques. What alternative is there? Every consumer cannot be expected to set up their own “trust deed” nor to enforce it. Special uniform trusts can however be created by law; sequestration in Scotland, for example, is a form of trust set up on personal bankruptcy, where the trust purposes are imposed for the benefit of the creditors/beneficiaries and the trustee in sequestration is subject to judicial supervision. US industry might find a limited statutory trust more acceptable, more familiar and more practicable than compliance with the full panoply of EC DP law. The emphasis would not as at present be on policing the “indoor management” of the trust – but on the *external* consequences, ie the negative and positive impacts on the consumers whose data was collected. The details of the trust purposes, and the nature of the duties owed by trustee(s) to beneficiaries, would need worked out and passed into law by statute. This would not be unproblematic: the common law prohibition on *auctor in rem suam* would, for example, have to be

discarded or at least altered substantially since, of course, the web site/trustee *does* intend to use the trust property – ie, the personal data collected – for his own benefit rather than exclusively apply it to that of the beneficiaries. Yet at least three ideas do seem to come through strongly if the trust model is accepted in some form:

(a) it is clear that data collection is *not just* for the benefit of the data collector but that as a result the data collector owes stringent duties of care to the data subject, eg the duty to keep that data secure and not to negligently disclose it. Indeed the duty not to disclose without consent might be construed as strict.

(b) the result is that the data subject is given an *individual right of action* against an abusive data collector, something which at moment is almost wholly lacking from the US model, barring the dubious possibility of enforcing a privacy policy as contractual terms. Extending the trust model, the data subject would also have the right to demand an “action of accounting” ie to ask the data collector what data they held and more importantly, what they had done with it and what profits they had made out of it.

(c) the data subject as beneficiary *is owed a share of the profits* made by the data collector from the collection of data. This is perhaps the most controversial and the most exciting result of the trust model. Currently neither the European nor the US regulatory models acknowledge that an asset of considerable value is being amassed by the data collector/website. Both models, less or more successfully, simply try to give the data subject the option to opt out of data collection at the start, rather than the option to opt in and share in the proceeds. What P3P *does* do is to accept that data on the Net has become a tradeable commodity, and tries to provide a framework for that trade – but because each consumer *individually* trades their data, no consumer can bargain for the true value of what they have given away. A trust model – where personal information collected would be seen *in aggregate* as the jointly owned trust property – would allow all data subjects/beneficiaries to make a claim on an asset of considerable value.

This raises the question of how that asset should be shared out. One way would be to distribute a dividend to all consumers based say on their time spent on line or number of visits to certain websites. This however would require monitoring and identification which might itself be heavily privacy-invasive. Furthermore the transaction costs involved in distributing small amounts of money to millions of consumers would be prohibitive. There is no evidence furthermore that what consumers want in return for giving up their privacy is small change; what they would prefer instead is protection from the harms described above. It is proposed therefore that the dividend should instead be paid *en masse* into a fund which could do three things:

(a) provide top-up funding to a body such as the FTC or DP Commissioner, or a wholly new body in each state, which could provide the public enforcement of private rights necessary in a consumer area; and

(b) provide for statutory set levels of compensation for harms such as spamming, associated harms (eg, denial of service due to spam overload, or page-jacking), and unauthorised disclosures, such as in the Eli Lilly case, or in identity theft. Because the scheme would be one of public compensation there would be no need to trace causally where the data disclosure had come from, nor to prove fault, both often extremely difficult. However it would still of course be open to (and desirable for) a body such as the FTC to pursue individual companies to improve data security practices. Given a system of managed sanctions however, the market should in theory act to clean up its own data privacy act.

(c) Provide PETs to those consumers who under no circumstances wish to give away their personal data. Products such as Freedom could be provided free for download with the license being paid out of the trust asset fund.

This is clearly at present merely the beginnings of an academic modest proposal with as can easily be seen, many details still to be worked out. However, it is my belief that we need to start thinking seriously about alternatives to the current stalemate of fine in principle, but impractical European data protection law, *versus* ineffective and likely to stay that way US privacy protection. Otherwise sooner than later we will find ourselves in the world so famously described by Scott McNealy, CEO of Sun Microsystems: where not only do we have “zero privacy – get over it” (Charlesworth, 2000) but to add insult to injury, we have also given it away for free.

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PERSONAL DATA, PRIVACY AND THE 2001 UK CENSUS

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ABSTRACT

The growth in the collection of personal data and its availability across the public and private sector is changing the way in which we understand the concept of personal privacy and also has direct consequences for the effective release and use of anonymised census and government survey data. Whilst protecting the confidentiality of census and survey respondents can be crucial, the application of disclosure control methods for reducing the risk of a breach can have a significant impact on the quality of the data. This paper explores the complex relationship between information needs, data value and confidentiality with respect to the release of the first disclosure protected tables from the 2001 Census. The analysis is placed within the wider context of what is happening in both the public and commercial sectors with respect to data collection, storage and distribution. It is clear that there is a pressing need for a wider public and academic debate about privacy, data value and data release in the UK.

KEYWORDS

privacy, confidentiality, census, survey data, data protection

1. INTRODUCTION

The UK census and a range of other government surveys and databases are one of the key tools for determining resource allocation across a range of policy areas and organisations. However, individual level data is only released in a limited anonymised form. Data collected via the census is subject to a range of statistical disclosure control methods (which were updated in 2002) and legal protection dating back to the 1920 Census Act. The 2001 UK Census form contained the following confidentiality commitment: “*The Information you provide is protected in law and treated in strict confidence. The information is only used for statistical purposes and anyone found disclosing census information improperly will be liable to prosecution*”¹. It is an offence for any member of the census staff to disclose personal information without authority. The census returns may be kept confidential for 100 years. The Office for National Statistics (ONS) has a commitment to protect confidentiality, and state that ‘*The protection of the confidentiality of personal census information to meet the assurance given when it was collected is paramount and must not be compromised in any way.*’ In the National Statistics Code of Practice 2002 the ONS states that it ‘*Guarantees to protect confidentiality*’ (ONS 2002). Moreover, the ONS add that “*it should not be possible for someone to recognise their own information or information about someone they know from census outputs with sufficient confidence that they would be prepared to act on that information as though it were true*” ONS (2002). But what are consequences of such a commitment in terms of the usefulness of the data?

The recent UK government’s report into privacy and data sharing within the public sector highlights the importance of individual level personal information in the form of health records, welfare benefits, police records and employee information in the delivery of high quality services (Privacy and Data Sharing 2002). Moreover, as part of the wider reform of service delivery and the move towards the electronic delivery of all public services by 2005 (Modernising Government 1999), the UK government is proposing, alongside the twin objective of enhancing privacy, to make much more use of data sharing and linking datasets to deliver public services (Privacy and Data Sharing 2002)². There are also moves to improve data standards in terms of

¹ See Hakim (1977) for a complete list of the different assurances given on UK census forms dating back to 1851.

² See also Better Information (2000) the report of the Policy Action Team 18.

format and cross government compatibility (Data Standards 1999). Other initiatives include the aim of giving citizens a greater say in how their personal information is used to deliver services. The UK government report recommends that such data sharing by public authorities should be with the consent of the individual (Privacy and Data Sharing 2002).

This paper explores the complex relationship between the need for both more information and disclosure control in light of the growth in the collection and availability of personal data within the public domain in the UK.

2. DISCLOSURE CONTROL AND CENSUS DATA RELEASE

A range of anonymisation techniques for disclosure control are employed in relation to different data sets, data releases and across different countries. Techniques are based around reducing data specificity and distorting the data and include increasing sampling sizes, perturbing, rounding, swapping and adding noise (see Marsh 1991 and Doyle et al 2001). A rounding-procedure was adopted by Eurostat in December 2001 as a confidentiality protection method. Rounding raises a number of issues including perceived usability, loss of accuracy and rounding error.

Initial data from the 2001 Census was released in September 2002 and the main release proposed over a period of thirty-two weeks began in mid February 2003³. The data is anonymised and produced in table format at a range of geographies. The combination of variables which are available is limited (though it is possible to request additional tables) and the tabular format prevents the use of statistical analysis on the actual microdata.

Although the general strategy for ensuring statistical confidentiality of 2001 Census output was stated in March 1999 in the Government White Paper *2001 Census of Population* (CM4253), many of the actual practical aspects of disclosure control were finalised subsequently. These include restricted output categories, aggregated variables, aggregated area data for particular counts, and data modification. It was proposed that the additional measure of rounding all counts to a multiple of three would be employed, however following widespread user concern rounding has been restricted to only small cell counts. Some record swapping has also been applied. In addition, the threshold numbers for output areas for Census Area Statistics were raised to 100 for resident persons and 40 for resident households⁴. The disclosure control measures to be applied to the anonymised microdata (SARs) are subject to separate measures that have yet to be finalised. But a number of the variables in the data are likely to be removed or reduced in detail and recoded, also geographic identifiers are likely to be removed. Such measures limit the usefulness of the data and have caused concern amongst users as Wathan (2002) has argued suppressing information on households with 7+ members and multi-ethnic households would not only lead to a bias in the data regarding ethnicity, overcrowding and number of children but would have important policy implications. See user consultation discussions <http://www.ccsr.ac.uk/sars/2001/consultation.html>

The disclosure protection in place for the 2001 Census has increased significantly from that of 1991. The ONS state that the new measures are in response to the increase in the availability of data from other public sources. This implies that census data released in the past is vulnerable to disclosing personal information using present techniques. However data collected ten years ago is far safer simply because of its age.

Protecting confidentiality in statistical databases has been extensively considered in relation to survey data and particularly census data (Flaherty 1979; Hakim 1979; Elliot 2001; Feinberg and Makov 1998; Marsh 1991; OPCS 1992 and Singer 2001). Back in the 1970s Bulmer reviewed the tensions between data collection, transfer and privacy and provides a summary of surveys of public opinion on data privacy. These surveys invariably found widespread concern for privacy amongst the public (Bulmer 1979). However, discussion has been much more limited about the public perceptions of confidentiality and data value and, as ONS have stated, there is no clear cut methodology to determine a particular level of disclosure risk and “*no standard approach to census disclosure control that is adopted world wide*” (ONS 2001).

³ There are 33 data sets at regional and Local Authority level available on the Neighbourhood Statistics Website from the 2001 Census.

⁴ A condition of use also applies that specifies users should not attempt to obtain or claim to have information about an identifiable person or household (See www.statistics.gov.uk/census2001/).

3. THE INFORMATION EXPLOSION

There has been a significant growth in the collection and use of personal data in all organisational sectors but particularly in the private sector (see Sweeney 2001). For example, commercial data companies using a combination of public records such as the electoral register, lifestyle survey data with methods such as statistical modelling and imputation have compiled huge personal databases. One UK company claims to have lifestyle information on over 44 million UK consumers. The types of information available include: income categories; occupation; number of children; household income; house type; tenure; second home; education; length of residence; car ownership; insurance packages; PC, satellite and cable ownership; holidays; smoking; leisure activities and social attitudes. Access to such databases is almost instant and relatively inexpensive. Databases can be screened in order to remove people who have recently deceased and unusual individuals can also be identified. The value of such databases is in the fact that individuals are identified by name and once named they become reachable (see Nissenbaum, 1999).

An ongoing study conducted by Mackey and Purdam (2002) provides a useful illustration of both the range of data collected and stored on restricted access databases in the UK. Mackey and Purdam collected paper forms used by a wide range of organisations in the UK including: private and public companies, charities, universities, local government and professional organisations. On the assumption that data collected through these forms was stored in a database they generated a set of variables that the organisations might have reasonably generated through the forms. They found that from an initial sample of one hundred forms a total of 590 variables could have been generated, many of these duplicate the type of demographic information that is found on anonymised datasets released by National Statistic Institutes (NSIs). For example listed below are the % of forms requesting the particular information: Age (69%), Sex (24%), Marital Status (28%), Nationality (14%), Country of Birth (7%), Length of time at current address (15%), Previous address (17%), Religion (6%), Education (8%), Employment Status (44%), Occupation (32%), Health (14%), Number of Children (28%), Tenure (19%), House type (4%), Relationships (30%), Number of rooms (4%), Number of cars (6%) and Income (18%). All the organisations surveyed, that specified a privacy agreement on their forms (49% of the sample), stated that they shared the information they collected with others within their organisational network. Of these organisations, 14% (all from the private sector) stated that they also shared the information with others outside of their organisational network, with 6% transferring information out of the EU.

With the development of the Internet, a huge range of other potential sources of personal data have emerged. These include personal home pages, online chatrooms and person search sites. For example, in the USA, a number of websites have been set up to give detailed private information on government and other public officials without the person's agreement or knowledge. One site in the USA posts the home addresses, salaries, social security numbers, court files and other information obtained from public records about US police officers, prosecutors and others who are part of the criminal justice system. The justification given on the site is that it gives people access to information that will assist them in the face of the massive databases held by for example, the police and serve to make the criminal justice system more accountable. In the USA, a number of one-stop shop online security data sites have been established. One company claims to provide searches by name and state of convicted criminals, sex offenders, drivers licence holders, civil court cases, voter registration lists, professional qualifications including medical examiners and real estate professionals. See Purdam and Elliot (2002) for a detailed overview of some of these potential sources.

The commercial value of personal data is growing not only in single databases but also in linking databases. In the USA the online advertising company DoubleClick has (through the acquisition of marketing companies such as Abacus Direct - whose database is reported to contain more than 2 billion consumer catalogue transactions) begun to build up a database of consumer profiles correlating personal information with cookies which the company uses to record surfing habits⁵. One of the largest video rental companies has considered selling mailing lists based on the subject matter of its customers video rentals and a major credit card company announced that, unless its customers opted out, details of their purchasing habits would be used to compile mailing lists and sold to other companies (see Culnan 1993). In the UK the submission to the

⁵ See the proposal by the USA company to produce MarketPlace - a CD-ROM containing addresses, demographic information and purchase information on of 120 million consumers. This proposal was eventually cancelled following public concerns about consumer privacy issues (Culnan 1993).

Information Commission of a list of names and addresses of shareholding widows, compiled from the Electoral Register and the Register of Shareholders highlights a range of confidentiality issues⁶. In the USA it has recently been reported that the Office of Information Awareness, in response to increased threats from terrorists, is proposing to build a single database of personal information including credit card, medical, school and travel information (see Wired 2002).

The trend towards the collection and linkage of personal data is also apparent within public sector organisations. For example, local authorities have a wide range of personal information databases, covering areas as diverse as: education, social work, housing, finance, planning and environmental health and equal opportunities. In part, as a response to the need to notify the Information Commission of personal data held, a number of authorities in the UK have conducted surveys to see what they hold in terms of data sets and databases. There is evidence to suggest that there has been a lack of co-ordination and knowledge of databases held by local authorities. For example, Stirling and Clackmannanshire councils found that, within their council, they had around 50 separate databases that hold the same, or similar, land, property and customer addresses (Common Data, Common Sense 2000). Whilst the Department of Health has also admitted that, before it can push forward with new data sharing initiatives, it needs to audit the different databases it holds (Data Sharing Advisory Group 2000). Recent reports in the UK of Inland Revenue staff breaching data protection law by accessing the records of celebrities, friends and family (some in relation to child support agency claims) do not add to the level of public confidence in public bodies handling of personal data (see Guardian 21.9.2002)⁷.

The increasing level of collection and storage of personal data by both the public and private sectors includes new variables, such as, for example, the UK Census 2001 which collected information on respondent's religion. In the USA a recent government employment survey of workers at an air force base included a full body scan on the database alongside other variables such as income, age and marital status. Moreover, new databases continue to be developed at national and international level including: DNA databases, finger print databases, CCTV camera records of movement, databases recording internet activity and mobile telephone call records. It is also reported that the USA security agencies under the provisions of the new Patriot Act are now tracking people's reading habits through public library borrowing records and bookshop purchasing records (Observer 16.03.03).

The information available in many personal databases is not just the superficial data. Further privacy and confidentiality issues are raised with the development of data mining and knowledge discovery techniques. High performance computing poses new challenges to our understanding of privacy. Sweeney (2001) estimates that across the world as a whole in the year 2000 there was enough computer power to store and analyse a page of information for every three and half minutes of a person's life. The use of datamining techniques and linking can be used to correlate and disclose confidential and sensitive facts and impute personal information about individuals.

The risks from data compiled in countries with less protection for personal information are a further complicating factor. Though international controls for the holding of personal information databases continue to develop, progress is limited. The EU, in a response to concerns about the sharing of information across borders with different levels of confidentiality protection, has developed a list of "approved countries" which identifies a set of compliance principles in the transfer of personal data between companies in and outside the European Union. However, negotiations have proved difficult over concerns about the civil liberties issues raised by granting US authorities access to personal data of European citizens particularly considering the perceived view of the weaker standards of data protection in the USA (see Guardian 30.11.2002). The contracting out of data processing can also cause problems. For example, the airline Lufthansa contracted out aspects of its work, namely the ironing out of coupons ready for inputting into electronic databases, to the Glasmoor prison in Northern Germany. Those prisoners entrusted with the work managed to get hold of and sell on to Europe's criminal underworld the airline's client list inclusive of names, addresses, credit card numbers and signatures (Observer, 25.8.2002).

⁶ Under the 1985 Companies Act in the UK a number of public registers were established relating to business including the register of company directors and company secretaries, register of directors interests, register of interests in shares, annual returns, disqualified directors register and the register of bankruptcy orders. The Electoral Register in the UK is a national database of those who are registered to vote. In November 2001 it was ruled in the UK courts that the selling of the Electoral Register contravened the European Convention on Human Rights (Guardian 6.09.01).

⁷ It is reported that the Inland Revenue took disciplinary action against staff in 226 cases of computer misuse in 2001 (Guardian 21.9.02).

Moreover, as highlighted by the Privacy and Data Sharing Advisory Group, standards for basic data do not presently exist across the public sector. For example, it has been reported that the Police National Computer had errors in 65% of its records (Guardian 21.9.2002). There are also a number of concerns about the robustness of so-called lifestyle data. It is often compiled from consumer surveys and product warranty information or imputed from other variables⁸. Some of the geographic data is based at area levels but used as if it were at the individual postcode level. From the aggregated data generalisations are made about the type of people that live in a particular area. As a result, services may be tailored that benefit certain residents at the exclusion of others⁹. Concerns have also been expressed concerning the software used to store data. Much data is held on Microsoft Windows and it has been argued that data should be stored on open source software to ensure reliability and access (see BMJ 2000).

4. THE LAW AND PERSONAL DATA IN THE UK

Though there is no distinct law of privacy in the UK personal data is increasingly subject to regulation. The Information Commission, which is an independent supervisory authority, has responsibility for enforcing compliance to the Data Protection Act 1998 and the Freedom of Information Act 2000. The Data Protection Act 1998 gives effect to the 1995 EC Data Protection Directive in the UK and establishes eight principles of good information handling such that data should be: fairly and lawfully processed; processed for limited purposes; adequate, relevant and not excessive; accurate; not kept longer than necessary; processed in line with respondents rights; secure and not transferred to countries without adequate protection. The Act also gives the public the right to find out what information is held on them (Section 7(1) DPA 1998). The main aim of the Act is to provide individuals with some control over the use of their personal data, in particular over unforeseen secondary uses and unwanted or harmful uses of their data.

Organisations holding personal data in the UK now have to register with the Information Commissioner and have to conform to the principles of data protection (unless they are exempt). Members of the public are able to check if a particular company is registered via the Information Commissioner website. It is not known, however, how many companies have registered. Furthermore, there is evidence of confusion amongst public bodies about the legal interpretation of the Data Protection Act and the implications of, the Human Rights Act and, the Freedom of Information Act particularly in respect to data sharing. There are also some tensions within the Human Rights Act in the area of privacy with respect to the right to freedom of expression (see Colvin 2002). In addition, the new demands on data holders are mainly policed via self-regulation.

The Freedom of Information Act 2000 which is yet to be fully implemented has a wider remit and builds on some of the principles of the Data Protection Act 1998 by giving individuals the general right of access to all types of recorded information, whether personal or non personal, held by public authorities and those providing services to them. There are, however, some substantial exemptions under the Act including issues relating to national security and law enforcement. The government claims that the development of the legal framework for privacy will lead to significant changes between the citizen and the state (Privacy and Data Sharing 2002). However, as we have outlined above it is not only the state with which the relationship may be changing but also the commercial sector and perhaps more universally how we see ourselves and each other. Though the neighbourhoods we live in may be less immediately connected, arguably we are all increasingly going to know more about each other as the data protection regulations still legitimate massive personal record-keeping systems.

⁸ See Hine and Eve (1998) for discussion of some of the weaknesses of consumer survey data.

⁹ Though there are codes of practice about the weighting given to geographic profiling amongst commercial profiling organisations they are not however legally binding.

5. CONCLUSIONS

In the UK census data is one of the key tools in determining resource allocation across a range of policy areas and organisations. However, individual data is only released in limited and anonymised form. Protecting privacy and confidentiality is seen as of primary importance even at the cost of the quality and usefulness of the data released. However, it is clear that there has been a rapid expansion in the volume of personal data collected and stored across the public and private sector. The ONS have begun to recognise this in relation to the risks it poses through more extensive data matching, however, they have not seen it as a reason to rethink their confidentiality commitments more thoroughly. Compared to the data available in the public domain the information contained in a census data set is arguably far less sensitive.

From the perspective of survey respondents and data users, it could be argued that disclosure control is not just about data release but about effective data use. For example, in the decision not to release certain variables or certain output geographies then this may have an impact on survey response rates, as people lose faith, not only in the confidentiality aspect of the census, but in the usefulness of the process as a whole. In the long term it is perhaps the effective and legitimate use of the data, rather than the primary guarantee of anonymity that could rekindle enthusiasm amongst data providers in what might be called the “nation’s database”.

More broadly, it is clear that as personal data becomes a key means of tailoring services, it also becomes the key to accessing services. We are all leaving bigger “identity footprints” in a multitude of contexts. It is now simple to find out a range of personal information about people by accessing multiple databases, linking information and using statistical and data mining techniques to impute further information. This raises a number of questions about accepted notions of privacy and confidentiality and ultimately personal identity. But exactly what is at stake? Is our privacy being invaded or does this merely represent a necessary gateway to more openness and transparency both in who we are and in how services are delivered? It is also important to consider that, as Shils argued back in 1966, government bodies are data hungry but do not always use (or need) the data they collect. Further research is clearly needed in this area.

Public opinion is central in assessing both the sensitivity and the data value of information in census outputs. This suggests that there is a pressing need for a wide-ranging public debate on the issues of data release. It seems plausible that the general public if consulted about data release and properly appraised of both the benefits and risks of such, would adopt a less conservative position on data release than NSI’s currently allow themselves to do.

ACKNOWLEDGEMENTS

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ICT BASED E-LEARNING OF ELECTRICAL CIRCUITS DURING THE FIRST CYCLE OF ENGINEERING AT UCL

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ABSTRACT

This paper describes an interactive website developed at the faculty of applied sciences of the catholic University of Louvain (UCL) for the teaching of electrical circuits during the first cycle of study. This website is part of a new pedagogical approach relying on project and problem based learning. One of the most innovative aspects of the site is the intensive use of Java Applets for visualizing the theoretical concepts.

KEYWORDS

E-learning, java, applets, electrical circuits.

1. INTRODUCTION

In 2000 the Faculty of Applied Sciences of the catholic University of Louvain has introduced the problem and project based learning approach in the first cycle of engineering studies [Aguire E. et al, 2001].

In this approach, the teaching of the basics of electrical circuits and the underlying physical concepts relies mainly on a project consisting in conceiving, designing, building and testing a circuit for a given application as a circuit for firing a flash lamp from a 1,5V battery or a circuit for feeding a small neon bulb from a battery.

The project aims to familiarize the students not only with Kirchhoff's laws and their application for writing the equations of a circuit but also with physical concepts as magnetic and electrostatic energies, power balance and conservation of energy.

In this frame students are invited to develop self learning skills and find by themselves useful informations. For helping them in this process, ICT's seem very attractive. It's therefore that with the support of the "Fonds de Développement Pédagogique" of the university we have developed the interactive website on electrical circuits presented in this paper. This tutorial is part of the site www.electromecanique.net [Labrique S. et al, 2002] which regroups several tutorials in the field of electrical engineering.

2. OBJECTIVES OF THE WEBSITE

The tutorial has been developed with the following objectives :

- help to identify the main characteristics of a circuit from its schematic diagram;
- teach through worked examples how to choose an efficient approach for solving a circuit by using appropriate methods based on series and parallel connections of elements, Thevenin and Norton equivalent circuits, superposition principle;
- help to acquire a good (physical) understanding of complex theoretical concepts as the difference between steady state and transient operation, the continuity of the energy stored in inductors and capacitors (in particular in switching circuits) or the phasor approach for solving AC circuits in steady state;
- give a first approach of e-learning.

3. ORGANISATION OF THE WEBSITE

Theoretical concepts are explained mainly through examples solved in a step by step approach with the help of animations which allow to visualise them (for instance how vary the current and the energy stored in an inductor with the voltage applied to it or how real voltages and currents are related to the corresponding phasors). This part of the site refers to a reference text book [Young & Freedman, 2000] in order to encourage the students to acquire the reflex to consult reference text books. The navigation in this part of the site has been organised in such a way that it is possible (figure 1)

- either to follow a progressive presentation which allows to acquire the concepts in a step by step approach;
- or to go immediately to a given item through a dynamic table of content.

It should be noted that when the step by step approach navigation is used, the user can visualise in the dynamic table of contents where he is.

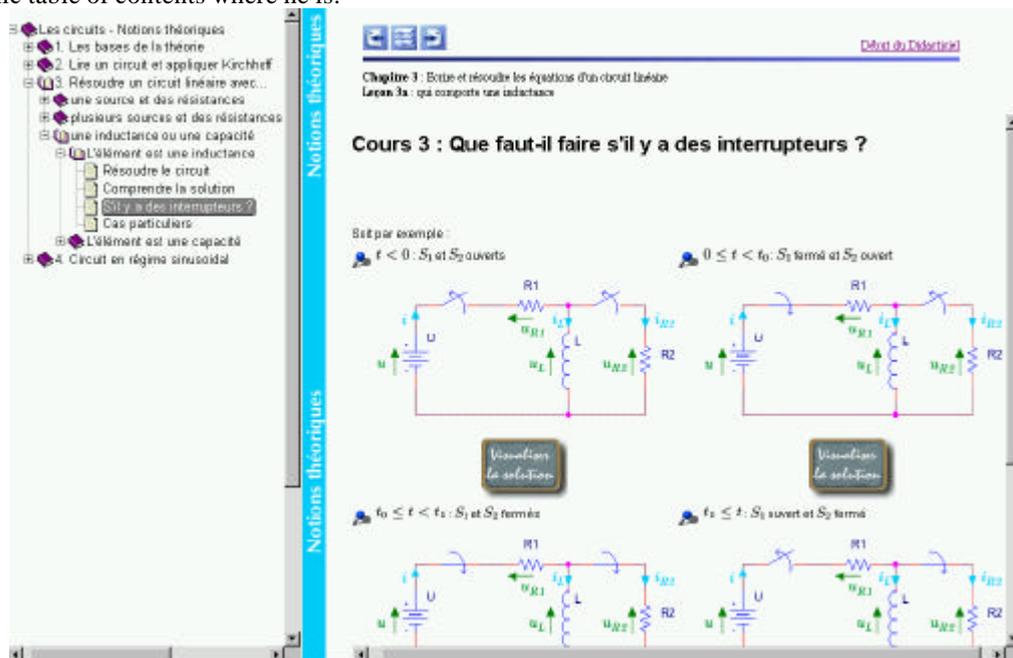


Figure 1. The dynamic navigation through the tutorial

Exercices are presented with a progressive navigation with help buttons and a step by step resolutions illustrated by animations (figure 3).

Interactive multiple choice quiz with a module of automatic corrections allow the students to check their understanding of the matter.

4. THE JAVA'S APPLETS

The most innovative tools we have incorporated in the site are the interactive animations used for visualizing the theoretical concepts or the solution of a circuit. These interactive animations have been developed as Java's applets.

Applets are Java program embedded in a HTML page. When a Web page containing a Java applet is encountered, a Java compatible browser (as Internet Explorer or Netscape) calls the launch program, which creates the "virtual machine", which, in turn, executes the Java applet code. Thus the students can see the pedagogical animations that we have developed by using a simple browser, without installation of any commercial program. The access is absolutely free, without licence, and the students can access to the tutorial outside the classroom.

The use of self-made programs rather than commercial programs (as Spice) has another advantage : it allows a more pedagogical approach. We are able for instance to propose simulations which allow to isolate a given phenomenon and show how it depends on given parameters which is helpful for its understanding.

Some examples of applets developed are listed below.

4.1 Transient behavior versus steady state operation

For instance for the response of a R-L circuit driven by a DC or AC source (figure 2), it is possible to visualize the influence of the values of the initial condition and of the time constant by varying them with the help of cursors. A time cursor allows to follow the time evolution of the voltage and current.

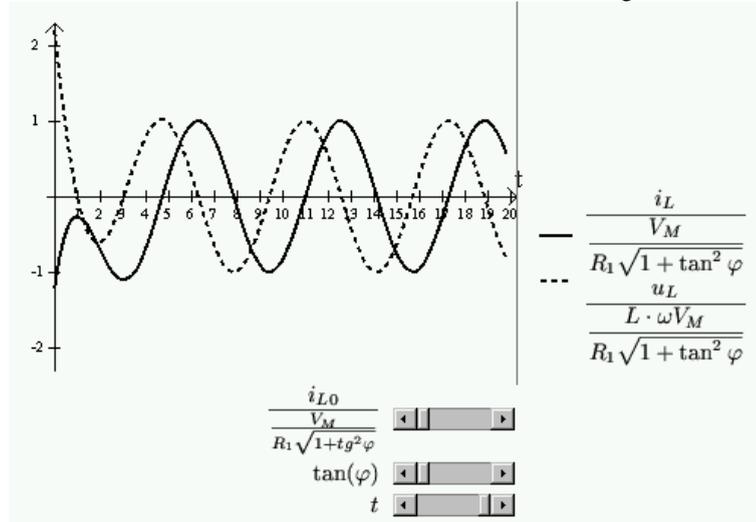


Figure 2. Response of a RL series circuit driven by an AC source.

4.2 Phasor analysis of the steady state operation of circuits driven by a sinusoidal source

4.2.1 Link between phasors and time evolution of corresponding voltage and currents

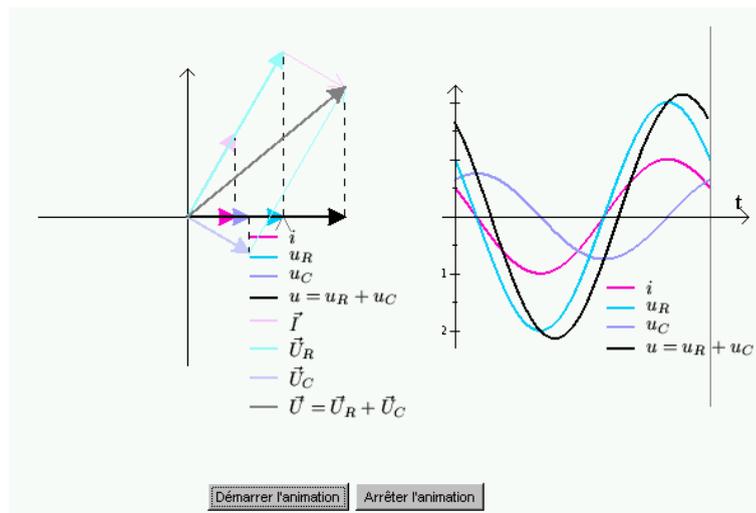


Figure 3. Representation of cissoidal quantities by rotating vectors.

The applet (figure 3) shows how cissoïdal quantities are related to rotating vectors and that the rotation which defines the time evolution of the variables associated to these vectors do not modify their relative positions so that the diagram at a given instant (i.e. at a given position) contains all the information on the cissoïdal quantities.

4.2.2 Use of phasors diagrams for solving a circuit

By considering for instance a R-L circuit fed by an AC voltage source (figure 4), with an interactive animation (figure 5) we can show that

- it is easy to draw the phasor diagram of the R-L circuit by starting with the phasor which is corresponding to the current flowing into the circuit;
- such a diagram drawn by taking an arbitrary phasor for this current can be transformed into the real diagram by rotation and scaling operations (controlled by cursors) which do not affect the relative positions or lengths of the various phasors;
- the arbitrary diagram firstly drawn may be used for determining the link between the current and the applied voltage as it contains all the informations needed for building a solution based on geometrical considerations.

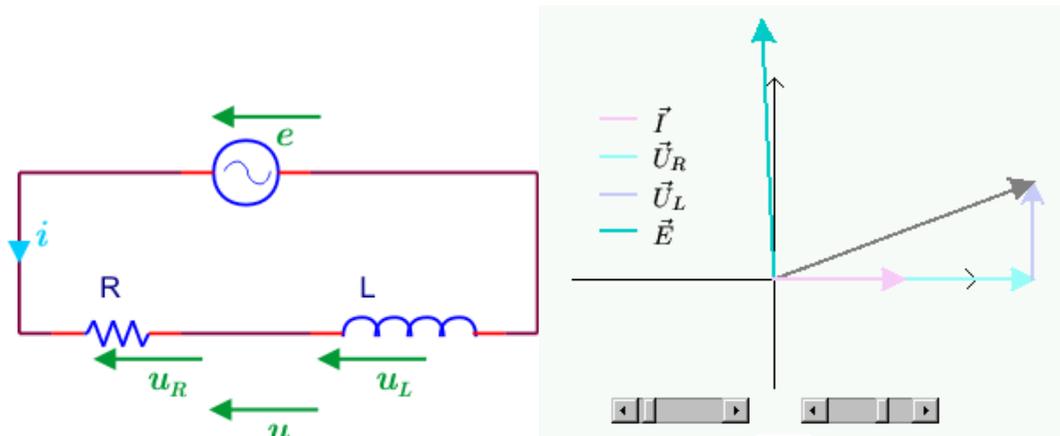


Figure 4. R-L circuit fed by an AC voltage source Figure 5. Resolution of a circuit by using rotating vectors.

5. USE OF THE INTERACTIVE TUTORIAL

A beta version of the site has been tested during academic year 2001-2002.

The free access to the web tutorial at any time has allowed the students to prepare the tutored sessions.

The tutorial has also been used during tutored sessions, in presence of a teacher. In this case, java animations have been particularly useful as they helped the tutor to favorise self-learning by the students, by saying for instance : "go to this animation, move the cursor and make by yourself the conclusion".

Statistics indicate that the site has been intensively used by students during

- the first phase of the project on electrical circuits in order to acquire skills in circuit solving;
- the revision periods before evaluations.

This shows that the website has been considered as a very useful tool not only for quickly develop skills in circuit solving but also for a self evaluation of the knowledge acquired through the project the problems and lectures.

6. STUDENT'S REACTIONS

- According to the students, the web tutorial doesn't take place of a reference text. The site illustrates the reference book : animations and examples (as resolution of a given circuit) are very appreciated and students ask for implementation of multiple-choice exercises and solved problems. The possibility of fast testing their understanding of the matter is also appreciated.

The complementarity of the tutorial with the pedagogical approach based on projects and problems is spontaneously mentioned by the students.

And last but not least, students free comments prove they are very satisfied of this tutorial. They ask also to extend such a type tutorial to other courses, as mathematics or chemistry.

7. CONCLUSION

The experiment we have made shows that an interactive website can be a very useful tool for helping student to develop self learning abilities but provided that such a site doesn't simply consist in putting its course on the web.

It is necessary to develop a didactic script based on [Linard, 2002] :

- interactivity;
- introduction of concepts through step by step worked examples;
- animations allowing to go to a more intuitive understanding of the theory.

It should be noted that such an approach needs an important investment, not only from the the point of view of the software implementation but also as concern the writing of the didactic script. But we think that the important work the development of such a tutorial implies will pay in the long range by increasing the ability of the students to work autonomously. It should also be noted that the inclusion of such tutorials in the teaching activities gives to the students a first experience about e-learning and will help to prepare them to use e-learning for continuous formation during their professional live.

But during the first cycle of formation when students have to go into a in deep learning the basics of physics, mathematics, chemistry, ... such a site must be part of a more complex pedagogical system as the one initiated in our faculty.

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TRADITIONAL COMPUTER LAB CLASSROOM VERSUS SMART E-CLASSROOM IN A DISTRIBUTED COMPUTING COURSE

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ABSTRACT

In this paper, the results of a study conducted to assess the impact on student performance and perceptions, of different types of technology access in a senior level undergraduate Distributed Computing information systems course, are presented. The results indicate that students in a “smart e-classroom” perceived better support for the acquisition of team-building and analytical skills than those in a traditional computer lab classroom and that they also achieved somewhat higher performance on grades.

KEYWORDS

E-classrooms, Computer labs, Computer classrooms.

1. INTRODUCTION

For most courses currently, technology integration into curriculum implies student access to a computer lab with networked stand-alone computers and, in some cases, course management software such as Blackboard. In addition to these resources, technology access can take the form of sophisticated “smart e-classrooms” in which computers can be used independently by students or in group-mode. These facilities allow for the sharing of screens and keyboards and the iterative development of the same project on the same computer by a group of students. Other features include the ability to project from instructor station or student stations to selected stations or all stations, full multimedia capability, seamless integration of video player, projection screens, computer, electronic whiteboard, and electronic writing pad. (J. Coppola and B. Thomas, 2000).

This paper examines the results of a study, designed to determine the impact on student performance and perceptions these two types of technology access – traditional computer lab classroom vs. e-classroom lab, have in the learning process. Smart electronic classrooms are expensive to install and maintain and require training in their effective use. Results from this study are useful in understanding the contributions these classrooms may have to the learning process relative to the now less expensive traditional classrooms.

2. BODY OF PAPER

One section of the study was held in the traditional classroom lab, with Blackboard support, while the other used the smart e-classroom, also with Blackboard support. Students could not be assigned randomly because of administrative constraints, but they had no idea to which section they had been assigned. Both sections ran for thirteen weeks and were taught by the author to ensure content equivalence. In both sections, students analysed cases (Umar, 1997) on a weekly basis, using a discovery, team-learning approach. In the traditional computer lab classroom section, students worked in class in teams of 4-5 using stand-alone computers to prepare their analyses, with Visio, Word, and PowerPoint. Presentations were done from the teacher console via an overhead projector. Those in the smart e-classroom had the luxury of having their computers hardwired into teams, which allowed them to take control of team members’ computers to iteratively develop

their solutions, also using Visio, Word and PowerPoint. Presentations could then be projected from individual student's consoles to the entire class.

Grades were collected for both sections and a final grade computed. Students' perceptions of the support they perceived was offered in the course to developing various team-building skills and analytical skills by the textbook, team activities, Blackboard, online discussions and documents were also collected at the end of the term. Team-building skills were given as developing communication skills, enabling coordination of work, and facilitating team harmony and integration. Analytical skills were given as conducting research, problem-solving, critical thinking and creative idea generation.

The research questions of interest were:

Is there a difference in student performance as a result of the different types of technology access?

Is there a difference in student perceptions as a result of the different types of technology access?

3. RESULTS

3.1 Demographics

In the traditional computer lab classroom (TC), there were 30 students, and there were 22 in the electronic classroom (EC). There were more males than females in both sections, 57% vs. 43% in the traditional lab classroom and 73% vs. 27% in the eclassroom. In both sections, most students were in the 20-29 age category, 83% and 77%, respectively. There was an approximately equal mix of those with moderate and extensive computer experience in both sections. In the traditional lab, 55% reported moderate experience and 41% reported extensive experience. In the e-classroom, this was reported as 45% and 50%, respectively. (See Table 1, below).

Table 1. Demographics

%	N	Gender		Age				Computer Experience		
		Male	Female	<20	20-29	30-39	39+	Min	Mod	Ext
TC	30	57	43	13	83	4	0	4	55	41
EC	22	73	27	9	77	14	0	5	45	50

Legend: TC – Traditional Lab; EC – E-classroom; N – Number of students
Min – Minimum; Mod – Moderate; Ext - Extensive

3.2 Performance

The average grade of students in the traditional lab was 83% compared to 87.5%, in the e-classroom.

3.3 Perceptions – Textbook Support

More students in the e-classroom perceived a lot of support for team-building skills by the textbook than those in the traditional lab. There were 45%, 59% and 41% of those in the e-classroom who perceived a lot of support from the textbook for communication skills, coordinating work and team-work, respectively, compared to 30%, 40% and 37%, respectively in the traditional lab. (See Table 2, below). Likewise, there was a higher percentage of those who perceived more support for analytical skills by the textbook in the e-classroom than in the traditional lab. Conducting research, problem-solving, critical thinking, and creative idea generation was perceived as having a lot of support from the textbook by 74%, 57%, 48%, 55%, respectively, of those in the e-classroom, compared to 37%, 33%, 33%, 30%, respectively in the traditional lab.

Table 2. Perceptions

%	TC			EC		
	N	S	L	N	S	L
Textbook						
Team-Building Skills						
Communication Skills	33	37	30	23	32	45
Coordinating Work	13	47	40	9	32	59
Team Work	16	47	37	14	45	41
Analytical Skills						
Conducting Research	7	56	37	0	26	74
Problem Solving	10	57	33	0	43	57
Critical Thinking	17	50	33	4	48	48
Creative Ideas	13	57	30	9	36	55
Legend: N - Not at All; S – Somewhat; L – A Lot; TC – Traditional Lab; EC – E-classroom						

3.4 Perceptions – Team Activity

With respect to the support offered by classroom team activity to the acquisition of team-building and analytical skills, those in the e-classroom generally perceived more support than those in the traditional lab. In the e-classroom, team-building skills – communication skills, coordinating work, team work, were perceived as getting a lot of support by 54%, 64%, 59% compared to 50%, 60%, 60% in the traditional lab. (See Table 3, below). For the analytical skills – conducting research, problem-solving, critical thinking and creative idea generation, these numbers were 48%, 59%, 50%, 55%, respectively, for the e-classroom, compared to 35%, 45%, 30%, 40%, respectively, in the traditional lab. In the e-classroom, team activity was supported by computers hard-wired into teams in which students could take control of a team members computer screen and keyboard to build on a project they had already started. No such technology was available in the traditional lab.

Table 3. Perceptions

%	TC			EC		
	N	S	L	N	S	L
Team Activity						
Team-Building Skills						
Communication Skills	5	45	50	5	41	54
Coordinating Work	0	40	60	4	32	64
Team Work	0	40	60	5	36	59
Analytical Skills						
Conducting Research	0	65	35	4	48	48
Problem Solving	0	55	45	5	36	59
Critical Thinking	0	70	30	4	46	50
Creative Ideas	0	60	40	4	41	55
Legend: N - Not at All; S – Somewhat; L – A Lot; TC – Traditional Lab; EC – E-classroom						

3.5 Perceptions – Blackboard

Once again, students in the e-classroom perceived more support of team-building skills and analytical skills by the course management system, Blackboard, than those in the traditional lab. Communication skills, coordinating work, team-work, were perceived as having a lot of support by 41%, 55%, 54%, respectively, compared to 40%, 47%, 40%, respectively. (See Table 4, below). Conducting research, problem-solving, critical thinking, creative idea generation, was perceived as having a lot of support by 52%, 50%, 55%, 55%, respectively, by those in the e-classroom, compared to 30%, 27%, 20%, 20%, respectively, in the traditional lab.

Table 4. Perceptions

%	TC			EC		
	N	S	L	N	S	L
Blackboard Overall						
Team-Building Skills						
Communication Skills	13	47	40	9	50	41
Coordinating Work	20	43	47	9	36	55
Team Work	13	47	40	14	32	54
Analytical Skills						
Conducting Research	27	43	30	9	39	52
Problem Solving	30	43	27	9	41	50
Critical Thinking	33	47	20	9	36	55
Creative Ideas	23	57	20	9	36	55
Legend: N - Not at All; S – Somewhat; L – A Lot; TC – Traditional Lab; EC – E-classroom						

In the e-classroom, 45%, 50%, 43%, perceived a lot of support from documents stored on Blackboard for communication skills, coordinating work, team-work. Only 27%, 37%, 30%, respectively, perceived such support in the traditional lab. For conducting research, problem-solving, critical thinking, creative idea generation, these numbers were 57%, 41%, 50%, 59%, respectively, in the e-classroom, and 33%, 27%, 27%, 20%, respectively, in the traditional lab. (See Table 5, below).

Those students in the e-classroom also perceived more support for team-building and analytical skills from online discussions held on Blackboard. Communication skills, coordinating work, team-work, were perceived as having a lot of support by 42%, 58%, 50%, respectively, by those in the e-classroom compare to 30% each in the traditional lab. (See Table 5, below). For analytical skills – conducting research, problem-solving, critical thinking, creative ideas, 42%, 42%, 58%, 58%, respectively, in the e-classroom and 20%, 25%, 30%, 35%, respectively, in the traditional lab, perceived a lot of support from these discussions.

Table 5. Perceptions

%	Blackboard Documents						Blackboard Discussions					
	TC			EC			TC			EC		
	N	S	L	N	S	L	N	S	L	N	S	L
Team-Building Skills												
Communication Skills	23	50	27	10	45	45	5	65	30	8	50	42
Coordinating Work	20	43	37	5	45	50	5	65	30	8	34	58
Team Work	17	53	30	5	52	43	10	60	30	17	33	50
Analytical Skills												
Conducting Research	17	50	33	13	30	57	0	80	20	8	50	42
Problem Solving	26	47	27	9	50	41	0	75	25	8	50	42
Critical Thinking	23	50	27	5	45	50	0	70	30	8	34	58
Creative Ideas	20	60	20	9	32	59	0	65	35	8	34	58
Legend: N- Not at All; S – Somewhat; L – A Lot; TC – Traditional Lab; EC- E-classroom												

4. CONCLUSION

This study attempted to look at different types of computer access in a Distributed Computer course and found that, overall, it would seem that students in the e-classroom perceived more support for the acquisition of team-building and analytical skills by the various course resources and activities than those in the traditional lab. They also seemed to score slightly higher on grades. Future research would need to replicate these studies in the same course and across other courses to determine the stability of these results. Currently, the author is also working with other colleagues on the results of a critical thinking skills instrument (Facione, 1998) to determine whether differences in this regard exist between the types of computer access provided to students. These results are important, as the efficacy of technology integration in the learning process is still an open debate, as is the extent of this integration, as well as what aspects of the integration.

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BUILDING AN E-BLENDED LEARNING COURSE USING LEARNING OBJECTS

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ABSTRACT

The Blended learning is the solution in which we can take now full advantage of ICT based e-learning combined with some traditional classroom activities. Dependent on the course topic and on the knowledge level of the learner, a scenario of the learning process has to be developed and entered into the Learning Platform. The learning materials/content have been managed independent of the course itself.

An architecture for the learning object model has been defined. A learning object can be seen as an extension of the learning content element, by integrating the scenario and the content in one object. This scenario must be integrated afterwards in the available Learning Platform.

KEYWORDS

Life long learning; eblended learning; learning process scenario, live sessions; learning object; learning content management

1. INTRODUCTION

During the last years we developed e-learning courses in the domain of information management. We evolved to the adoption of e-blended learning model. We developed a learning content management system or Warehouse of learning materials.

In the next months we will develop a first prototype learning object. The architecture as proposed in this paper, has still to be discussed and will be changed taking into account the reactions on this paper.

2. ORGANISATION OF E-BLENDED LEARNING COURSE; AN EXAMPLE OF A LEARNING PROCESS SCENARIO

2.1 E-blended learning model

Blended learning is a new methodology that associates different learning tools to offer a better follow-up, a tailor-made course, matching the needs of the participants and an effective learning process. Different learning activities are organised along the learning process. A blended learning solution consists of a mix of ICT supported learning activities: making basic course texts available, putting the assessments online,

making reference materials, organising online coaching, organising discussion sessions, creating help facilities and job-aids,...

Recreating learning online and determining the right blend isn't easy or can't be taken lightly. To create interactions that meet the same standards as traditional programs and to get the right blend, the audience and the technology tools have to be invested.

2.2. Adoption of live sessions in the e-blended learning model

The adoption of live sessions in the learning process is a new evolution in e-learning technology. Those synchronous events are key to the learning design because they give learners the opportunity to ask questions, interact with peers and practise skills in a more realistic environment.

Student groups can „meet“ in synchronous chat rooms. Real time events are best handled using this medium. Here are some best practices for discussion.

- Chat rooms are good for brainstorming. Often document sharing occurs in this area as well
- Use chat for office hours; use the syllabus to state office hours and instructions for getting accessing chat. Student can enter the chatroom and ask questions. Help students understand that unless a private chat appointment has been set up, other students can read the conversation.

2.3 An e-blended learning scenario for distance learners

- The introduction into the topic: a powerpoint presentation by the teacher in a live session (voice over IP);
- Interaction between students and teacher about the topic;
- During the presentation students can ask questions through the option of 'handraising' & chat writing;
- The instructor can stop presentation and give feedback on questions (voice);
- Questioning at the end of the introduction (Simultaneous writing on whiteboard);
- Instructor writes question about presentation in middle of whiteboard;
- All students are able to write their answer on the whiteboard at the same time;
- Instructor comments (voice) on all the inputs of the students;
- Assignment as part of the session (Screen sharing & coaching room);
- Introduction of 15' by the instructor;
- Instructor puts some questions on the whiteboard;
- Students have 30' to write down an answer in a word document; meanwhile students and instructor stay connected to the LS live session;
- After 30', course starts again; students will share their documents (screensharing);
- Students can give additional comments/explanation through voice over IP;
- Assignment organised as an assimilation activity to be done within a short time period (discussion board);
- Instructor explains assignment at the end of the presentation (voice);
- Students have to post their task on the discussion board before the next class;
- Online tutoring of the selfpaced activity;
- Once a week an online questions and answers session is planned;
- Students can connect to the live session and get in contact with.

3. LEARNING MATERIALS MANAGEMENT SYSTEM

To support the e-blended learning model, we developed a learning materials management systems.

In our learning materials management system we split the physical storage of the document on one hand and the definition of the document on the other hand.

The metadata or the characteristics of the document are stored in a database-table. The documents themselves are centrally organised in a directory/ subdirectory hierarchical and multilevel structure. The documents are belonging to a domain/discipline and have to be published in the corresponding discipline

directory. The directory organisation is following the well-known library catalogue system UDC (Universal Decimal Classification) complemented with some home-defined UDC codes. The document is linked with its metadata in the database table.

An author/user can decide to centralise his files/documents on the warehouse server and to publish them immediately or later on.

The UDC code is one of the metadata items and will force the storage of the file/document in the corresponding UDC directory.

Once the file/document is published it will be accessible for other users through the Internet. A user will query the knowledge pool to become some selected information. A query interface in the browser (as an ASP based application) has been built for all staff members and students. The query is executed on the metadata table and a query report of the corresponding linked documents has been generated by this application.

Another kind of use is the integration of the warehouse learning documents in the e-learning platform to be used in the courses. An important requirement is the independence of the learning materials from the learning system. Our warehouse guarantees this independency. The documents are stored as html-files in our warehouse and the most advanced learning systems can create linkages to those html-pages.

In our University we are using LearningSpace 5 (Lotus Notes). A main characteristic of this learning system is the independent management of the learning content. In our learning process we are following a learning path organised as a series of modules. The content is preferably stored as html documents in the warehouse and is simply linked with its URL. The learning activities themselves (integrated in the e-learning platform) can be started from this learning path

4. LEARNING OBJECTS, AN EXTENSION OF THE LEARNING MATERIALS

4.1. A learning object

A learning object consists of: content elements, learning method model/scenario, learner knowledge level, and the attributes describing all elements. The collection of the objects is the warehouse of learning objects.

Knowledge is available in all kinds of digital sources. The knowledge experts can be identified as knowledge content experts and experts in learning process modelling.

The users of the learning objects are the trainers/teachers. They will create courses using learning objects. The kernel of a knowledge object is a learning process scenario, composed of a list of learning activities, accompanied by linkages to learning content connected with the learner knowledge level.

4.2. Open learning object

The created learning module/course has to be imported into an e-learning platform. The trainer/teacher has planned some activities delivered by it and the students do start learning from that interface.

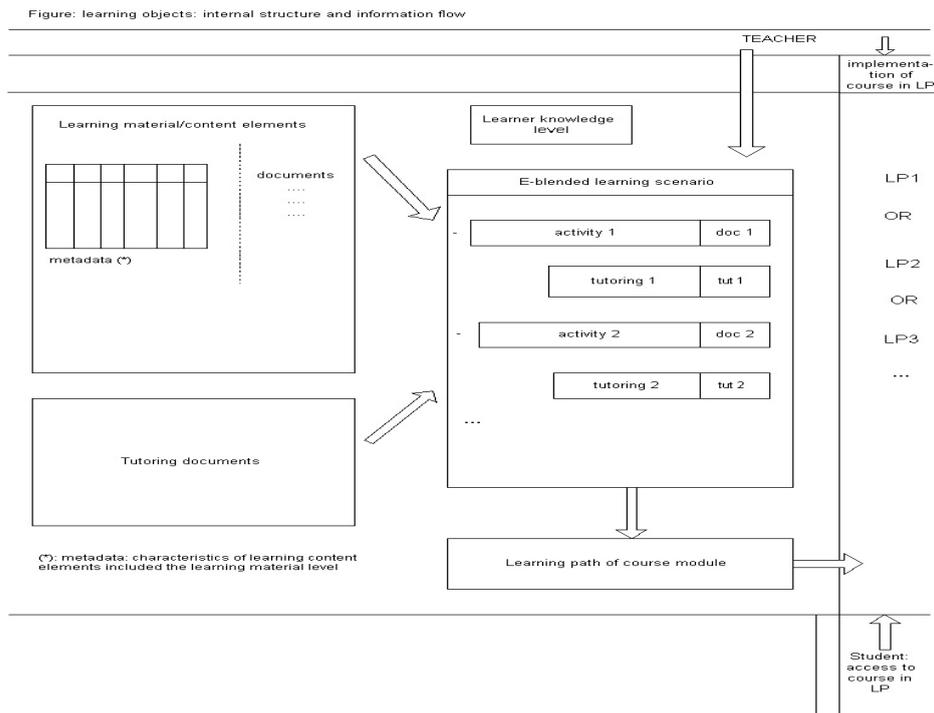
To be open, the learning module is created using an empty XML schema. The teacher has to enter the activities, the linkages to the learning materials to be used, and the activity support tutoring information.

4.3. The internal structure and info flow of a learning object.

In the figure you can see the object oriented warehouse system of learning objects. It is an extension of the learning materials management system.

Not only the learning content and its metadata is available, but also linked with it is the blended learning scenario as a kernel of the object.

The output is the planned learning path of the course including all activities and content documents. It has to be imported into the learning platform (LP) to make available the systems supporting the activities.



5. CONCLUSION

Many research projects are ongoing on point of the creation of learning platforms based on open standards and reusable learning objects. In this paper we introduced the idea of learning process scenario based learning objects. The architecture has still to be discussed. The development of a first prototype will be built in the next months.

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FIPA COMPLIANT PEDAGOGICAL AGENTS IN DISTRIBUTED INTELLIGENT LEARNING ENVIRONMENTS

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ABSTRACT

Over the last years, many organizations started to use Distance Teaching tools as instruments in employees qualification programs, creating what we may call Elearning or Virtual Training in Human Resources Development Programs. However, usually these organizations tend to use technological resources already available, and do not shape their technological platform into a pedagogical project. Recent advances in the field of Intelligent Teaching Systems have proposed the use of Artificial Intelligence through architectures based on agents' societies. Teaching systems based on Multi-Agent architectures make possible to support the development of more interactive and adaptable systems. The objective of the paper is to discuss the feasibility of implementing Distributed Intelligent Learning Environment – DILE based on the Multi-Agents Architecture approach, aiming at the achievement of human resources qualification through Virtual Training. Besides, we present a proposal of an architecture based on the approach of FIPA compliant Multi-Agents systems named Java Agent Framework for Distance Learning Environments..

KEYWORDS

Intelligent Learning Environments, Artificial Intelligence, Multi-agents systems.

1. INTRODUCTION

Computer Science, together with Psychology and Education, has been trying to refine teaching computational tools towards personalized self-learning. Everyday, new approaches to the use of Computer and Education are bringing new perspectives to this area. The evolution of Computer and Education became computational teaching environments an excellent choice for Distance Learning, by bringing new vigor to this field of science. Computer Networks and Multimedia fields have provided tools for the development of Tutoring Systems based on client-server architectures. The popularity of Internet along with the extensive development and use of standard protocols and services make Internet very attractive for Distance Learning. There has been a big boom of tools and mechanisms available for implementation and support of Distance Learning. The traditional Computer Assisted Instruction Systems approach (CAI) lacks to provide an adaptable learning process according to each individual student.

The state of the art in Intelligent Tutoring Systems and Intelligent Learning Environments fields points to the use of Agent Society-Based Architectures. The fundamentals of the Multi-Agent systems have demonstrated to be very appropriate to design tutoring systems, since the teaching-learning problem could be handled in a cooperative approach (Cheikes 1995; Giraffa et al. 1998; Johnson & Shaw 1997; Mathoff & Hoe 1994; Norman & Jennings 2000). Using Multi-Agents Systems approach to design Intelligent Tutoring

Systems can result in more versatile, faster and at lower costs systems. The introduction of AI techniques and, specifically, the use of Multi-Agents architecture in these environments aim to provide student-modeling mechanisms (Johnson & Shaw 1997). We believe that these concepts can be used in modeling and implementation of Intelligent Distance Learning platforms aimed at qualification programs in organizations.

The objective of the paper is to discuss the feasibility of implementing Distributed Intelligent Learning Environment – DILE based on the Multi-Agents Architecture approach, aiming at the achievement of human resources qualification through Virtual Training. Besides, we present a proposal of a new architecture for Java Agent Framework for Distance Learning Environments (Silveira & Viccari 1997; Silveira 1997; Silveira 2000). This architecture represents an evolution over the old one toward a more robust communication framework among the agents by using a well known Agent Communication Language (ACL): FIPA-ACL over a agents communication platform FIPA-OS.

2. THE PROJECT

This project, based on Java Agent framework for Distance learning Environments proposes an infrastructure of project, development and implementation of Distributed Intelligent Learning Environments – DILE, based on the approach of FIPA like Multi-Agents architecture. The Java Agent Framework for Distance Learning Environments was born in 1997 as a thesis project. In this project we use the Eletrotutor prototype (<http://www.inf.ufrgs.br/~rsilv/eletro31/eletro.html>) as a test bed. Eletrotutor is a teaching environment for Electrodynamics teaching, and in each version we have been refining the agents architecture.

2.1 Architecture

This architecture encompasses a very short Multi-Agent family composed of just three types of agents (Figure 1): an agent responsible for the student interface, one responsible for student model, and a set of agents responsible for tasks related to teaching tactics (Pedagogical Agents), where each agent may have its tasks specified according to its goal.

This agents are implemented according to FIPA recommendation. In order to improve the FIPA compliance the FIPA-OS platform (<http://fipa-os.sourceforge.net>) was used. The FIPA-OS framework provides several JAVA classes for FIPA compliant agents construction, a agent runtime environment and a set of FIPA message interchange services. All the FIPA-ACL agent's message interchanging is controlled by FIPA-OS.

The system contains a special agent responsible for each teaching strategy (Pedagogical Agents), that is, for the domain knowledge retrieval over each point to be presented to the student, for the task of proposing exercises and evaluating proposals, examples and extra activities.

The Student's Model agent takes all actions of student's data accessing. When a Pedagogical agent is required to update the student's history, this agent sends to the Student Model agent the data to be updated, as well as any other change in the student's cognitive state.

The Interface Agent performs the communication between the student and the system. He recognize the student actions over the graphical interface and generates the corresponding messages to other agents and produces content displaying according to the received messages from them.

Agents knowledge is implemented as a relational data bank. The Student Model agent performs all actions related to knowledge base retrieval and updating. When a pedagogical agent needs to update the student's historic, for example, it will send data to the Student Model Agent. The major roles of the Student Model Agent are: To load the current student's state; to generate the overall student's historic; to generate the report of every student's steps; to generate the assessments results; to select the teaching strategies; to check the last access date and to verify tactics available for a certain lesson.

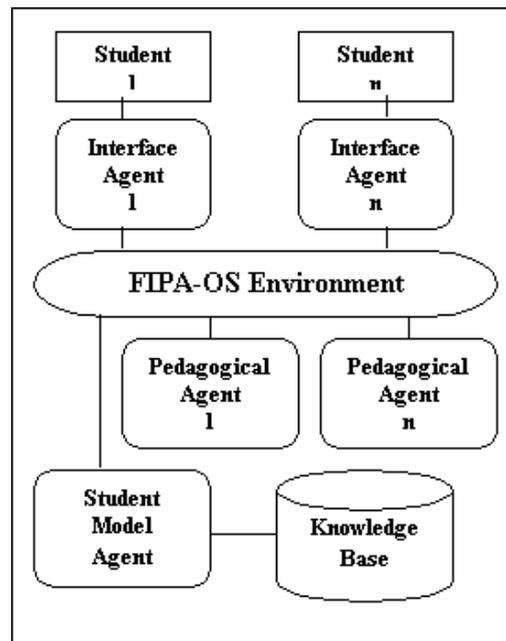


Figure 1. Architecture System.

The Pedagogical Agents are generated from a tactics previously defined by the course specialist. Their tasks are defined according to the agent's needs. However, as the tutor is based on the content presentation (HTML pages presentation), some tasks are previously defined for all pedagogical agents:

- Show current content:** when the pedagogical agent receives this request, it communicates with the Student Model manager agent to retrieve from the knowledge base the content that is being presented to the student and sends it to the student's browser.
- Advance:** with that request, the pedagogical agent communicates with the Student Model Manager to retrieve from the knowledge base which content will be presented to the student.
- Return:** the pedagogical agent retrieves, from the knowledge base and through the Student Model Manager, which is the content previous to the one the student sees at that moment.
- Options:** if requested, the pedagogical agent can propose some tools or resources to the student, according to the teaching tactics she/he is performing
- Update historic:** at every task implemented, the pedagogical agent must register at the Student Model the actions that were performed, as for example, date and hour the student left the current content, date and time of a new content input, etc.
- Evaluation:** the agent has evaluation mechanisms for the tactics the agent implements.

3. CONCLUSION

In this work we intend to bring some important contributions, refining the efficacy of learning environments, aggregating concepts of different areas to establish a methodology for the implementation of Distance Education projects, and stressing the use of cooperative problem solving paradigm using Multi-agent architecture.

The use of some FIPA-compliant communication framework (FIPA-OS) improved the message interchanging among the agents and provide more adaptability and flexibility to the system.

Further work will integrate the implementation of this pedagogical agents with commercial or well-known academic learning environments or frameworks. This integration takes advantage of the pedagogical and administrative resources of these environments and improves their adaptability using cognitive modeling and solving problem strategies of the framework.

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MATE – MOBILE AGENT TECHNOLOGY FOR ECOMMERCE

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ABSTRACT

The present short paper discusses the application of mobile agent technology in the e-commerce domain. It describes the architecture of MATE (Mobile Agent Technology for Ecommerce), which aims on delivering a solution for current and emerging B2B and B2C e-commerce requirements and outlines its implementation.

KEYWORDS

E-commerce, Mobile Agents, B2C, B2B

1. INTRODUCTION

E-commerce can be viewed as a set of processes that support commercial activities within an information network. These activities produce information about products, events, services, suppliers, consumers, publicists, transactions, advanced search algorithms, transactional security, authentication, etc. In brief, e-commerce entails the development of a business vision, supported by information technology with the goal of enhancing efficiency within the process of trade [Adam99].

From the appearance of EDI in the early seventies to today's internet boom, e-commerce has had a significant boost in its development, where technology has served as a fundamental role in its process. The problem now is how to handle the growth of offer that can be found on the Internet, specially regarding non-tangible goods. With the implementation of automatic facilities to deliver non-tangible goods immediately to the end-user [Chaves03], the important task now is to construct an efficient brokerage system that helps the customer find the best possible offer for his needs. Mobile agents play an important role in this process, as they represent the user in his interaction with the ever-growing marketplace.

The popularity of software agents, on the execution of tasks related to information filtering, mapping of people with similar interests and automation of repetitive behaviors is well known [Maes99]. It is thus,

without surprise that agent based technology is seen as the one that will revolutionize e-commerce in the way it is seen today, promising a new and innovative approach in the way transactions are processed, may these be business-business, business-consumer or even consumer-consumer.

Using mobile agents represents an important leap in the development of first generation (static) agent systems. The possibility of working offline, thus saving network resources, is one of the main advantages. There is no need to keep a connection active while a transaction is processed. Other advantages are [Lange99]:

- They overcome network latency
- They encapsulate protocols
- They execute asynchronously and autonomously
- They adapt dynamically and react autonomously to changes
- They are naturally heterogeneous, providing optimal conditions for seamless system integration
- They are robust and fault tolerant

A buying agent may migrate to merchant servers and execute locally functions for search, filter, negotiation and payment. In this context, the involved entities are:

- A buying agent for each merchant
- A buying agent for each client
- Objects that contain information that represents products
- Monetary values and currency

Fig. 1 illustrates how a commercial transaction can be executed using mobile agents. In this case, the buying agent migrates to the merchant’s site where all requests and replies needed to complete a transaction will be processed. All of the required processing is performed on the merchant’s site. Finally, the buying agent returns to the client’s site where it will present the results.

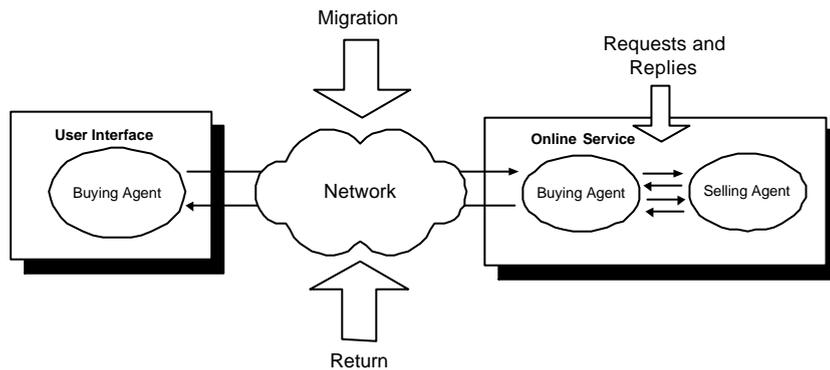


Figure 1. Transactions involving mobile agents

2. MATE ARCHITECTURE

MATE is not intended to replace actual e-commerce systems, but to expand them with mobile agent support. In fact, this platform is aimed to be part of the generic e-commerce platform proposed in [Chaves02] and [Chaves03]. The architecture is illustrated in Fig. 2:

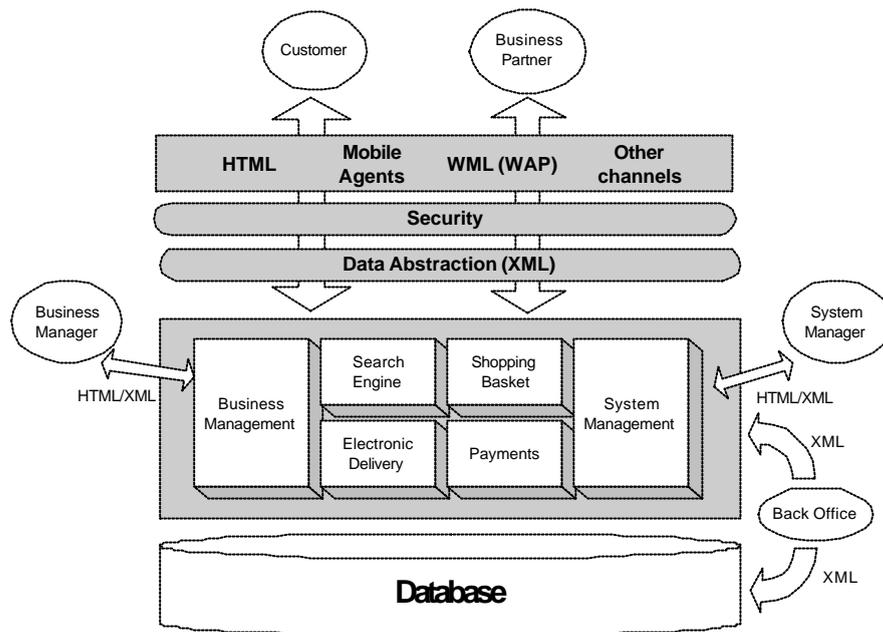


Figure 2. Components of the proposed e-commerce System

External entities (customers, business partners, managers) interact with the system through specific communication channels (HTML, WML, mobile agents, etc.) to access the main modules that build up the core of the platform (search engine, shopping basket, payments, etc.). A specific security layer takes care of all aspects regarding to authentication, privacy, integrity and non-repudiation. Although the system supports several communication channels, the internal applications interface with external modules and entities using XML, which is becoming a standard in e-commerce applications. All information is stored in a database (data layer), which is accessed by the *backoffice*, via structured XML documents (i.e. queries and replies).

Since integration is performed via specific interfaces, the systems become multidimensional and open to several communication channels, be them standard http or mobile agents. This is the main advantage of following a modular approach to systems development. Modules can be developed and integrated independently.

From a conceptual point of view, MATE can be divided into several domains, which are closely related to the entities that take part in current “real world” transactions:

Buyer Domain – It is associated with the potential buyer involved in a transaction. This is where the *Buying Agents* (BA) are generated and parameterised in order to search and eventually purchase products.

Mediation Domain – It contains all information about suppliers and respective areas of business. The agents that are generated in this domain are called *Mediating Agents* (MA) and have the main goal to interact with the BA so that these can fulfil their objectives. This type of cooperation between agents is quite similar to current mediation services.

Seller Domain – It contains information regarding to the catalogue of products of a seller that wants to take part in the marketplace. The corresponding agents are called *Seller Agents* (SA) and they have the function of “talking” to the MA to promote their products and “talking” to the BA to supply the results for product brokerage. Eventually they will also complete commercial transactions with the BA.

Payment Domain – Normally, in commercial transactions, payments are carried out by external entities that provide this service to merchant and customer. This is the case of, for example, credit card payments and wire transfers. The proposed system offers the flexibility of performing payments via an external entity or this can be carried out directly at the seller domain. Associated to the payment domain are the *Payment Agents* (PA) that will perform in accordance to the parameters of a particular negotiation.

Fig. 3 illustrates the functional model of the MATE architecture, with its domains, associated agents and interactions between them.

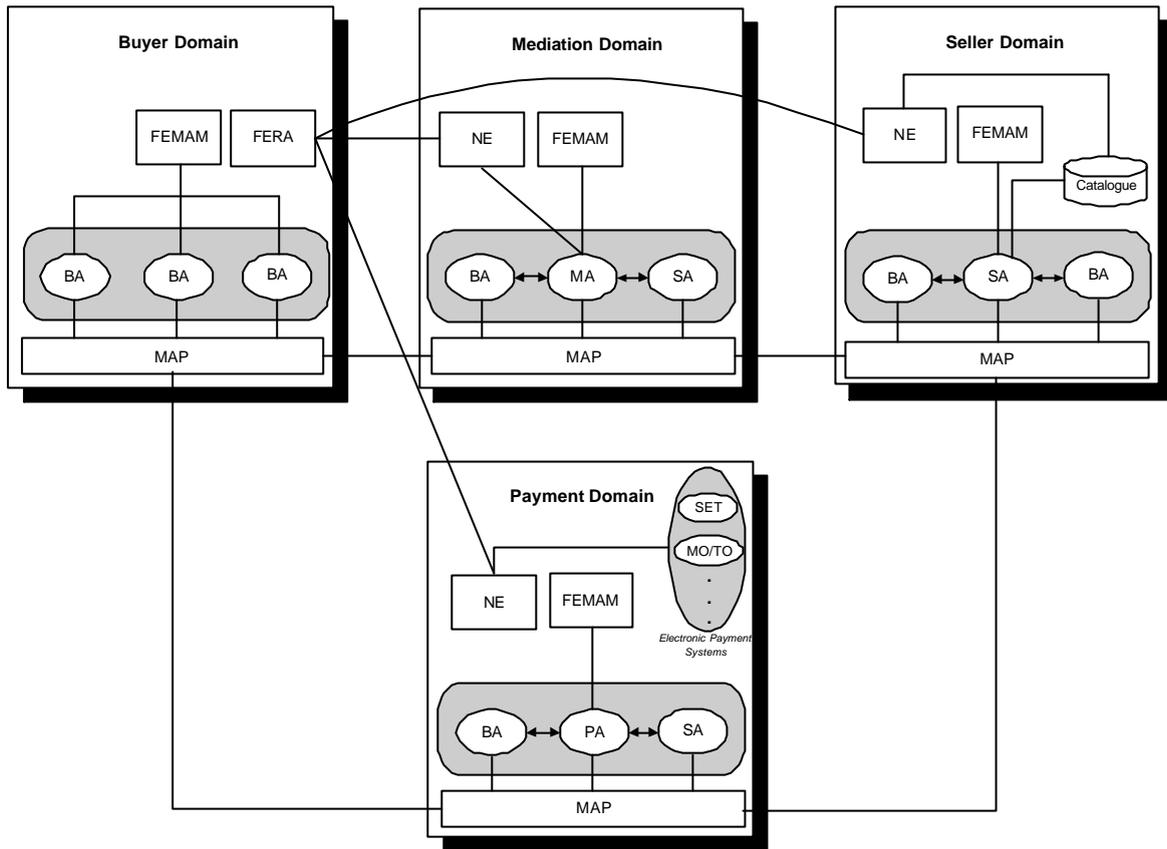


Figure 3. Transactions involving mobile agents

Table 1. Components of MATE

MAP	Mobile Agent Platform
BA	Buying Agent
MA	Mediating Agent
SA	Selling Agent
PA	Payment Agent
FEMAM	Front-End for Mobile Agent Management
FERA	Front-End for Remote Access
NE	Navigation engine
SET	Secure Electronic Transactions
MO/TO	Mail Order / Telephone Order

Agents will cross several seller domains searching for the best options, based on multi-criteria evaluation of characteristics that are based not only on price. In fact there are other important characteristics that value a product, such as size, color, availability, delivery time, etc. The weight of each criterion is a configurable parameter of the system.

A successful implementation of MATE is directly dependent on its ability to integrate with the e-commerce platform. Implementing MATE in a JAVA environment (to permit code and data mobility) enables the testing of the mobile agent functionality and the migration procedures. After integrating this system with the e-commerce platform it will then be possible to use real users and data. By respecting the XML definitions provided by the data abstraction layer, this task is possible, which means that all information transported by the mobile agents is coded in XML. Agents will also pass through the security layer, which means that they should comply with the security requirements of the e-commerce platform,

which has been tailored to support mobile agent interaction. In order to ensure the safety of both the agents and the domains, a security policy is applied. The policy contains rules for restricting or granting access to data and services, controlling the consumption of resources and restricting and granting agent capabilities. The agent system should also be able to evaluate the amount of trust in an agent, depending on the sender of the agent, successful authentication and integrity checks.

3. CONCLUSIONS AND FUTURE WORK

MATE will be integrated within the current e-commerce platform and tested with concrete use case scenarios. The main goal is to offer a complete transaction system that covers the needs of modern users. Selection of catalogues and real users representing sellers and buyers is very important to also measure the overall success of the system. Results will be important to fine-tune all parameters (i.e. criteria weights for product evaluation, agent decision and negotiation capabilities, XML messages, encryption keys, etc.) and also to predict how users will accept this new form of conducting electronic transactions. The visual interface of the mobile agent client program, that runs on the customer's side, should be easy to understand and intuitive, so that the management of each user's mobile agent(s) is straightforward. With the development of mobile communications, specially with the arrival of next-generation mobile systems, the client programs for mobile agents will run on the customer's mobile terminal, which will then be one of the main instruments for conducting commercial transactions, regardless of time or location.

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AUTOMATIC METADATA DISCOVERY FROM NON-COOPERATIVE DIGITAL LIBRARIES

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ABSTRACT

Building unified higher-level services for a set of heterogeneous digital libraries (structured data) is a challenging task, and particularly when digital libraries are not amenable to modifications (non-cooperating). In this paper, we provide a lightweight, user centered approach based on LFDL and post-processing techniques. Specifically, we provide a metadata retrieval mechanism from non-cooperating DLs. This allows a user to search seamlessly across a large domain of 'hidden' web pages and obtain a complete set of metadata for the results. In addition, this allows metadata to be stored in a local repository to create an intelligent cache for better performance and efficiency.

KEYWORDS

Digital Library; metadata; interoperability; XML; interface; structured data

1. INTRODUCTION AND BACKGROUND

Building unified higher-level services for a set of heterogeneous digital libraries (structured data) is a challenging task, and particularly when digital libraries are not amenable to modifications (non-cooperating). Interoperability is a key area of DL research, facilitated by open frameworks and standards, involving lightweight protocols. Our emphasis is to achieve interoperability among non-cooperative digital libraries. We addressed some of the issues and challenges of DL interoperation in our earlier work in LFDL (Lightweight Federated Digital Library) [1][2][3]. In LFDL we presented a more general approach to interoperability – Data Centered Interoperability (DCI). We observe the user interaction with the digital library and develop an XML specification of all possible user/DL interactions including the way a DL presents the results of a query to the user. We created a testbed LFDL implementation in which we defined a universal search interface and a DL definition language to describe a DL's specification. The specification defines the rules of query mapping between universal interface and native interface.

The resulting testbed system had a fairly high level of quality of service in terms of precision/recall and users were given rich functionalities in their resource discovery. However, not much effort was placed on processing the search results, and they were presented in a flat structure. Organizing of result set helps user to locate the target object quickly in the result set. This requires post-processing of the result set, which is a challenging task in the distributed approach. Performance is another major issue in a federated centralized service using distributed queries against non-cooperative DLs. In our earlier work on LFDL we improved the performance by using a local cache to store the query results. However, the cache reusability was low as only an exact matched query string resulted in a cache hit. What one needs is a local repository with an "intelligent cache", so that there are more cache hits without reducing the search result quality. Both the tasks, organizing the result set and intelligent caching, require additional processing of the result set using all the metadata available from the result set. However, extracting metadata from a DL that is not cooperating is a non-trivial problem. In this paper, we present an automatic metadata discovery and retrieval mechanism by observing the external behavior of a DL. The DLDL (Digital Library Definition Language) has been enhanced and an XML specification is used to define the rules to obtain metadata from each DL's result pages.

2. AUTOMATIC METADATA DISCOVERY AND RETRIEVAL

2.1 Approach

Obtaining metadata from a DL without any cooperation is not a trivial task. A DL does not provide metadata or a way to obtain its metadata; secondly, each DL has its own way to define metadata, and can display any subset of its metadata at its own discretion. The most difficult part is that there is no consistent way among DLs to display metadata; each DL has its own rules as to which metadata to display and in what form.

Each individual DL provides a search service by three general web-based interfaces: a search page, a list of output pages of search results, and a detail page of a single record/document. In LFDL we describe each DL's behavior by using a specification that defines the rules of query mapping to provide federated search service. The results list page and/or document details page provides a possible source of result metadata. Typically, results page lists important meta information about each matched document and once a user clicks on a document link more detailed meta information about that document will be presented. Therefore, an automatic metadata discovery and retrieval from a non-cooperating DL is possible as long as such metadata is available from its search results page and/or record details page. Our approach is to define rules to extract metadata from these pages, and to develop a metadata parser that will use these rules to obtain the metadata.

Handling differences in metadata definition among different DLs is relatively easy. We use Dublin Core (DC) metadata set as a common set, and each DL's metadata fields are mapped to the closest DC field. Some DLs may have fields that cannot be mapped to DC fields. We can define a set in addition to DC; if those fields are commonly used, we will map them to the extra set. If a field is unique to a DL, we will still specify it and keep it. The metadata description of a DL will be limited to the exposed fields of that DL.

The difficult part is to define the rules to handle all different cases to gather metadata from different DLs, or how to parse search results and record pages. Ideally, different DLs would use consistent ways to make their metadata publicly available. But in reality each DL has its own way to display such information, and many times no meta tag is used but all information are in the actual HTML code. Therefore, our common metadata retrieval rules have to be generic enough to parse different result pages for different DLs.

2.2 Architecture

To realize the approach described above, we start with the overall LFDL system architecture design that is shown in the Figure 1. The basic idea is to add DL metadata parsing rules to the DL's specification and to have the LFDL use these rules to parse the DL's result pages. All parsed metadata is stored in a local repository so that they can be reused by future search queries.

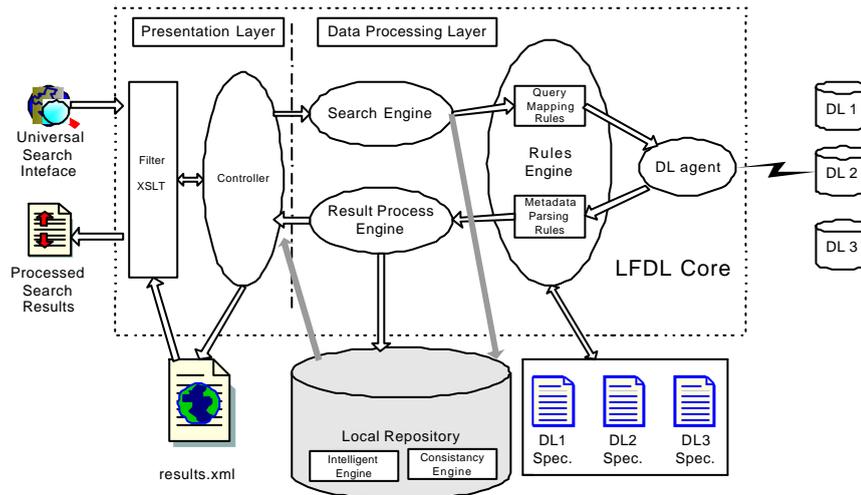


Figure 1. LFDL Architecture and Data Flow

The data flow and interaction among the modules is as follows:

- At initialization the system reads all DL specifications including query mapping rules and metadata parsing rules
- A resource discovery user submits a query using the universal search interface
- The front-end filter does pre-processing (query clean-up) with the help of a central controller, and then the query is passed to the Search Engine
- The Search Engine uses the query mapping rules to transform the universal query to a DL's native local query
- A DL agent sends the transformed query to the remote DL and receives the search results
- The Result Process Engine parses the search results pages and extract the metadata according to the metadata parsing rules and store them in the Local Repository
- All parsed results are merged by the Controller into an intermediate XML document
- The resulting XML document is displayed using a XSLT processor.
- Once the Local Repository has been populated, the Search Engine executes searches against the Local Repository (cache) first instead of sending queries directly to remote DLs.

2.3 Metadata Retrieval and Parsing

As we stated in section 2.1, we define DL output metadata at two levels: results list page level, and if available, record page level. Still, some DLs do not provide any metadata at all. Following is the algorithm used by the Result Process Engine to retrieve and parse metadata from HTML pages in two levels.

1. Once search results from a DL arrive, the Result Process Engine checks for parsing rules from the DL's specification.
2. The Process Engine applies parsing rules to get metadata from HTML page, and the generated metadata will be stored in a cache.
3. If DL specification also defines lower level (record page level) metadata parsing rules, all record HTML pages will be retrieved from remote DL, and parsed
4. Extra process on cached metadata so that they are ready to be displayed.
5. After post-processing is done for all results from all DLs, results are merged and then displayed to end-users.
6. Periodically, cached metadata will be saved to persistent storage such as a database.

2.4 Metadata Parsing Rules Definition

We use the same DL XML specification to define metadata-parsing rules as we use for query mapping and metadata retrieval. We extend the DDL to define parsing rules at two page levels: result list page level and single record document level. As shown in the following DTD, the basic idea is that the raw string is separated into several segments, and each segment has one or several metadata fields. MATCH-START and MATCH-END specify a segment, and EXCLUDE and REPLACE will remove unrelated strings. Actual metadata fields will be separated by DELIMITER.

```
<!ELEMENT RESULT-METADATA (MATCH-START,MATCH-END,EXCLUDE*,REPLACE*,DELIMITER*,METADATA-FIELD*)>
<!ELEMENT RECORD-METADATA (MATCH-START?,MATCH-END?,EXCLUDE*,REPLACE*,DELIMITER*,METADATA-FIELD*)>
<!ELEMENT METADATA-FIELD (#PCDATA)>
<!ATTLIST METADATA-FIELD
  Title CDATA "information about a particular metadata field">
<!ATTLIST METADATA-FIELD
  order CDATA #IMPLIED>
<!ATTLIST METADATA-FIELD
  multiple (true | false) #IMPLIED>
<!ATTLIST METADATA-FIELD
  delimiter CDATA #IMPLIED>
<!ATTLIST METADATA-FIELD
  format CDATA #IMPLIED>
<!ATTLIST METADATA-FIELD
  null_value_string CDATA #IMPLIED>
```

2.5 Local Repository

Once metadata are parsed, they are stored in a local database to form a repository so that all future searches will be checked locally first before sending queries out to remote DLs. By using such a local repository, both search performance and service reliability will be improved. We call this "intelligence cache" as compared with the old caching mechanism in the earlier versions of LFDL. By using a cache grouped by metadata fields, we can provide service at a quality as good as or close to the search service provided by an individual DL that maintains all the data it serves. A consistency engine will handle the cache consistency between local storage and remote DLs.

3. RESULTS AND FUTURE WORKS

We have implemented this architecture and created specifications for seven digital libraries (ACM, NEEDS, NACA, COGPRINTS, CSTC, LTRS, and WCR). All of these libraries are from the federation of the LFDL, hence we only had to add the parsing and extraction rules to the DL specification documents. We illustrate the process for both a list page level DL and a record level DL. From the experience of adding the seven DLs to our federation we can say that the average the effort to observe and analyze anew DL is on the order of hours rather than days; these specific DLs took an average of three hours to define. This bodes well for the scalability of the approach at least from the specification perspective.

Following screenshot shows post processed results from ACM and Cogprints after metadata parsing.

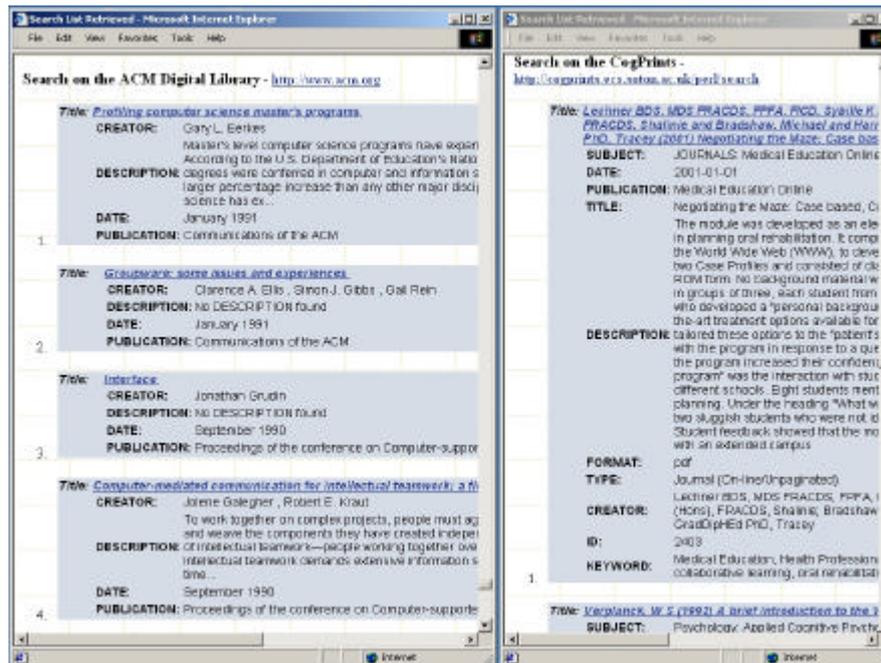


Figure 2. Post Processed Results in LFDL after Metadata Parsing

We are now working on how to utilize the extracted metadata both to improve the performance through intelligent caching and to increase the quality of service to the user through better result set navigation tools. We are designing a rich, user-friendly, and flexible result-displaying mechanism, so that users can group or process results by any metadata field, without re-sending the query or start a new search. The major direction in this effort will come through focus groups and usability testing of the existing LFDL. The intelligent caching problem we have outlined in the paper needs considerable more design for us to achieve efficiency, flexibility and usefulness.

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A CRITICAL APPROACH TO THE EXPERIENTIAL DESIGN OF ON-LINE GROCERY STORES

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ABSTRACT

This paper introduces ongoing work to address the issue of the on-line grocery shopping experience and particularly, how to compensate for the lack of possible sensory interaction with products on-line. From the state of knowledge about grocery shopping experiences, the paper highlights a research agenda and introduces a framework for application to the analysis and interpretation of web user experience. Benefits of adopting the framework to solve problems for the experiential design of on-line grocery storefronts are discussed in the context of ongoing research.

KEYWORDS

Experience, "On-line grocery stores", "Interaction design", Senses, "Product information", Aesthetic, HCI

1. INTRODUCTION

The notions of consumption and shopping experiences are now prolific in the marketing literature, where the emphasis is on characteristics of holistic consumption experience, eclectic methods and treatment of consumers as rational and emotional beings (Schmitt, 1999). Researchers have explored determinants of on-line store choice (Kim & Lim, 2001) and factors affecting online shopping experiences, particularly elements of the on-line shopping process that affect consumer satisfaction, such as logistics, customer service, pricing and storefront design (Koivumaki, 2001). The user interface has also been discovered to increase on-line shopper satisfaction (Lohse and Spiller, 2000). Westland and Au (1997) found that shoppers perceive a more intense shopping experience when presented with a richer interface in terms of content and format and that shoppers place high value on convenience and ease of on-line purchase process. Particularly relevant in increasing enjoyment of the overall shopping process are features related to ease of product and information retrieval and the speed and responsiveness of the virtual storefront to create a sense of interactivity. Studies like these tend to concur that high quality information is relevant to on-line shopping experiences. Very few studies, however, have explored ways of enabling consumers to make *informed* product choices on-line, despite the special issues of on-line shopping regarding the lack of direct physical contact with products and the presence of a comparatively large body of research looking into ways of increasing on-line purchases.

Indeed, these issues bear particular relevance in the case of food products, which lend themselves to be touched, smelt, tasted, looked over and listened to before buying (Bowbly, 1997; Lawless & Heymann, 1999; Francis, 1995). Consumers are used to being able to test for freshness and other product attributes with their senses during shopping, yet on-line, products cannot be physically examined, excluding a major dimension of the shopping experience. The user interface of on-line storefronts instead assumes the job of interpreting between product and consumer through which the shopper can explore and 'handle' products through means of their affordances. Affordances being all the possibilities perceived by an individual consumer to be offered by it with the potential to satisfy their needs and allow an enjoyable consumption experience (Heeter, 2000). For food products "consumers learn about the shapes, texture and perceived functions of a product ...[they] visually inspect it from different angles" (Li et al, 2001, p.15). The interface is the sole means of enabling consumers to gain access to such affordances when shopping for food on-line.

2. CONCEPTUALISING STEPS TOWARDS EXPERIENTIAL ON-LINE GROCERY SHOPPING

As these new issues arise, a need is suggested for extra support to on-line food shoppers, for them to elicit the attributes of products they are buying and to have a rich consumption experience. Mathieson et. al. (1999) have highlighted long-term benefits for both consumers and retailers in improving on-line decision making and providing appropriate ways for shoppers to achieve their goals. They discuss the fact that consumers continue to learn over time and have different experiences, needs and expectations, complicating the task of providing a grocery-shopping interface that interprets between consumer needs and product affordances. Vijayarathy and Jones (2001) take one possible approach to tackling the lack of physical interaction possible when buying on-line, suggesting that when products require direct sensory inspection, retailers address other areas of marketing, adopting methods such as promotions and increased variety. Other research (Fiore, 2002) has instead sought progress towards the provision of, as opposed to detracting from, a sensory evaluation of food products on-line. Findings suggest that depth (how detailed the product information is) and objectivity (information describing or presenting non-subjective, physical characteristics) of product information presented to consumers, impacts on how confident they feel and how easy they perceive the on-line choice process to be. Such approaches pursue new avenues for the design of on-line grocery storefronts as *tools* to enable consumers to carry out sensory evaluation, recognising that "...computer mediated experiences reduce the body's representation to mouse actions, keystrokes, or low bandwidth audio" (Heeter, 2000, p.10).

From this stance, in attempting to design web stores that support user experiences, it first becomes necessary to understand experience conceptually. To this end, this research has seen the development of a unified holistic framework to conceptualise user *aesthetic* experience. Such work represents an attempt to unify knowledge from diverse disciplines of consumer behaviour/marketing and Human-Computer Interaction (HCI) to develop an human-centred approach to supporting on-line (sensory) grocery shopping experiences. The remainder of this paper focuses on explaining the make up of the new experience framework and indicating how it forms the basis for ongoing work.

3. A FRAMEWORK TO GUIDE DESIGN FOR EXPERIENCING

Up to now, much of Human-Computer Interaction work towards modelling and designing to support computer use, has tended to derive from a Cognitive Psychology approach, viewing the human brain much like a computer processor, primarily as a respondent to various stimuli. However, such a model does not provide a satisfactory means of accounting for dimensions of human experience such as emotion, social interaction and intersubjectivity. More recent work is beginning to tackle this imbalance towards cognitive approaches, looking to aesthetic and cultural disciplines for inspiration, ideation and transferable knowledge (Bertelsen & Pold, 2002; Wright & McCarthy, 2003; Muller, 1995; Laurel, 1993). The current research adopts such an approach, drawing on theories of literary studies, philosophy and psychology in devising an interpretive framework for understanding and analysing user experience with computer artefacts and, in particular, web interfaces. The experience framework (discussed in more detail in Fiore, 2003) draws on the multidisciplinary works of John Dewey (philosophy) (Dewey, 1933; Dewey, 1958), Mikhail Bakhtin (literary theory/philosophy) (Hirschkop, 1999) and Csikszentmihalyi (psychology) (Csikszentmihalyi & Csikszentmihalyi, 1988) to provide a conceptualisation of experience with specific relevance to computer-mediated activities, aimed at assisting understanding of and designing for user aesthetic experiences with emerging technologies. It suggests nine foundational and universal dimensions of an aesthetic experience (that which is appreciative, perceiving and involves undergoing, where the emotional, practical and intellectual phases move toward a consummation together), namely that it is:

- **Educative and memorable:** affecting and affected by previous experiences and the objective possibilities open to the experiencing subject.
- **Whole and unique:** an experience cannot be repeated due to the coming together of various conditions, persons, objects, all in a given context and at a certain time.

- **Historical:** activities exist in a cultural-historical setting, influenced by past happenings. Also, experiences are linked through their *meaning* to past and future ones.
- **Meaningful:** an experience is pervaded by communication. Contextual and historical conditions, both internal (e.g. feelings/knowledge) and external (e.g. other people/objects) help the user give meaning to an experience, learning from it and relating it to past experiences
- **Qualitative:** an experience is also pervaded by a *quality* that gives it individuality and unity (e.g. a memorable journey becomes *that* journey – an indefinable quality setting it apart from other events). This quality may be emotional and/or intellectual and may or may not be perceivable.
- **Instrumental and intersubjective:** experience is controlled through attention to it and it’s relation to other things. Thus, knowledge held by a user is instrumental to altering the quality of an experience. However, the designer and user each have roles to fulfil and bring meaning to the interaction.
- **Contextual:** an experience cannot be detached from the socio-cultural context in which it is situated where objects and artifacts within are conceived, used and related to.
- **Physical/sensory:** people rely on their senses to interact with surrounding people and objects. Also, sensory information, such as colours, smells and other sensations have meaning for a person, according to their knowledge (e.g. knowing that a green apple tastes more sour than a red one).
- **Spatio-temporally situated:** events occurring in an experience are spatially and temporally related to one another. Time may be distorted and a space (physical or virtual) may have relevance or invoke emotional responses (e.g. a claustrophobic space). Metaphors may also represent space that is not real (e.g. ‘shelves’ in an on-line store).

Given the co-constructed nature of experience emphasised in this framework, where user, designer and, in this case retailer, all play roles, intersubjectively perceiving, interpreting, sharing and acting in the experience, it is necessary to recognise that experiences themselves cannot be *designed*, but only *designed for*. Only the *external* conditions for experience to occur in and the physical objects as the focus of experiencing, can be contributed by the designer. In this sense, the design process becomes ‘experiential’, with the experiences and perceptions of the designer just as relevant and influential as those of the user(s) and other stakeholders.

It is also important to recognise when evaluating experience, that activities may be goal driven or entirely autotelic (intrinsically rewarding). They may also be perceived as associated with work or leisure, or be familiar to the person. In addition, on-line, there is the possibility that the activity may have a real-world equivalent, as with on-line shopping. The nine key dimensions of aesthetic user experience are represented in Figure 1, where each occupies equal relevance and is required to make the *whole* aesthetic experience. If one or more dimensions were omitted, the ‘wheel’ would be incomplete. As such, the framework emphasizes the holistic nature of aesthetic user experience, whereby all composite elements are essential and integral.

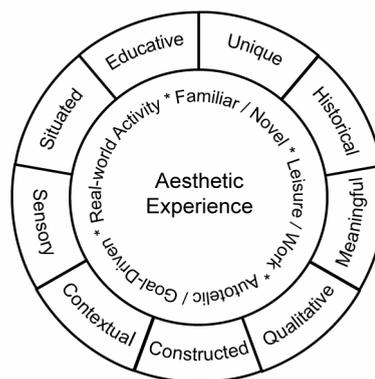


Figure 1: ‘The Wheel of Experience’ framework: each of the 9 segments contributes to making the whole aesthetic experience.

With this framework, it is possible to begin to appreciate the dimensions expected to characterise on-line food shopping experiences, recognise the impossibility of designing experiences on behalf of consumers and understand the need to consider all dimensions as relevant in design. The framework essentially aims to build on

work in this direction (Buchenau & Suri, 2000; Heeter, 2000; Li et al, 2001; Wright & McCarthy, 2003) by addressing the physical and sensory delimitations imposed by virtual or 'remote' media such as the WWW. It posits that the sensory dimension (along with eight others) of experience is always present and relevant. Users will experience sensorially during on-line shopping and may potentially perceive an inadequate sensory experience. According to the framework, if shoppers are to achieve aesthetic experiences on-line, the sensory dimension must be supported like any other dimension. In this way, the framework should serve to highlight all considerations for designers aiming to support aesthetic experiences for users. Antecedents and consequences of an experience are not distinguished between in the framework, in order to reflect the fluidity of experiencing. To take a hypothetical example, an outcome of buying wine from an on-line store on one occasion (e.g. pleasure at finding a favorite vintage) may be the basis for a future experience (e.g. enjoying the wine with friends) and thus neither solely antecedent nor consequent. Generally, the framework may serve equally well as a basis for assessing experience needs and various aspects of 'Experience Prototyping' (Buchenau & Suri, 2000) as the basis for the Experience Sampling Method (see Csikszentmihalyi & Csikszentmihalyi, 1988) or less formal user centred evaluations and design problems. The next paragraph describes how the framework is beneficial in providing a conceptual base for ongoing work to aid the design of on-line grocery stores.

4. INVESTIGATING FOOD SHOPPING EXPERIENCES

The conceptualisation of the experience framework marks the first result of investigations and literary research, to seek a new paradigm for designing for user experience, yet such a framework requires testing and application to evaluate its long-term potential usefulness for designers and conceptual 'accuracy' for considering *user* experience. The next stage of this research will employ the framework to guide examination of user experiences of on-line grocery shopping and the gradual formulation of design guidelines to maximise the nine dimensions of shopping experiences as aesthetic experiences. The remainder of this paper, however, will focus on the benefits of and present need for this framework for tackling the specific problems for on-line grocery storefront design.

A basic tenet of the framework is that an experience is linked to previous and future ones, in both the objective and subjective conditions of it. It is therefore sensible to first examine the food shopping activity as it takes place for potential users of a web store and in doing so, identify objective conditions set (e.g. objects in the store environment/presence of other shoppers). It is also helpful to begin to identify the range of potential subjective conditions that may be brought to use experiences by users, including previous knowledge and factors such as mood. This is likely to involve examination of real-world-based experiences. In particular, understanding the activity of choosing food in physical shopping environments is the starting point for identifying how specific product attributes can be used to aid choices on-line. Shoppers rely on their senses to perceive colour, size, texture, aroma, flavour and other attributes (Lawless & Heymann, 1999) and knowledge helps them determine what these attributes mean about the product to infer such things as quality and freshness. Previous work (Fiore, 2002) suggests that over time, food shoppers become more practiced at inferring product attributes, marking a step towards a better understanding of the physical food choice activity. Building on this, future phases of the research will aim to understand more about the activity of choosing food products, highlighting salient tools, methods and information used by shoppers.

Work has also highlighted the individual and subjective nature of food shopping experiences and how people choose, shop, consume and think about food and their role in relation to buying from within a social, historical, cultural, religious and familial context. Additionally, ongoing development ensures that an experience is unrepeatable, even for the same person under identical external conditions. On-line stores thus need to support each user in constructing *their own* activity and experience at each visit, providing tools to enable them to achieve their goals, whether they perceive those goals as leisure or work. Such tools should encompass knowledge already held by consumers.

The challenge for designers is to provide the objective conditions to users of the on-line storefront, to not hinder the potential for aesthetic, or emotionally fulfilling shopping experiences. It is important to emphasise however, that this does not mean that either designer or user is a passive recipient; both are active, undergoing, perceiving, making sense and communicating in constructing an experience. The next stages of the current research are aimed at extending previous findings regarding the provision of information to on-line shoppers to

support product decisions and in thus doing, begin to eliminate barriers to aesthetic experiencing (such as not being able to generate expectations of action consequences). Specifically, this involves:

1. Exploring characteristics of aesthetic food shopping.
2. Investigating means of helping shoppers translate their aesthetic food shopping experiences on-line.
3. Experimenting with various media to support the sensory dimensions of on-line shopping experience, through encapsulation of knowledge in 'objects' to form the focus of experiencing.

Regarding the latter, Englis and Soloman raise some issues surrounding the use of images and visual information to on-line consumers. They recall the assertion that "product evaluations are a gestalt phenomenon where design features must interact" (Englis & Soloman 2000, p.6) and suggest benefits of pictorial information. In particular, images can be processed simultaneously, rather than sequentially as verbal or textual stimuli. Additionally, "aesthetic, sensory, or symbolic benefits of products must be heard, tasted, or seen to be appreciated...pictures are more memorable than words and are more impactful stimulants of mental imagery" (ibid, p.6).

Previous work (Fiore, 2002) has shown benefits of providing pictures of food products for sale in an on-line store that portray higher levels of detail and objectivity, and so enable the shopper to see more attributes of the products. The research shows that use of pictures to present products, as well as or instead of text, offers additional benefits, in that they provide information captured without subjective interpretation. Textual descriptions, on the other hand, will involve a process of interpretation during their composition, expressing perceptions of product characteristics that might not be shared by a shopper. The framework above supports the notion that all experiences are intersubjectively constructed. Therefore perceptions of a product cannot be predetermined for a shopper by the designer. Images in themselves convey certain meanings, but do leave open the possibility for the shopper to draw on their knowledge to make meaning of what they see. Future investigations will primarily explore the best possible use of available on-line media to communicate product attributes and meet experience needs. Work can thus be expected to expand to consider audio and video as means of enhancing the sensory dimensions of experiences.

The experience framework will guide these investigations. It is, however, potentially most helpful for the second objective. The sensory dimension of the framework prompts questions relevant to food shopping and, in particular regarding the actual physical sensations and actions that interacting with the storefront interface involves. This might encompass buttons to be pressed (e.g. mouse clicks), visual stimulation such as colours, images and fonts and any audio (e.g. a sound to indicate an error, such as product not available). It may equally, however, relate to the way in which sensory knowledge held by consumers is embodied in objects present at the interface. Product images, for example, may provide objective conditions to be perceived by the user (e.g. recognizing a preferred apple by its colouring or choosing a cake with a lighter or denser looking texture). Looking at these issues, it may be possible to identify how users can achieve aesthetic shopping experiences on-line through the use of 'surrogate' sensory stimuli (e.g. a picture of the cake texture, rather than feeling the weight directly). The framework provides that sensory experiences be pervaded by a necessary link between doing and perceiving. It therefore encourages a look at ways of meeting the needs of users by setting up the objective conditions to encourage aesthetic experiences.

5. CONCLUSION

Despite a prolific body of research into consumer behaviour with regard to food shopping in physical stores and a shifting emphasis in HCI design towards supporting user experience goals, research is lacking into how to support and, if possible, aesthetically enhance consumer experiences at on-line grocery storefronts with particular emphasis on support for making of informed product choices and sensory information. This paper has reported current research moving in this direction. So far, this work, building on previous research into the use of on-line media to support product sensory evaluation needs on-line, has involved the construction of a framework to aid conceptualisation of user aesthetic experience. This framework provides an holistic account of experiences that are consummated through an emotional and/or intellectual fulfillment and are meaningful. It also implies that experiences are not passive, but constructed by the shopper, retailer, web designer and all people, objects and artefacts they interact with. Progress at this stage is marked by the provision of a foundation for the evaluation of user experiences that accounts for the lack of sensory interaction possible on-line between consumers and products. Imminent developments will seek methods of

testing application of the framework to aid the design of on-line grocery storefronts, in terms of product information presentation, user-system interactions and support for fulfillment of individual user experience goals during the shopping process. Work will, in particular, focus on the potential for development of technological objects that encapsulate and represent knowledge held about sensory product attributes. The framework provided promises help to designers and researchers to guide improvements to on-line grocery storefronts that facilitate desirable aesthetic experiences. It marks a first attempt at the provision for and application of such a framework to tackle the lack of sensory experience at on-line stores and aims primarily to encourage developments in this complex problem area.

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AN ARCHITECTURE FRAMEWORK FOR ONTOLOGY DEVELOPMENT

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ABSTRACT

This paper identifies requirements for an ontology development platform to facilitate methodical ontology engineering and ontology application development. It introduces the DOGMA ontology framework, developed with insights from semantic modeling and methodology in database engineering. Based on this framework, an architectural paradigm is put forward in view of ontology engineering and development of ontology applications and a development portal designed to support ontology engineering, content authoring and application development with a view to maximal scalability in size and complexity of semantic knowledge and flexible reuse of ontology models and ontology application processes in a distributed and collaborative engineering environment.

KEYWORDS

Ontology, semantic processing, ontology portal, architecture, methodology

1. INTRODUCTION

This paper summarizes the DOGMA (Developing Ontology-Guided Mediation for Agents) framework and our exploration of one of the architectural paradigms of the framework, with focus on the problems and requirements in the current research projects (STARLab, VUB). It is organized into six sections on the subjects of requirements, DOGMA framework, MCU architecture, ontology development portal.

2. MAJOR REQUIREMENTS OF ARCHITECTURE

This section reviews briefly some major requirement issues for the current study. *Ontology* is an approximate linguistic representation of agreed conceptualization concerning a subject matter. *Ontology development* means ontology modeling, content authoring and application development.

2.1 Modular, scalable, collaborative and evolutionary modeling

The supporting tools and infrastructure of ontology modeling needs to support managing model complexity with modularization and stratification, scalability in complexity and size of knowledge, managing evolution and change in an iterative modeling cycle and collaborative distributed effort.

2.2 Interoperability across systems

Here *system* means any semiotic system, such as database schemas, languages, ontologies, network systems. Interoperability issues encountered in our study are multi-linguality with ontology, information retrieval from heterogeneous databases, communication between agents and processes.

2.3 Reusability of ontology

The reuse of ontology is different from reuse in component-based software development. Besides needs for semantic transparency, the ontology reuse tends to be partial and dynamic. It can be adoptive, without transforming or modifying the semiotics, augmentative and adaptive, translating or modifying the semiotics.

2.4 Development of ontology-based applications

We are working on the scenario of using ontology in knowledge system applications, such as ontology-based information extraction, ontology-based decision support, ontology-based HCI and natural language processing. Ontology is seen as abstract model underlying database or knowledge base to facilitate a large-scale information and knowledge engineering. In addition, it can also be regarded as part of knowledge base, contributing to inferencing, problem-solving search, justifying and explaining an automatic conclusion and advice.

3. DOGMA REPRESENTATION FRAMEWORK

This section describes the key concepts of DOGMA framework for ontology representation. It will be the basic constructs of ontology development architecture.

3.1 Lexon and lexon base

Lexon is a quintuple $\langle g, t_1, r_1, t_2, r_2 \rangle$ where $g \in \Gamma$ is a *context* identifier, $t_1 \in T$ and $t_2 \in T$ are *terms* over alphabet A , $r_1 \in R$ and $r_2 \in R$ are *roles* in the semantic relationship. Γ , T and R are strings over an alphabet, A^+ . With a context identifier $g \in \Gamma$ and $t \in T$, its concept can be uniquely identified. Context is a set of sources referring to some documents. Intuitively, a given document source $g \in \Gamma$ contextualizes ideationally the relationship between two concepts. The semantic validity of the relationship is established through the developer/user agreement on the sources. In fact, the context is ideational. A lexon base, Ω , is a set of expressions composed from a ordered pair $\langle A, I \rangle$ where $I = \Gamma \times T \times R \times T \times R$ is the set of lexons.

Lexons captures fact types rather than their instances. The ontology base is an ontology of fact types underpinning knowledge and data bases. This model-theoretic paradigm of semantic modeling has great significance to ontology engineering as to database systems (Meersman, R. 2000) (Spyns P. et al, 2002), especially ontology scalability size and complexity during both engineering and processing time.

3.2 Commitment layer

Lexons are not the specification of application-related information about data population or rule-based processes, unlike database schemas or rule bases. They are declarative and static description of relation types underlying application domains. In the DOGMA representation framework, application-specific business rules, data integrity constraints are left to an interface layer between the model, the ontology proper, and applications (Meersman, R., 2000). It is introduced into an otherwise monolithic representation of declarative and operational semantics. In addition, it enables decoupling semantic knowledge from the IT applications, so that the latter makes use of an external ontology for its semantic processing. A comparable approach to data independence brought about successful development of database systems and their client applications.

4. MCU ARCHITECTURE

M stands for *model* as in database terminology. It is a subset of ontology base and a way of structuring the lexon population. *C* is *commitment* to the lexon models with respect to task or task types. *U* is *use* for system-specific configuration of commitments and its processing for a given application.

4.1 Architectural dimension, viewpoints, processes

The ontology base is structured into *models* whereas *commitments* and *uses* are the two architectural dimensions based on the commitment layer of the ontology representation framework. The *model* and pertain to ontology modeling whereas *commitment* and *use* are concerned with ontology application. The former defines what semantics is whereas the latter how the semantics is applied. *Commitment* acts as interface between heterogeneous and general models of ontology and various task-specific intelligent processes in diverse applications.

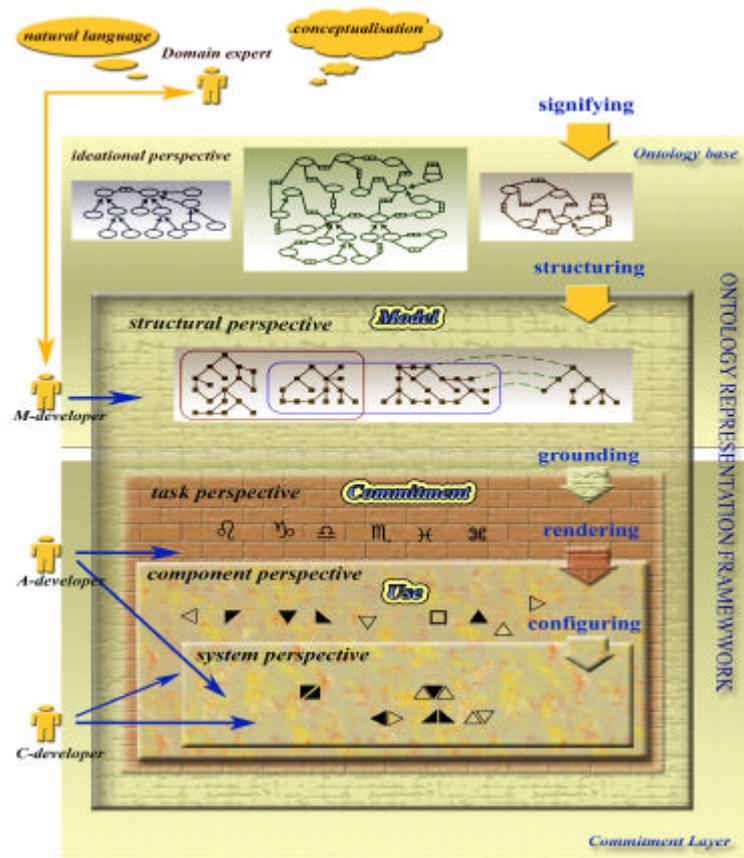


Figure 1. DOGMA MCU Architecture

As depicted in figure 1, the ontology development gives four ontology deliverables: models, commitments, processing components and their assembly, from four development processes: *signifying*, *structuring*, *grounding* and *configuring* in four development contexts: *ideational*, *structural*, *task* and *application*. Across the dimensions of *model*, *commitment* and *use*, there are five architectural viewpoints, *ideational*, *structural*, *task*, *component* and *system*. Methodology of ontology development and use are developed to capture the best practices, guidelines, procedures and development management in these viewpoints. The targeted users are model developers (M-developer), application developers who develop and architect commitments and their processing components into uses (A-developer) and content developers who author contents with ontology (C-developer).

4.2 Model

The model is a device to structure the lexon base. It can be defined recursively. A model consists of one or more lexons. It can include one or more models as its constituents. Each lexon enters into direct or indirect relationship with the rest of symbolic entities in this finite semiotic space where "... elements ... do not have intrinsic meaning as autonomous entities but derive their significance from oppositions which are in turn related to other oppositions in a process of theoretically infinite semiosis." (Culler, J., 1981).

4.3 Commitment

Committing to ontology is the adoption and interpretation of lexon models to enable particular behaviour in the software agent for a given task in given applications. The adoption is selective (Gruber, T., 1993) and 'a partial semantic account' (Guarino, N. & Giarretta, P., 1995). The interpretation imposes constraints and instantiations on lexon models so that the models are semantically consistent and unambiguous in the context of tasks and applications. A commitment consists of a set of selected lexons and their constraints and instantiations concerning particular tasks. For example, a commitment of ontology for database operations imposes the integrity constraints or other rules over the selected lexons. Commitments can be specified in a commitment specification language, for example, ?-RIDL (extended from RIDL (Meersman, R., 1981)) for ontology-based query over multiple databases.

4.4 Use

The architectural dimension of *use* features software processes using or interpreting commitments. It is divided into two dimensions: *components* and their *assembly*. The components fall into two categories: commitment interpretation and conversion with respect to task types. Interpreting executes commitments and generates the interpretation of lexons with respect to application tasks, thereby, lexons are grounded on particular task semantics in a given application process. Conversion translates, encodes or transforms from one semiotic into another on the basis of commitments. The semiotics can be an ontology model or any other task-specific semantic codes. One example is the translation from lexon models or commitments into formally different but equivalent semiotics, such as ontology exporting, natural language verbalization, translation into SQL or C++ codes aggregation. Another example is understanding or annotation of texts or database schemas in terms of ontology. These components can form into a development framework or library to allow systematic reuse and extension. They are associated processing task or task types. On the *assembly* dimension, these components are configured or pipelined into 'filter and pipes' (Shaw, 1996) to constitute composite semantic operation.

5. ONTOLOGY DEVELOPMENT PORTAL

The ontology portal based on the MCU paradigm is not only a portal to support distributed ontology modeling, but also provides facilities for developing applications of ontology with shared model transformation, commitments, uses, software framework. As depicted in figure 2, it is presented in a style of layered architecture of functional components. It is 3-tiered: presentation, business logic and data. The middle tier, itself, is of n-tier structure.

The ontology development portal supports ontology engineering and development of ontology applications and facilitates collaborative content and model authoring as well as development of knowledge components for a given software system. The presentation tier consists of a set of client-based facilities for the ontology developer to author, design, check in and out, query, browse, program, configure, import and export, merge, share lexon models, their task-oriented commitments and uses for a particular application system. The main functionality of the second tier is data interpretation and management. It processes the requests and operations on the presentation layer, synthesize, validate, translate, and guarantee the integrity of models, commitments and uses. The tier is also responsible for client and communication management.

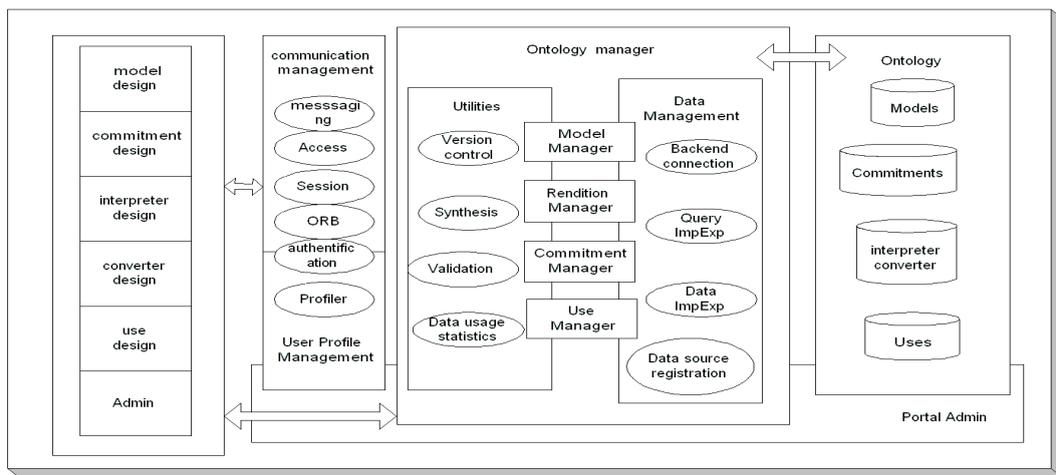


Figure 2. Architecture of Ontology Development Portal

6. CONCLUSION

We introduce the DOGMA ontology representation framework and its MCU architecture. We illustrate their significance in ontology engineering and application with an architecture ontology development portal and service portal, deploying developed outputs. It not only supports ontology sharing as SEAL (Maedche A. et al, 2002), Ontobroker (Fensel D. et al, 1998) and OntoWeb (Zheng J. et al, 2001), but also provides means and layout for specific knowledge application development and ontology deployment for application services, such as mediation in semantic search, agent communication. Among the core requirements of semantic modeling and processing, we emphasize issues such as distributed collaborative engineering, share and reuse of knowledge components on different architectural dimensions, in different development perspectives, scalability in size and complexity, development methodology with specific conceptual framework and architecture.

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ACHIEVING INTEGRATION OF ICTs WITH BUSINESS PROCESSES: INSIGHTS FROM SMEs

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ABSTRACT

This paper presents an analysis of a pilot study of 24 SMEs, which seeks to elicit the various determinants of employing information and communication technologies (ICTs) and the level of sophistication of use. The paper analyses the approach used to facilitate the introduction and implementation of ICTs, with a view to achieving integration with business processes. A conceptual model provides a framework for determining the level of sophistication of SMEs in their exploitation of ICTs. Initial findings highlight that characteristics of the firm and industry sector are contributory factors to the extent of this adoption and exploitation.

1. INTRODUCTION

Although SMEs form a substantial constituent of the global economy, there is limited knowledge available surrounding the adoption of ICTs. For example, the study by Cragg *et al* (2002) provides evidence that some IT investment can impact on small firm performance and that IT alignment is important in understanding the relationship between IT and firm performance. However, the dissemination and assimilation of ICTs in SMEs is ripe for investigation, due to the paucity of relevant literature, empirically rigorous data and focused research in this area (Martin and Matlay, 2001; Fallon and Moran, 2000).

There are not only economic benefits which organisations can achieve from adopting and exploiting ICTs, but also the managerial knowledge, skills and experience of owner/managers of SMEs which have the potential to make a significant difference in exploiting new opportunities offered by ICTs (Matlay, 2000). Chapman *et al* (2000) claim that most managers who lack in-depth understanding of ICTs and their potential benefits would benefit considerably from assistance on how to link technology to specific operational aspects of their business.

Venkatraman's (1994) model of IT-enabled business transformation examines the range of potential benefits from employing IT and the degree of organisational transformation. The model suggests, that organisations adopt a "bottom up" approach and progress through a five-stage sequential process. This model recognises organisational differences, with the view that businesses will engage in this linear process at different stages and in relation to internal structural changes and external competitive issues. However, it does not encompass other key factors of adoption, in terms of organisational size, sector or geographic location.

Conversely, the model promulgated by Poon and Swatman (1997) concurs with Venkatraman's model to the extent that a stage-based transformation process occurs when SMEs use ICTs to improve their strategic position. However, Poon and Swatman (1997) propose a "top down" approach, from an industry-wide perspective is more appropriate for SMEs. However, the lack of adoption and implementation of ICTs by SMEs, preventing them from overcoming current performance deficits and exploiting new opportunities (Zmud, 1984) or fulfilling strategic goals of efficiency and effectiveness (Feher and Towell, 1997), suggests that the Poon and Swatman (1997) model is in its infancy.

It was considered that the Venkatraman (1994) model could be explored further to ascertain the transferability of the framework (or at least some aspects of it) to an industrial landscape dominated by SMEs. Small business researchers have examined factors which influence the use of IT (see Kettinger and Teng, 1998; Grover *et al*, 1997), yet many of these factors are irrelevant to the successful adoption and use of ICTs in SMEs.

This study assesses current sophistication levels of adoption and exploitation of ICTs within the study sample selected, in conjunction with their integration with business processes, utilising variables adapted from the Venkatraman (1994) model. From a review of the relevant literature, the following four inter-related

dimensions variables, which are aligned with those identified by Waring and Wainwright (2000), into the possible views of the nature of integration of systems and technology, have been identified to measure the sophistication of ICT adoption and exploitation by SMEs:

Technical Integration (TI) : analysis includes number of networked PCs with Internet and e-mail access; availability of appropriate applications; client in use; regularity and security of backups; evidence of valid anti-virus software; presence of a firewall.

Operational Integration (OI) : analysed through the integration of ICT with internal business practices e.g. evidence and use of website and relevance/effectiveness of the site to the overall business, ability to highlight most profitable part of the business, how stock management functions are controlled.

Inter-Organisational Integration (II) : analysed by the use of technology from supplier-to-company-to-customer and the technological interaction with suppliers and customers.

Strategic Integration (SI) : analysed through examining the role of ICT in supporting the co-ordinating and managing business processes internally and externally in order to assess the role of ICTs within the strategic operations of the business and also their extended business network.

2. METHODOLOGY

This pilot study aims to analyse the sophistication of adoption and exploitation of ICTs, in a sample of 24 case study SMEs within Northern Ireland and establish the drivers in developing and implementing appropriate ICTs, based on the four research dimensions identified. The companies were selected from the retail, construction, wholesale and distribution sectors - sectors which have traditionally fallen outside the local government-funded initiatives.

These multiple case studies were a combination of a series of interviews (using semi-structured questionnaires), site visits and thorough investigative work in the specific industry sectors. This data was used to assess and score the levels of sophistication using the four dimensions identified. A 6-point Ordinal scale with 0 indicating no evidence of the criteria in use, to 5 indicating maximum use of the specific criteria, was used. The organisational scores on each scale were normalised and averaged to obtain a composite sophistication score on all four dimensions. As part of this analysis the following research questions were considered:

1. How effective are SMEs generally in the adoption and exploitation of ICTs?
2. How does the use of ICTs impact upon the business transformation process?
3. What is the level of inter-organisational integration facilitated via ICTs?
4. What are the challenges confronting owner/managers of SMEs in the development of a strategic approach in the adoption and use of ICTs?

3. FINDINGS

The initial level of assessing ICT sophistication highlights the significant disparity between the most sophisticated and least sophisticated companies within this sample, ranging from totals of 15.00 to 0.75 respectively.

Grouping the sophistication levels of each company by industry sector, highlights that the retail and wholesale sectors are clustered around the median point of 9.5, whereas the construction and distribution sectors dominate both the high levels of and low levels of ICT adoption and sophistication. Due to the large volume of data associated with investigating 24 companies, it was decided to analyse the findings of the dominant companies as case studies. Hence, the three most sophisticated (D1, D6, C4) and three least sophisticated (C6, C7, D7) adopters and users of ICTs, shall provide the basis for further analysis.

Technical Integration (TI) : Some of the companies appear only to have reached an introductory stage of technical functionality within this assessment criterion.. Workstations within the six selected case studies have varying levels of e-mail and Internet penetration, through a combination of ISDN, PSTN and leased lines. The superior performers (C4, D1, D6) operate company-wide networks and have e-mail and Internet access varying from 30 percent to 100 percent of workstations with full access, which are backed up

regularly. Whereas the least sophisticated companies (C6, C7, D7) do not have designated servers, have limited peer-to-peer networks for a minority of their workstations, have e-mail and Internet access ranging from one percent to 50 percent and employ an adhoc method of information back-up.

Operational Integration (OI) : The most sophisticated performers who own and use a website, employ it primarily as a marketing tool to promote the company and its products/services. Industry and product specificity have influenced these companies in the extent of use of the Internet to support their business operations, with the distribution sector being dominant.

Inter-organisational Integration (II) : Whereas none of the sample performed particularly well in this category, there are marked differences, with the construction industry presenting the poorest results. These findings are supported by Love *et al* (1994), who claim that this industry sector is fragmented and adversarial in nature. Conversely, the distribution sector possessed a higher level of sophistication, which can be attributed to the nature of their business operations and the type of customer they target.

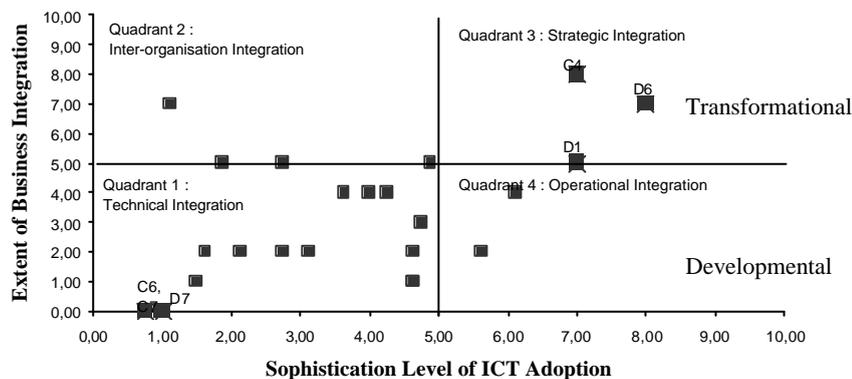
Strategic Integration (SI) : Only one company (C4), was deemed to have achieved the highest level of sophistication within this variable. This was attributable to their excellent project management abilities, a highly developed internal communications structure, a progressive-thinking management team and their effective CRM practices. From this research, the determining factor of the sophistication of the technical infrastructure, is the commitment of senior management. This concurs with the findings of Standing *et al* (1998) which found the driving force of adoption of technology was in fact the owner-manager.

Evidence from this pilot study, would suggest that there is minimal integration between the Internet and internal systems. Waring and Wainwright (2000:145) suggests “understanding the phenomenon of integration” is paramount to the success of implementation, which is supported by Themistocleous *et al*’s (2001) study.

3.1 The ICT Exploitation and Business Integration Model

Based upon these findings and review of relevant literature, the following conceptual model, the ICT Exploitation and Business Integration Model [Take in Figure 1], has been developed, which can be utilised to assess the level of adoption and exploitation of ICTs within SMEs.

Figure 1. ICT Exploitation and Business Integration Model



Although not linear in format, it is designed to provide an incremental approach for SMEs to measure their advancement in adopting and exploiting ICTs. The purpose of this model is to provide a framework which would guide SMEs to denote their current level of sophistication, which could then be further utilised to indicate advancements made, as they become more sophisticated in integrating technology with business processes.

Quadrants 1 and 2 are deemed developmental to this assessment in terms of how ICTs are implemented and utilised within an SME. In contrast, quadrants 3 and 4 are deemed as transformational in terms of how ICTs are integrated with business processes to transfigure the operational activities within an organisation.

- Quadrant 1: Technical Integration:** Companies in this quadrant need to compare current internal ICT infrastructure with industry ICT infrastructure benchmarks. The commitment of senior management needs to be secured in order to conduct a review of current and future infrastructures for performance, flexibility and projected growth. Companies within quadrant 1 will normally move to either quadrant 2 or quadrant 3, depending upon the emphasis placed on the organisation to concentrate more on improving their technical infrastructure or improving ICT integration with business processes.
- Quadrant 2: Operational Integration:** Securing a position within this quadrant, suggests that a company possesses a highly sophisticated technical infrastructure, yet the benefits from IT functionality cannot be fully realised if merely superimposed upon existing business processes. However, a sophisticated technical infrastructure could provide the basis for redefining existing business processes or designing new business processes
- Quadrant 3: Inter-organisational Integration:** This quadrant requires companies to integrate their technical infrastructure internally (across functional areas), in order to achieve external linkages (with customers and suppliers). Companies in this quadrant utilise an effective business strategy, yet their technical infrastructure may not be particularly sophisticated. This could be due to the nature of their business operations or industry sector, which may not necessitate a highly sophisticated technical infrastructure. Conversely, it could also suggest that there is a need to improve the technical infrastructure throughout the company (by aiming towards and securing a position in quadrant 4).
- Quadrant 4: Strategic Integration:** The final quadrant builds upon the strengths of quadrants 2 and 3 through embedding technical infrastructure with the operational activities of the organisation. In order for companies to move into this quadrant from any of the other three quadrants, it is essential that an ICT strategy is developed and designed in conjunction with the business strategy to ensure that existing processes and technology are aligned and monitored.

4. CONCLUSION

The findings have highlighted how characteristics of the firm and industry sector have had an effect on the adoption and use of ICTs to support business processes, which suggests that the findings have the potential for transferability to other industrial sectors and beyond the geographic restrictions investigated initially.

This research set out to determine a level of sophistication in key areas of ICT adoption and use, using a pilot study of SMEs in Northern Ireland. The impact on business performance resulting from implementation of the solutions suggested within this project, could be used to determine the types and levels of efficiency gains achievable through further exploitation of ICTs, which is consistent with the findings of Cragg *et al* (2002). This initial research has demonstrated that there is minimal evidence either of ICTs being adopted rapidly or with any high level of sophistication. Understanding the benefits and drawbacks of implementing these solutions has the potential to increase the competitiveness of local SMEs in wider geographic markets.

The conceptual model designed and utilised in this project, has the potential to offer a structured approach to measuring performance improvement through the further adoption and use of ICTs by SMEs. Further work is required in determining the importance of alignment or “fit” between the internal (organisational) and external (environmental) contexts in which ICTs are implemented and utilised, from both operational and strategic perspectives. The case-study approach of this exploratory study provides a basis for building more comprehensive, prescriptive models.

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RF TECHNOLOGIES IN EDUCATION – ADVANTAGES AND LIMITATIONS

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ABSTRACT

A review is made of the Bluetooth technology as an alternative for wireless extension to educational institutions with wired LAN. First an outline is made of some wireless technologies, including Bluetooth and its characteristics. Following is a comparison and a detailed elaboration on the advantages, open issues and expected benefits of using RF technologies and specifically Bluetooth in educational environments. Supportive on-going research in this area is highlighted.

KEYWORDS

wireless networks, ad-hoc networks, Bluetooth, education

1. INTRODUCTION

Nowadays there is rarely a university or college without its own LAN infrastructure to provide high-speed communication and connection for its personnel, faculty and students. The general practices are wired LANs with fixed end point devices (PCs connected to the LAN) located in areas like computer labs, seminar halls, lecturers' and personnel rooms, etc. Students in particular, are confined and limited to these end points in order to participate in the educational process. In a society where information can be accessed anytime from anywhere this picture is soon bound to change. The educational process is becoming more dependent on new methods of teaching and learning, stressing on the collaborative effort and collaborative knowledge building. It is a field where connections and information exchange structures between entities have to be dynamically formed and reconfigured, known as ad-hoc networking. In this article we present an overview of some of the latest technologies in the wireless field and discuss their applicability to the educational process in specific.

2. WIRELESS TECHNOLOGIES IN EDUCATION

2.1 802.11b

RF wireless LANs are specified in the IEEE 802.11 series. The 802.11b is so far the most popular one for creating university wireless LANs. It relies on a CSMA/CA access scheme to provide two types of configurations: **direct configuration** - communication between mobile stations without the need of access points and supports ad-hoc networking; **infrastructure configuration** – mobile stations communicate via access points. It uses a Direct Sequence Spread Spectrum (SS) that requires a transmission bandwidth of 26 MHz and provides data rates of 1, Mbps, 2 Mbps, 5.5 Mbps, and 11 Mbps up to 100 m. Some consider it a wireless version of Ethernet because of its high speeds. For extending the coverage it relies on a mesh of access points - "hot spots". It suffers severe interference from other RF devices, buildings and materials. Power consumption is very high, restricts its use with laptops and especially PDAs. Only few models have it in-built. But there are quite a lot of average and above average priced cards and devices in the market.

2.2 IEEE 802.11g

This is another emerging standard, still under development with the final version expected by early 2003, and product vendor releases of radio cards and access points by the end of 2003. It is envisaged as an extension to the 802.11b standard. The main advantage is its aim to broaden the 802.11b's data rate to 54 Mbps within the same ISM band using OFDM (Orthogonal Frequency Division Multiplexing). On the flip side, at 54 Mbps the range is expected to be less than that of 802.11b at 11 Mbps. The bandwidth needed for a transmitted signal is 30 MHz. The big issue for the time being is the interference from other devices in the same band.

2.3 The Bluetooth Technology (802.15)

In the last few years ad-hoc networking has become a very active research area due to a certain extent to the success of the low cost Bluetooth technology (BT) [5]. A short range radio transmission based technology, it was created to address mainly mobile and home networking market, connecting devices in a Personal Area Network (PAN - IEEE 802.15), with support for both voice and data. The immediate application was substituting cables between peripherals and main devices especially mobile phones. It is generally known as a low cost, limited range (up to 10 m) and restricted bandwidth (less than 1Mbps) technology [8,10]. BT networks use Frequency Hopping SS and are based on a strict master-slave communication scheme. Groups of 2 to 8 devices form a piconet where one device is the master and the rest are slaves (Figure 1). Communication in a piconet, point-to-point or point-to-multipoint, is strictly governed by the master. A scatternet is a topology consisting of several interconnected piconets (Figure 2). It is this feature that provides flexibility and extends the roles of BT networks outside the simple scope of cable replacement.

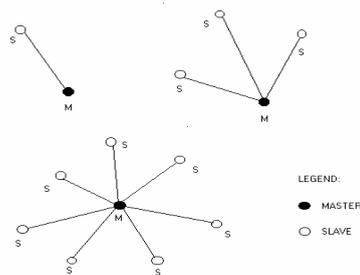


Figure 1. Example of piconets topologies

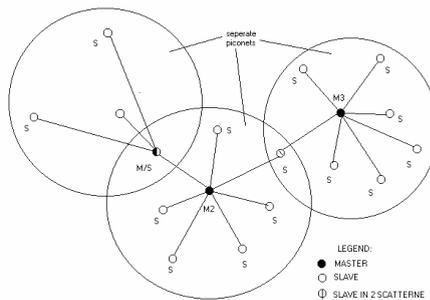


Figure 2. Example of a scatternet topology

There is very little in the standards in respect to scatternets and there are a lot of open issues. In Revision 0.95a [7], the following two general scenarios are discussed: network access points (NAP) and group ad-hoc networks (GAN) (Fig.3). Each one specifies unique network architecture and requirements. In the NAP scenario, there exists a direct connection of one slave or master of the scatternet to a network interface device with network access. In the other scenario, a group ad-hoc network (GAN) is a collection of possibly mobile hosts that cooperatively create a self-contained network without use of additional networking infrastructure.

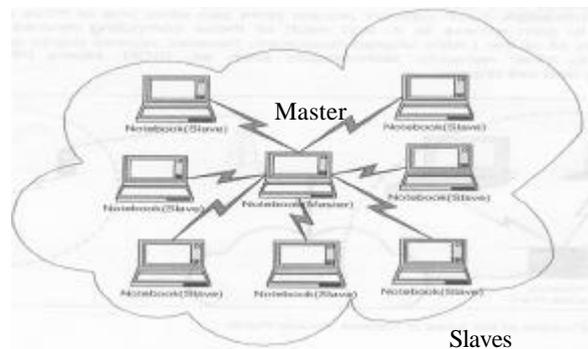
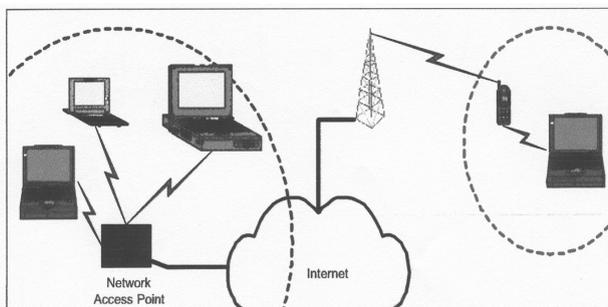


Figure 3. Example of a NAP and GAN - source Bluetooth SIG

3. COMPARISON

When comparing the existing wireless technologies, 802.11 and BT the most important factors are price, availability and supported devices. 802.11b requires huge investments both in network structure and wireless PC cards. It provides greater speeds and is a suitable solution where conditions and structure do not permit wired implementations. Based on “hot spots” it is a good choice for institutions that can afford the investment and/or are starting from zero. High power consumption limits its application to PCs and printers. BT on its part provides considerably lower bandwidth and shorter range. But it has the advantages of being much cheaper (a BT based circuit costs less than \$10 nowadays, an 802.11b - around \$46) and because of its low power consumption (60 mA compared to 300mA for 802.11b circuitry) comes in-built in a lot of laptops and handheld devices. BT is backed up by a large consortium of companies including giants like Sony, IBM, Nokia, Toshiba and others (forming the Bluetooth SIG) and its price is continuously dropping. Both Mac OS X and Microsoft Windows are shortly expected to provide BT support, which will definitely make it attractive for consumers to buy BT enabled devices. BT cannot compete with 802.11 in creating high-speed wireless LANs but it is a much cheaper and flexible solution when it comes to expending the bottom level (closest to the user) of an existing wired LAN infrastructure. Another important criteria is that in order to act as an extension to an existing wired LAN the wireless technology should provide ample abilities for networking. We try to define three scenarios for wireless networking to point out the application areas of BT and 802.11b.

Data and Voice access points – in this scenario we look at a wireless network as a gateway to either a GSM or 802.3 networks. Obviously 802.11b is providing a possibility for higher data rates. It is definitely suitable for solving bandwidth-heavy connectivity issues. Factors like increased coverage and request for broadband services will favor 802.11b networks. On the other hand, providing a wired 802.3 infrastructure exists, BT based NAP would be suitable for shorter distances, low-bandwidth exchange of information between mobile users (PDAs, laptops, mobile phones).

Ad hoc networking – in this scenario we consider aspects like roaming in and out of range, connecting flexibility, forming ad-hoc networks, which provide both peer-to-peer and multipoint connections. It is obvious that both BT and 802.11b rate very close to each. Market penetration will favor one. Two facts in favor of BT are ongoing dynamic research in scatternets and BNEP and the influence of the BT SIG [14,3].

As cable replacement – BT is an unquestioned leader in the market with its very low price and continuously increasing range of supported devices.

Obviously technically BT is not a panacea. At present there are quite a few limitations and open issues:

- a lot of people argue that the BT standard does not support routing in piconets and scatternets
- BT does not support multi-hop multicasting
- the master is a bottleneck
- there are coexistence problems - Even though Compaq and some other companies have already announced parallel modules, supporting both BT and 802.11b, there is so far no solution to their mutual interference problems.

There is rigorous research [4] in defining the topological connection limits that would best suit the BT principle of work and supported devices. Questions like how should the nodes define their roles of masters or slaves, how many piconets should be bridged together etc. are still under discussion.

3. BLUETOOTH AND THE EDUCATIONAL FIELD

Wireless technologies are quickly finding their way into universities and other educational institutions because of two main reasons. First they support mobility and a versatile educational process and second they reduce the burden for the university of providing physical end points (PCs). Students do not have to be clustered in libraries, labs or dormitories to carry out their work. Even though penetration of WLANs in universities is higher than other sectors, only 26% of the universities have implemented some form of WLAN [1]. There are a huge number of educational institutions that do have a wired LAN and cannot afford the investments for a new wireless structure.

College and university education is a complex process that requires high level of cooperation between all entities involved: among teachers and students, among lecturers and research assistants, among the students

themselves. This operation is greatly affected by the mobility of all participants, especially students. Also in many universities more and more courses are project based or an integration of classroom education with small projects. BT is well suited for exchange of information and materials in electronic form among smaller groups of participants. By cooperatively working on shared tasks students can generate ideas, explore concepts and construct arguments to build deeper understanding and come up with faster and more efficient solutions. This in the long run will enhance the level of education. In our opinion BT is an affordable technology that has appeal for both lecturers and students because it allows dynamic exchange of information, supports mobility and provides the “anytime-anywhere” connection, which is becoming an essential feature of our lives. Another point is that “low price-low power” mobile solutions can prove very useful for education in unusual settings that are changing in time: for instance courses and lectures in production facilities, hospitals and educational institutions for disabled people. Such activities as well as conference meetings and seminars can benefit from existing wired structure adding an affordable and flexible ad-hoc network to it.

Lack of cables, low cost, low power consumption and utilizing an existing LAN or GSM are the basis for the fast and substantial penetration of mobile BT enabled devices. New wireless BT supporting products like InterActive Whiteboards, SchoolPads and cheap portable computer solutions for educational purposes replacing laptops are entering the market every day.

A study on the penetration and acceptance of usage of mobile technologies (based on a similar in NTNU [4]), is carried out in our university (work in progress). Preliminary results point out to the fact that especially mobile phones and PDAs are an important means of collaboration between students working in groups on projects. In our future work we are planning to create a small size BT based test bed in our Faculty and in cooperation with the Faculty of Education carry out a quantitative study on the investment needed and the effects of RF technologies, specifically BT, on the educational process in the university.

4. CONCLUSION

BT scatternets are very dynamic and flexible structures, which in our opinion are perfectly suited for increasing the quality of the learning process. We believe the BT technology has the potential to become a low cost, versatile extension to wired university LANs. Its benefits will not only comprise financial aspects (utilizing existing infrastructure, low price technology) but also, and maybe more important in the long run, quality aspects elevating the educational process and collaborative knowledge building in a way unthinkable in the past.

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PROJECTS FOR LECTURING WIRELESS JAVA

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ABSTRACT

Since our studying courses are performed in a joined education between the University and partner companies, one of the important aims of the University of Cooperative Education is to lecture industry - and application-near contents. For the area of information technology (IT), wireless JAVA represents a recent interesting and also promising topic. Therefore, this actual knowledge enabling the students to develop software for handheld devices was introduced in our IT courses. As first step wireless JAVA was investigated and applied within a team project on system components for unified messaging, which ran over two semesters. As second step, one of the enhanced programming lectures out of the IT curriculum was used to teach this new content to an entire class of students. Some of the developed applications are based on a C2C concept, which shall demonstrate how wireless data services can be made more attractive and efficient for customers. Here, the teaching concept, the exercise results, and the success of introducing this new topic are reported.

KEYWORDS

Wireless JAVA, WEB-based Training, Personal Assistant Applications, Mobile Devices, C2C.

1. INTRODUCTION

During the study of the Information Technology courses, our students finish several lectures on programming and software engineering. In the first studying year, procedural programming on base of ANSI C (Kerninghan and Ritchie 1988), and object-oriented programming on base of JAVA are taught, while each of these lectures lasts 60 hours of teaching including theory and exercises. Between all the theory semesters, there are additional practice semesters, which are accomplished in the educating companies. During these phases, the students work on practical projects, e.g. implementing programs, and may have further theoretical lessons, which are given by company experts. From this experience, the students are well trained after the first studying year in standard JAVA development covering language basics, (graphical) user interface, networking, and many more related topics (e. g., like contained in Bell and Parr 2002).

Following this, the learned basics are improved in the second studying year by additional lectures on programming. From attending a tutorial (Mahmoud 2001-1), the idea came up that wireless JAVA (J2ME) would be feasible for this kind of enhanced lecturing. Due to the well-founded base on standard JAVA, J2ME can be efficiently introduced by mainly displaying the difference between the JAVA standard edition and the wireless variant. It is important beside explaining the general J2ME philosophy (Muchow 2002) to particularly line out the restrictions and constraints of embedded run-time environments, and to introduce the relevant aspects of programming embedded systems with limited capabilities in respect to memory space, CPU speed, and I/O, especially the UI.

Another lecturing part of our IT curriculum are guided, self-working projects, which are realized in collaboration of small teams in the final studying year of the IT course. These projects allow an amount of around 150 working hours per student, which enables that such a work can be performed in deeper detail. This frame was used in 2001 to start a first investigation of the applicability of J2ME solutions.

2. PROGRAMMING LECTURE ON J2ME

2.1 WEB mining of teaching contents

Since Wireless JAVA realizes a special branch of the global JAVA language tree, which is owned by the company Sun Microsystems, lots of professional information is accessible through Sun's WEB pages (<http://java.sun.com/j2me>, <http://wireless.java.sun.com>). On these pages, small WEB tutorials, slide sets for seminars, example code, literature references, articles, and book samples are provided in addition to downloadable tools and code for development.

This source offers a helpful base for developing a new lecture on wireless JAVA, and during related practical exercises, the students can benefit from this information source to solve their detail problems. Due to this good WEB resource, the frontal lecture, which was specifically designed for our application here, could be reduced to an introductory session of four hours. Since the curriculum defines 24 hours for our enhanced programming lectures, the remaining time could efficiently be used for the practical working contents including a considerable portion of WEB-based self-learning. The theory session covered an explanation of the wireless JAVA concepts, the key words, and the class libraries, while the following items especially were focussed¹:

- General frame: KVM (kilo virtual machine), CLDC (connected limited device configuration)
- Device-specific frame: MIDP (mobile information device profile) and targeted device classes
- Details on a few dedicate class libraries: MIDlet (application layer), LCDUI (user interfacing)
- Overview of additional J2ME specific class libraries: Networking, persistence storage, I/O, ...
- Development procedure: Process, tools, run-time environment, constraints

For enabling the students to autonomously start with the development of own programs, the MIDlet and the UI concept (Mahmoud 2001-2, pp. 59 – 93) were explained in very detail. In addition, the working steps for generating a small "Hello World" application (similar to White and Hemphill 2002, chapter 4) were displayed at a detail level that the procedure could be repeated without help. The other topics were covered more as general view of possibilities. Finally, hints were given, how relevant information on these topics can be collected in self-education by using Sun's WEB pages.

2.2 Exercises and training tasks

As basic acquainting an enhanced "Hello World" program was defined, which should list names and photographs of the members of the small development teams, which were founded for the exercises. As core task, the students were allowed to choose from the following list of wireless applications:

- Business:** 1) Retrieving e-mail headers, 2) Retrieving traffic information from a WEB service site
Personal: 1) Decimal fixed point calculator, 2) Bionic rhythm calculator
Fun: 1) PacMan game (simplified version), 2) Car racing game

With these tasks, today's typical application areas are addressed. The business applications are to be linked to other information suppliers on the Intranet for e-mail, and on the Internet for traffic information access. Therefore, these had to be realized as client-server solutions. The defined personal and fun applications do not require wireless communication; hence, these run as standalone MIDlets. For having a common development base for the exercises, it was defined that the test environment should be Sun's kToolBar (Knudsen and Nourie 2002) with its simulators of wireless devices.

The students grouped themselves in working teams of between two and three persons, and selected their favorite topic. All the exercise tasks were selected, several by two teams. Joined sessions in the computer laboratory were organized, where help was supplied by the lecturer. Some of the teams didn't need help, some did. In most cases, the problems were not arising from J2ME questions, but more from other issues related to the solution concept, like, e.g., the implementation of the server programs on base of UNIX scripts. One team had difficulties with the general concept for board games. After some guided discussion, a solution

¹ J2ME specific terms, e.g. KVM, CLDC, MIDP, are used here without any explanation, since the introduction of the J2ME system itself is out of the scope of this paper. For obtaining fundamental information on J2ME, the cited sources can be used.

could be figured out for them. As J2ME specific approach, the PacMan playing board was not realized as a two-dimensional array, but as one-dimensional array for saving resources. Other J2ME-specific solutions are seen in the biorhythm calculators: For entering the required date information, the appropriate J2ME class *DateField* (Mahmoud 2001-2, pp. 78 – 81), which is not known from the standard JAVA library, was useful. The lack of floating point operations for computing the bionic curves was overcome by using constant tables for the required sine values. In total, all teams were able to successfully accomplish the selected tasks (some samples are visible in Figure 1), which is outlined in more detail in (Weghorn 2003).



Figure 1. Here, samples of the developed applications are visible (from the left to the right): A MIDlet selection screen; a result of the enhanced HelloWorld program; the menu screen, the UI screen for setting the birthday by using the J2ME class *DateField*, and the graphical result for the biorhythm calculator.

3. THE C2C PRINCIPLE AND APPLICATION SAMPLES

3.1 The idea of C2C

If the user directly wants to access data on the open Internet, there usually arise different serious problems with today's handheld devices: Only a very small portion of the available huge data amount is formatted in a manner, which is convenient for a display on small devices. In addition, the size of Internet content pages are also more than inappropriate for a direct download through the relatively slow and expensive wireless links.

A concept to overcome these fundamental problems is to have a server tool residing on the Internet / Intranet, which filters the desired contents and supplies the selected data sets in a format, which is convenient for a wireless download. Such a service of providing customer-selected, customer-preformatted data for a wireless download shall be called here a customer-to-customer service (C2C). The disadvantage of this method is that an additional server application is required, which is to be configured – in most cases manually – by the user. For University users this is not really a problem, because the services can be supplied to the Internet on open central servers.

In general, such a C2C service is useful not only for one specific customer, but the intermediate, pre-selected and pre-formatted data may be shared with other customers. For sharing the service, the other users need the appropriate wireless display software, which, e.g., can be realized as J2ME application. The sample of accessing dedicate traffic information through a J2ME display client (Weghorn 2003) is a typical useful sample for such a C2C application.

3.2 Wireless access to personal e-mail as C2C service

One of the tasks defined by the J2ME lecture described in section 2 was to develop an application for a wireless access to e-mail accounts. The identical problem was already investigated earlier by two students within a project work, which ran over two semesters starting in 2001, and ending in 2002. The goal of these applications was to access newly received Internet e-mail headers from handheld devices. Since the desire was not to directly download the e-mail, but to access only a part of the entire e-mailing information, the problem was feasibly solved with the C2C approach. As state of technology, the server application would today be implemented as JAVA servlet (Bell and Parr 2002, pp556). Unfortunately, it was not possible to use

JAVA servlets, because our central WEB server, which had to host the server application for this task, runs outdated versions for the system software components, and it won't be upgraded any more.

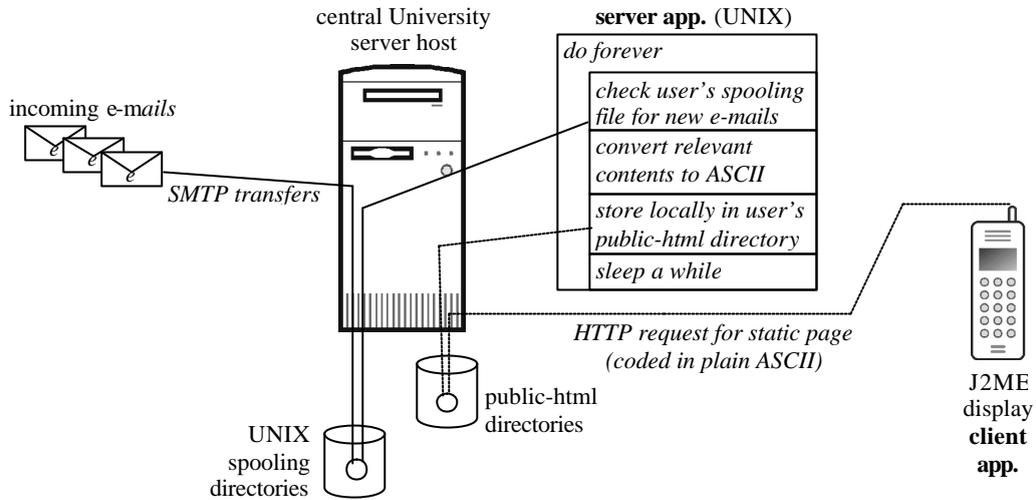


Figure 2. The simplified system for accessing Internet e-mail headers from a handheld device is based on pseudo-static WEB pages: The display application – a J2ME MIDlet running on the handheld device – requests a static HTML page, which is updated regularly by a server program, which translates e-mail information into the proper WEB resource on the central server host.

For the simple variant, which was developed in the limited time frame of the described J2ME lecture, active server queries were avoided by using pseudo-static content pages as intermediate exchange media (Figure 2). A server program, which was realized as UNIX script, retrieved newly received e-mails from the UNIX spooling directory. The user's UNIX spooling file for incoming e-mail was checked with a certain rate (e.g., every five minutes), and the server program produced an ASCII file in the user's public-html directory, from which a simple-styled J2ME display client retrieved the actual information (all new mail headers). The disadvantage of this approach is that the information may not be recent enough depending on the questioning rate of the server program. On the other hand, the problem could be solved with a unidirectional system concept.

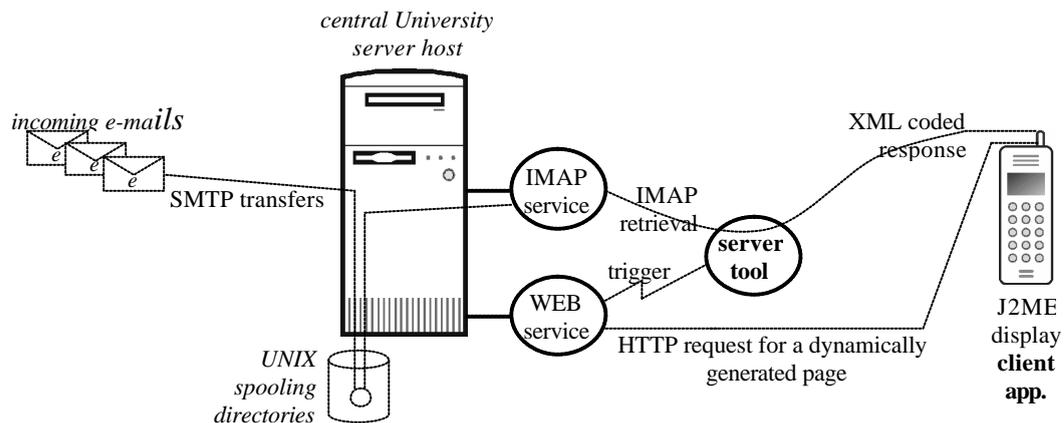


Figure 3. In the enhanced system for accessing Internet e-mail headers from a handheld device, the responded content is generated just in time by the client-server system.

The more enhanced variant for solving the e-mailing problem was to use concepts, which are much more generalized (Figure 3). In particular, as data exchange format for the retrieved mail headers, XML formatting was defined and used. This implies that on the J2ME client a parser was required (for resource reasons, the

MinML parser was selected, which is available through <http://www.wilson.co.uk/xml/minml.htm>), but such a system is expandable more easily. The lack of servlets was overcome by a relatively complicated tool construction (the server application consisted of three intercommunicating programs), but the obvious benefit of the active server page method is an accurate information response. It further implies that interference between different clients accessing the same e-mail account is avoided by the fundamental concept. As a general concept, not a dedicated UNIX mail file was used as an information source, but the system could collect information from different e-mail accounts through enhanced mail protocols (POP3, IMAP). The combination with filtering and selection mechanisms as described in (Weghorn 2001) is also easily added in this system in contradiction to the possibilities of the simplified solution outlined before.

4. CONCLUSION

In total, the students were very interested in the new lecturing content J2ME. Comparing, in particular, the J2ME lecture to alternative topics (C++, further JAVA contents) for the enhanced programming lecture in our second studying year, the experienced acceptance level appeared considerably higher. An interesting and important aspect was that the self-learning contents could be accomplished successfully. This was visible from, e.g., the fact that all the teams, who needed networking, were able to develop a proper solution on the basis of the WEB information material (this topic was not explained in detail in the theory session). The required help, which was needed during the exercises, addressed mainly topics, which were not directly related to J2ME, but which were more of a common nature, e.g. fundamental approaches for designing the proper system concept.

The students stated in the feedback discussion that they now find themselves capable of developing wireless applications on their own. For the companies, where the students are working, the achieved experience will offer a true benefit, because since several years mobile devices are of high interest either as control terminals or as access points for wirelessly managing all kinds of company processes. The described C2C system concept may help to implement many of these applications in an efficient design. Due to the high interest level, this kind of lecturing content shall be continued and improved in future semesters for our IT students.

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MOBILE VALUE AND ACTIVITY THEORY IN M-COMMERCE

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ABSTRACT

This paper aims at a process that mobile value motivates mobile users to use m-commerce. It reveals three mobile value-creating features; time, place, and individual, and a framework to describe three features according to the degree of sensitivity. And then by applying activity theory, it investigates that these mobile value-creating features are offered through the interaction mediated by m-commerce application for the mobile user's object, creating mobile value, and that the mobile value motivates the use of m-commerce.

KEYWORDS

Mobile value-creating features, Mobile value, Activity theory

1. INTRODUCTION

The m-commerce market has been rapidly growing along with the development of a variety of m-commerce applications and services and the increasing number of mobile Internet users. IDC group predicts that the number of m-commerce subscribers is expected to increase to 29 million by 2004¹. And the m-commerce transaction is expected to yield more than \$200 billion in 2005 (Davidson et al. 2000).

The most distinctive feature of wireless devices is mobility, which is able to communicate, inform, transact and entertain any place at anytime on the move without fixed Internet access (Clarke III 2001, Lehner & Watson 2001). Another feature is that the devices are personal because it is always available on a person and retains its user identity (Kannan et al. 2001). These two technological features endow m-commerce services compelling characteristics, differentiating them from those of e-commerce. And mobile users obtain 'mobile value' created through the use of m-commerce services (Anckar and D' Incau, 2002).

This paper aims at a process that mobile value motivates mobile users to use m-commerce. For this objective, first, this paper reveals the components of m-commerce services creating mobile values by redefining mobile value-creating features and establishing a framework to present them comprehensively. Second, by applying activity theory, it suggests a model in which mobile users perceive mobile value through mobile value-creating features of m-commerce services and how they are motivated to use m-commerce.

¹ Re quotation from Schultz, B., 2001. The M-commerce Fallacy. *Network World*, Feb. 26, 2001

2. LITERATURE REVIEW

Although several researches refer to, or study mobile value-creating features, little research examines these features in any depth. Mobile value-creating features are diversely identified under a category of benefit, feature, etc. Table 1 summarizes research literature on the mobile value-creating features. According to literature, similar concepts for mobile value-creating features are referred to several times among authors.

Table 1. Literature review of researches on mobile value-creating features

Research	Category of studying	Results
Siau et al. (2001)	Feature of Mobile Commerce	Ubiquity, personalization, flexibility, dissemination
Anckar and D'Incau (2002)	Five different missions/settings creating mobile value	Time-critical needs, spontaneous needs, entertainment needs, efficiency needs, mobility-related needs
Kannan et al.(2001)	Characteristics of wireless	Ubiquitous interactivity, distinctly personal, location aware,
Booz, Allen & Hamilton (2000)	Factors driving wireless Internet services	Ubiquity and personalization, immediacy, convenience, security, localization
Daitch et al (2000)	Benefits of wireless technology	Mobility/ubiquity, speed, tracking/localization, personalization easy to tap into the infrastructure, safety
Baldi and Thaug (2002)	Distinctive characteristics of mobile entertainment	Ubiquity, accessibility, reachability, localization, personalization
Tsalgaidou & Pitoura (2001)	Consumer and businesses additional benefits offered by mobile electronic commerce applications	Location-awareness, condition of usage, adaptivity, ubiquity, personalization, broadcast ing
Clarke III (2001)	Value propositions of mobile commerce	Ubiquity, localization, personalization, convenience
Devine & Holmqvist (2001)	Opportunities for mobile Internet content	Personalization, positioning, timeliness
Rangone et al. (2002)	Specific value of a MI application.	Availability at any time and everywhere, localization, Integration with telephony, pushing, personalization

3. MOBILE VALUE-CREATING FEATURES AND MOBILE VALUE

As shown by the review of studies on characteristics of m-commerce services, terms relative to mobile value-creating features are generally classified according to three features; *time*, *place*, and *individual*. Each of these features can vary in sensitivity between *high sensitivity* and *low sensitivity*.

Time includes two mobile value-creating features depending on the sensitivity. High time sensitivity is related to immediate access to the mobile Internet. Where a mobile user gets time sensitive information instantly in a time-pressed situation, m-commerce retains high time sensitivity. In contrast, low time sensitivity refers to killing time in free time or saving time in niche time since mobile devices are always-on and accessible to the Internet at any time. M-commerce services such as game, gambling, etc. can offer low time sensitivity to mobile users who are waiting in line or are involved in a daily commute they can access.

Place is further divided into high place sensitivity and low place sensitivity. High place sensitivity can be translated to localization, which is ability to be aware of a user's specific location and customize m-commerce services to the location information. High place sensitivity involves the case where a mobile user can get mobile coupons, customer services depending on his location. However, low place sensitivity refers to m-commerce applications independent of a user's location and context. Low place sensitivity occurs where a mobile user can get access to the Internet at any place, even which no one can notice, or where a mobile user can be involved in simultaneous activities e.g. Internet activity in meeting people or traveling.

Individual can be divided into high individual sensitivity and low individual sensitivity according to the extent the 'individual' aspect is related to an m-commerce service. High individual sensitivity relates to personalization, which is the customization to one specific person. Since a mobile device belongs to one specific individual, a mobile user can be offered an m-commerce application such as advertising tailored to his individual profile and preference. On the other hand, low individual sensitivity involves broadcasting or dissemination of the same messages to all mobile users within a specific geographical area. Simultaneous delivery of m-commerce services, such as weather information, or advertising to a large consumer population,

allows mobile users to be engaged in low individual sensitivity.

The three mobile value-creating features are demonstrated with a three-dimensional cube (Figure 1). The framework can exhibit the degree of sensitivity to three features, which Devine and Holmqvist (2001) failed to show, even though they have identified three mobile value-creating features similar to those above.

In the framework, three axes represent place, time, and individual, respectively, extending from low to high sensitivity. Points on each axis correspond to an m-commerce service which involves only one mobile value-creating feature. An m-commerce service rarely retains only one feature, as Anckar and D'Incau's classification of mobile services by mobile value-creating features (2002) has shown². Most m-commerce services, however, involve more than one mobile value-creating feature, and are represented by positions inside the cube. For example, ticketing can be high time- and low place sensitive, because this service enables mobile users to get immediate purchase in traffic. A point located at the corner of the cube, diagonally opposite the origin, represents m-commerce services with high sensitivity of time, place, and individual, leading to differentiate m-commerce services from the existing fixed e-commerce services.

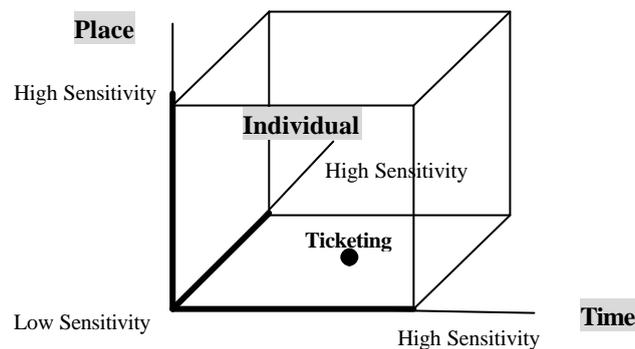


Figure 1. A framework for mobile value-creating features

These three features of m-commerce services are translated into elements to create mobile value for a mobile user when a certain feature of an m-commerce service combines with the mobile user's needs. Mobile value is defined as a user's perceptual benefit or value through the use of m-commerce services (Anckar and D' Incau, 2002). For instance again, ticketing creates mobile value to satisfy a mobile user on the move in traffic, who wants to reserve a movie ticket immediately to escape a sold out show or get a good seat. The mobile user perceives mobile value in terms of high time sensitivity and low place sensitivity through the use of the m-commerce service.

Then, how do the mobile value-creating features examined above contribute to a mobile user's perception of mobile value? Does the mobile value drive mobile users to use m-commerce and how does it do? To answer these questions, we need a theory base to explain a process that a mobile user perceives mobile value utilizing the mobile value-creating features.

4. MOBILE VALUE IN ACTIVITY THEORY

Activity theory is a socio-cultural, socio-historical framework for conceptualizing human activities and describes a mediated interaction among *subject*, *object*, and *community* (Bannon, 1997). The components in the activity theory are as follows (Jonassen & Rohrer-Murphy 1999, Hypponen 1998, Collins et al. 2000).

Subject refers to the individual or group involved in possession and usage of new devices or service to satisfy his or their needs. In m-commerce environments, it is a mobile user or consumer who utilizes wireless technologies to achieve his object.

Object is the target of activity. It starts by being expressed as a state of need, feeling, which motivates subjects to search for different means to satisfy the need. For the m-commerce example, the object will be entertainment, information, transaction, and communication, etc.

² See the table 1. Sources of mobile value offered by the applications included in the empirical study, from Anckar and D'Incau(2002), pp 52.

Community includes an interdependent group who shares the object with the subject. In m-commerce, community consists of two groups; *user* and *mobile* communities. User community refers to the peer group like actual friends and colleagues who use m-commerce applications and form the trend of m-commerce. Mobile community means the cyber portal community within m-commerce environment.

Technologies/Tools refer to mediating means which influence the object to fulfill the subject's needs, and help to achieve the outcomes of the activity. Technologies include wireless technologies and m-commerce applications and services that enable a mobile user to fulfill their objects.

Rules regulate actions and interactions within the activity system. They are society and community regulations, policies, standards, norms, ethical issues and individual beliefs. An example of the rules can be norms to guide mobile participants in m-commerce.

Division of labor refers to how different community members have divided responsibility in identifying and affecting the object horizontally and vertically.

Table 2 diagrams the examples of some components of activity theory in case of Japanese NTT DoCoMo's mobile Internet service, i-mode.

Table 2. Examples of activity theory model for i-mode

Technology		Object	Community
Wireless technology	M-commerce applications	Information Entertainment Communication Transaction	<u>User community</u> -I-mode subscribers -Kids and teenagers group -Young adults group -Business user group <u>Mobile community</u> - I-mode portal. -Mobile chatting room
Personal Digital Communication i-mode network, cHTML-based websites, i-mode terminals,	Ringtone, screensaver, games, news, graphics, video, city guides, map, directory, traffic and weather, SMS, banking, brokering, shopping e-mail, auctions, betting, chatroom, karaoke, booking & reservation, horoscopes, videoconferencing, etc		

In the activity theory, tools mediate the interaction between the subject and the object, and rules mediate the interaction between the subject and the community. Also, the division of labor mediates the interaction between the object and the community. The whole interactions from activities eventually create an outcome the subjects are pursuing through activities and mediation.

Figure 2 illustrates activity theory in m-commerce. A mobile user achieves his object by mediating m-commerce applications and services. In this interaction, certain mobile value-creating features among low and high sensitivities of time, place, and individual, which m-commerce applications retain, are delivered according to the type of m-commerce services that the mobile user use for his object. For example, ticketing gives high time sensitivity and low place sensitivity to a mobile user who uses that application for the need of entertainment or transaction. Meanwhile, both user and mobile communities who share the same object support a mobile user to achieve the object, based on the interactions mediated by rules and division of labor.

Mobile values are created through these activities. A mobile user can perceive mobile value emerging from the use of m-commerce services to satisfy his object. Mobile value-creating features of a certain m-commerce service fulfill his object and then generate positive mobile value for the mobile user. Outcome is evaluated by the satisfaction and dissatisfaction of the mobile user after seeking to his object. In this process, the mobile value encourages the satisfaction of m-commerce and motivates mobile users to continue using m-commerce.

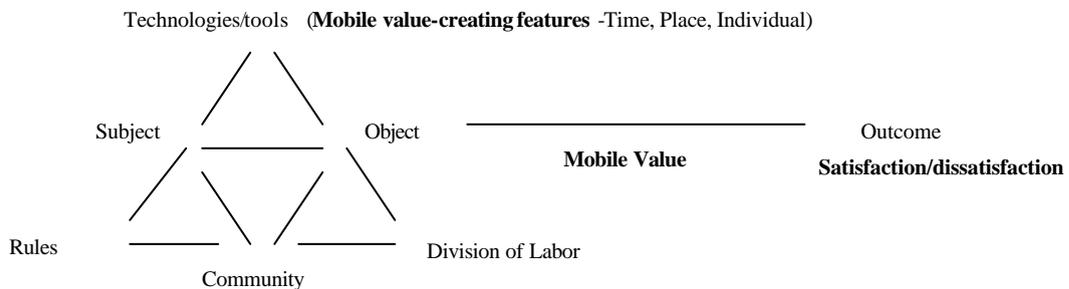


Figure 2. Activity theory model for M-commerce

5. DISCUSSTION AND CONCLUSION

In this paper, three mobile value-creating features are identified as time, place, and individual and are illustrated on a framework according to the degree of sensitivity. And then by applying activity theory, these mobile value-creating features are offered through the interaction mediated by m-commerce application for the mobile user's object, creating mobile value, and the mobile value motivates the use of m-commerce. The interaction with community in the activity theory, however, leaves room that mobile value can be created in a broader area. M-commerce context factors including emotional and social factors emerged within community may create mobile value. Emotional factors refer to psychological needs of mobile users, and social factors mean satisfaction derived from belongingness to a certain group or participation in any social activities via mobile Internet (Lee et al., 2002). The recent research on mobile Internet subscribers in South Korea reveals that the motives to use m-commerce are ranked as 'curiosity (40.5 %)', 'availability anywhere and any time (36.1%)', and 'encouragement by other users' (10.4%) (KRNIC, 2002). This fact can explain that emotional and social factors from the interaction of community are more involved in the creation of mobile value, although mobile value-creating features play one of the most important roles.

Future research will be able to discuss mobile value in which m-commerce context factors are involved along with the mobile value-creating features. Moreover, the theory can be fortified with several case studies of m-commerce phenomenon in a certain country such as Japan, Italy, Finland, South Korea, etc.

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TOWARDS NATURAL LANGUAGE - BASED INTERFACE TO APPOINTMENT MAKING SYSTEM FOR MOBILE DEVICES

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ABSTRACT

Mobile devices such as Internet enabled phones or personal digital assistants (PDAs) are becoming ubiquitous. Many of mobile devices are equipped with small displays, which make it difficult to browse web pages (Chan et al., 2002). On the other hand, mobile devices are increasingly used for sending textual messages such as emails and short messages (short messaging service or SMS). In many countries messaging from mobile devices became a way of life for younger generation. The goal of this paper is to discuss the functionality of a system that provides natural language understanding and enables students to make an appointment with a professor. We introduce some of the research problems that will be explored during system development.

Users of mobile devices will be able to send an email or a short message to the system and using their own words to make an appointment with a professor at the time they specify. The system will engage in communication with the user by sending emails or short messages if there is not enough information to make an appointment. Most mobile devices have limited text input capabilities. From the natural language processing point of view the system is capable of mapping unstructured information into data structures required to make an appointment. One of the major features of the system is the capability to recognize semantics of misspelled or abbreviated words. This research is based on the study conducted by the authors to evaluate interfaces of most commonly used mobile devices for an appointment-making task.

KEYWORDS

Short messaging, SMS, natural language interface.

1. NATURAL LANGUAGE INTERFACES TO WEB APPLICATIONS

This research is based on the study conducted by the authors, in which human subjects were asked to evaluate interfaces of most commonly used mobile devices. All subject were asked to perform the same task: make an advising appointment with a teacher using two types of applications: an on-line site with forms and an email client. During an interview with each subject, large amount of information was recorded about the usability of mobile devices and their interfaces. The idea of developing a natural language interface to the appointment making system was initiated by the comments from the participants of the study who expressed preference for email and messaging applications over web site- based applications for mobile devices.

In this paper, only the basic functionality of the system will be discussed without getting into details of natural language processing.

Mobile devices such as pocket PCs, Palm Pilots, WAP phones and other personal digital assistants (PDAs) connected to the Internet are gaining importance in our everyday life. Mobile devices used for exchanging short messages (short messaging service or SMS) or emails are an important way of information exchange particularly for young people. Sending text messages from mobile devices is attractive for several reasons. First, sending a textual message requires little bandwidth. Secondly, many mobile devices are equipped with very small displays, which make it difficult to display regular websites (Xu et. al, 2003). As a result, separate websites need to be maintained or enabling applications have to be implemented. In any case,

the content available to mobile devices is limited (McGarvey, 2002). Thirdly, users are accustomed to communicating via emails in natural language.

The major problem is development of a system that is capable of understanding natural language. The applications are abundant. Many e-commerce areas, for example business to consumer (b2c) e-commerce could benefit from the extra capability of using natural language to search for products, order products or complete transactions without using hypertext forms. Imagine a scenario in which an Internet store features a very complex web site. Browsing such a web site requires high-resolution screen, fast processor and a broadband connection to the network. The majority of these requirements can't be fulfilled by mobile devices with wireless connections to the Internet. A repeat buyer would like to order a product from his/her favorite web site but at the moment he/she is on a business trip and the only device available to the user is a mobile phone. It would be very useful for the user to be able to email an online store at his/her convenience with an order request in his/her own words. Additionally, knowing that typing on a mobile phone keyboard is not easy (this applies to most of mobile devices) we have to assume that the message will contain misspellings, abbreviated words and ungrammatical sentences. In the body of the message a user would identify himself/herself, specify the product and quantity required, provide shipment information. These are all the things that users normally do when browsing hypertext-based web sites using their desktop PCs. Certainly, without seeing the actual website the user may not be able to specify unequivocally what he/she wants. Perhaps many users will forget to include their names or shipment information. However, having a natural language understanding system in place, the system will discover missing pieces of information and send back a message requesting clarifications and confirmations. The interactions between the user and the system may have several stages, in which the user will be engaged in the dialog with the system.

2. NATURAL LANGUAGE INTERFACE TO AN APPOINTMENT MAKING SYSTEM FOR STUDENTS

The appointment making system described in this work allows students to make an appointment with academic advisors using email or SMS messages sent from any computer including mobile devices. This application is a test bed for the development of conversational interfaces for mobile devices. If a student wants to meet with an advisor he or she will send an email to an address that is easy to remember e.g. appointments@organization.edu and in his/her own words reserve a half an hour time slot. When the system receives a message, the natural language processing module analyzes the syntax and semantics of the message and extracts information that is necessary to make an appointment. The information required to make an appointment contains such features as: time and location of appointment, name of the academic advisor, name of the student, purpose of appointment.

If any of the required features is not present, the system will send back an email or SMS with a list of missing features. The student will then respond and provide the required information. This process might require several information exchanges. Once the system receives enough information to make an appointment a confirmation is sent to the student. If the student needs to cancel an appointment he/she will send another email to the system with a cancellation note.

Interactions between users and the system are based on a dialogue. An example of such a dialogue, along with the general system architecture, in which the student submitted all required pieces of information to make an appointment, is displayed in Figure 1. More complex interactions, in which the system has to follow up and elicit missing information e.g. the student forgot to specify the time of appointment will be discussed in subsequent sections.

3. NATURAL LANGUAGE INTERFACE REQUIREMENTS FOR MOBILE DEVICES

In this research we assume that in order to communicate with the appointment system a mobile Internet-enabled device is used i.e. wireless phone, Pocket PC, Palm Pilot, etc. Because of the fact that many of these

devices have limited display capabilities and even more limited text input capabilities there are several implications for the natural language processing application.

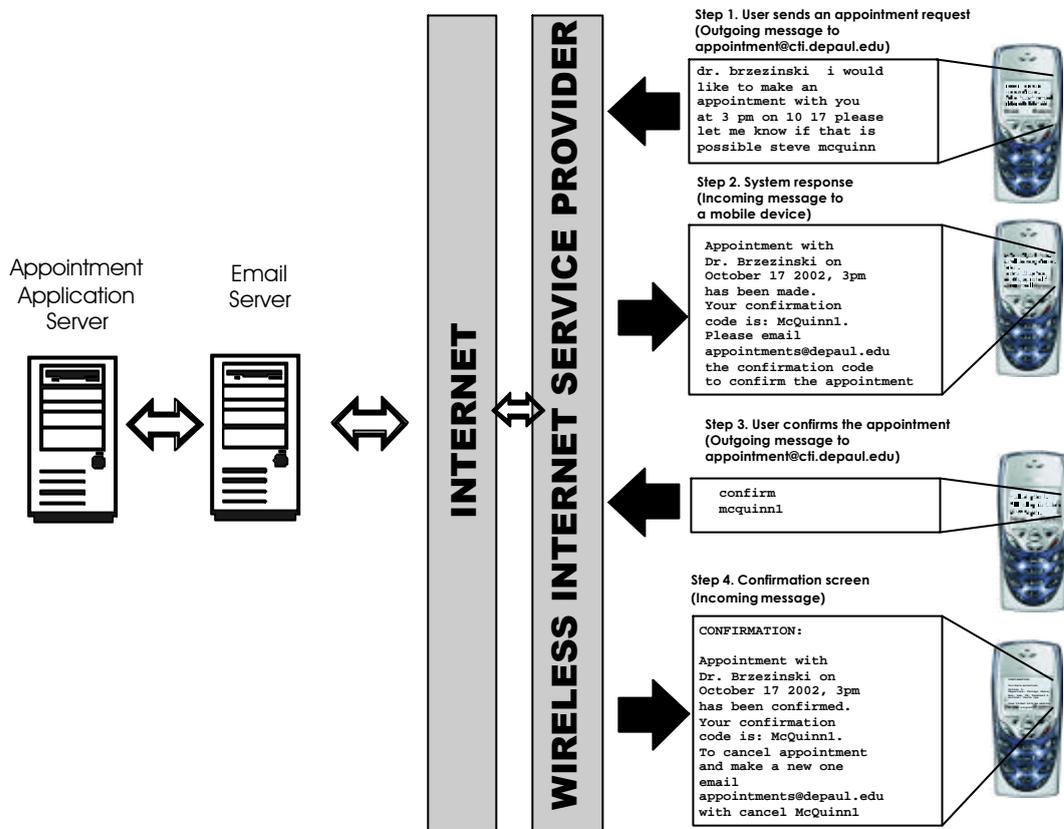


Figure 1. Example of using email enabled mobile phone for making appointments

First, we have to assume that there will be many misspellings in messages send by users. For example, typing a message using a keyboard of a wireless phone is slow and error prone. Additionally, most wireless devices are not equipped with spell checking and predictive input applications (McGarvey, 2002). In the appointment making application for students there is another source of misspellings. One of the features that users have to include in their messages is the last name of the academic advisor. Often, it is not easy to spell the last name correctly. A similar problem for the natural language application is the presence of abbreviated words. Users, who try to make messages shorter, implement their own spelling rules. In many societies this became a matter of manifestation of a cultural identity. Interestingly, there are many formal initiatives aimed at introduction of spelling rules in many languages e.g. [<http://www.les.aston.ac.uk/sss/>]. Some of the initiatives are receiving strong backing from computer science community. The spelling rules might be quite radically different from correct spellings e.g. "today" vs. "2day", "appointment" vs. "appnt", "see" vs. "c", "thank you" vs. "thnx", "please call me" vs. "pcm", "by the way" vs. "btw".

Secondly, messages sent from mobile devices will often contain sentences that are not grammatically correct, which is an important implication for natural language processing because the presence of grammar in text is a foundation for par-of-speech annotation and parsing (Allen, 1995). Frequently, users try to make messages short by not obeying most of the grammatical rules and by not using punctuation. This might also be the case for messages emailed from desktop PCs because if the user is aware that he/she is communicating with a computer, he/she might be inclined to pay little attention to grammatical rules. In our study performed on human subjects not a single short message was grammatically correct.

4. DIALOG STRUCTURES BETWEEN THE APPOINTMENT-MAKING SYSTEM AND USERS

The input to the system is always in natural language format. We do not assume that there is any structuring of the information similar to hypertext form-based structuring. Given the fact that a message can be sent from a wireless phone or a PDA with a wireless modem, the first or last name of the sender might not be present in the message. This is important because many desktop email applications include return information with the name of a sender in the "signature" section. As a result, many users might assume that sufficient information about the sender identity is always included. Similarly, there might not be any information attached to the message, which contains the subject information.

The appointment making system is based on information exchange with the user. The dialog might be short if the user submits right away all information that is required to make an appointment. If any piece of information is missing then the system will contact the student with a message specifying missing information. Assuming that all required information is there and that the appointment slot is available the system responds with a confirmation message, which includes a confirmation code. The second message that the student is supposed to send in order to complete the appointment-making procedure is to confirm the appointment by sending back the confirmation code. The system then responds with a final confirmation that the appointment has been entered into the database. To summarize, in an ideal situation it will take two emails or SMS messages from the student to complete an appointment-making procedure. Once the messages are interpreted, the system updates the appointment database and the respective teacher is notified that the appointment has been made.

5. CURRENT AND FUTURE RESEARCH

Our current research concentrates on developing an optimal conversational model based on sentence frames. An important part of the research will be a study aimed at evaluation of the user perception of the sentences generated by the system.

The natural language processing component involves pattern analysis on the morphological level to address the issues of words that are possibly misspelled or abbreviated. The semantic analysis of the sentences will involve classification of senses into categories of meanings that are required to complete the tasks. For example, the system will recognize if the message is an appointment request or appointment cancellation. Discourse analysis will provide context information for the semantic analysis. Our current experiments in the field of language processing are based on data mining techniques, vector space representation (Salton, 1989) and utilize a lexical database (Wordnet url).

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SOCIAL WELFARE ASPECTS OF INFORMATION WITH SPECIAL REFERENCE TO NEWS

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ABSTRACT

The information society thesis, according to which economically advanced nations are undergoing transformation into post-industrial, information-based societies, can, with caveats, be taken as a premise. Essentially empirical or predictive, this influential set of claims quickly gives rise to major normative issues. The paper asks how, as part of a prospective normative theory of the information society, information may be shown to contribute to social goals in general and social welfare in particular. Given the diverse range of referents of the term 'information' in the context of the information society debate, the paper focuses on news as a form of information whose communication is widely held to be important to society. The problem is how to quantify or otherwise prove this intuition. It is suggested that a fusion of welfare economics and the economics of information may yield a solution. The paper is designed to be exploratory, offering a potential line of inquiry for the future research and policy agenda of information society studies.

KEYWORDS

information communication society news welfare economics

1. INTRODUCTION: THE PREMISE OF AN INFORMATION SOCIETY

Many believe that the economically advanced nations of the West, along with a few Oriental highfliers, have entered a new stage of development variously called 'information society', 'information age', and 'post-industrial society'. According to Daniel Bell, the journalist-turned-academic credited with being one of the most influential social theorists of the second half of the twentieth century, the 'coming of post-industrial society' is the salient story of the present epoch (Bell 1999). A changing economic base whereby services replace manufacturing as the chief source of wealth and employment, a new centrality of theoretical (as opposed to experiential) knowledge, the emergence, albeit still inchoate, of a politically influential knowledge class, all of this catalysed by the information machine of information machines, better known as the computer—such developments mark out the new age from the recent industrial era. This set of propositions has been disputed extensively, of course (for monograph-size overviews, see Duff 2000; May 2002; Webster 2002). Nevertheless, even most critics of the information society thesis readily concede that information has become a nonnegligible modifier of emergent social formations, a useful prism through which to view the transformations that are unfolding before our eyes. In that loose sense, at least, the premise of the information society is no longer especially controversial.

2. SOCIAL GOALS OF THE INFORMATION SOCIETY

Now interpretations of the information society divide into two genera. First, there is the descriptive or empirical genus, that is to say propositions making verifiable (or, in Popperian terms, falsifiable) truth claims

about the nature of society. The set of claims mentioned above, summarised as the 'information society thesis', falls naturally into this genus; another species, although some tough-minded critics of 'futurology' would dismiss these as more of a supernatural than a natural category, comprises predictions and forecasts about the future of society and its technological infrastructure (Kuran and Molitor eds 1996; Roszak 1994). The second genus is prescriptive or normative, i.e. ethico-political value judgements about what moral principles the information society should enshrine. This category does not properly include a long-standing tradition of left criticism, according to which the information society thesis represents little more than a novel ideological smokescreen for industrial capitalism (on doctrinaire Marxian variations, 'late' capitalism) (Traber ed. 1986; Woodward ed. 1980), since such critiques are primarily analytical. Instead, the latter genus runs along the lines of ideal theory (not to be confused with utopianism, which apart from being unrealistic tends to be pseudo-empirical rather than seriously prescriptive). Freedom, equality, justice, solidarity: the problem is by which understanding and in what combination ought these ideals to be factored into the incipient information AND society equation, a task for the major discipline of political philosophy, with assistance from the minor field of social policy studies.

Although it would be mistaken to claim that there is anything like a consensus on this matter, it is clear that axiologically many normative theories of the information society are essentially social-democratic in character. That is to say, the virtue and nonnegotiability of a political set-up upholding Isaiah Berlin's 'negative liberties' are assumed, but the liberal-democratic *socio-economic* order is rejected as inadequate. Instead, as exemplified by Miles and Gershuny's astute early proposal that 'the reduction of major inequalities should be explicitly incorporated as a goal in the design of information society' (Miles and Gershuny 1987, p. 222), normative theorists of the information society have wanted economic liberty to be constrained, in a typical leftwards direction, by robust state interference in the market to ensure the social goals of less poverty and (here social democracy diverges from centre politics) significantly less disparity between the well off and the worst off. Not all would express this in terms of Berlinesque 'positive liberty', but the basic intuition that unregulated market orders cannot deliver the freedom promised by liberal-democracy is, I think, behind much socially responsible normative work on post-industrial society (see, e.g., Duff 2002; Loader ed. 1998; Wyatt et al. 2000), just as it was behind 150 years of 'industrial era' criticism.

3. NEWS AS A DETERMINANT OF SOCIAL WELFARE

The ideal of social democracy can be articulated, with some hope of quantitative precision, in terms of social welfare. Of course, this must go beyond commitment to a narrowly-conceived 'welfare state', which can mean little more than a social security safety net for the worst off. Such is valuable, even morally paramount, but social welfare incorporates many additional dimensions of relational and distributive justice. The question which this paper wishes to begin to explore is in what manner *news* can be shown to be a mode of information conducive to social welfare in the information age, where social welfare is construed in this wider sense.

Although neglected as a formal category by information scientists, news has widely been assumed to be a vital mode of information in society. There is a plethora of common-sense beliefs around such an assumption. For example, news is believed to be instrumental in the democratic process. Also, news is believed to a contributory factor in cultural development. Again, news is thought to be an integral aspect of contemporary electronic communications and of their apotheosis in the idea of a digitised global village. Within the field of journalism studies, not surprisingly, this assumption becomes explicit. Thus, Anthony Smith begins his history of newspapers with the observation that 'in all societies there exist innumerable chains of information, rather like the food chains of nature, through which different types of knowledge pass by custom or by contrivance'. 'Since the end of the Middle Ages, in the Western world,' he continues, 'the printed form we call the newspaper has acquired an important role as the major link between many of these cycles, providing for a constantly growing audience large quantities of information drawn from countless different spheres' (Smith 1979, p. 7). Responding to the growth of consciousness of the information age, as well as to a perceived need to protect 'hard' news from arguably worrying empirical trends such as 'infotainment', recent work on the nature of news has increasingly emphasised the informational quality of news (e.g., Manning 2001, ch. 2; Sheppard and Bawden 1997; Silvia ed. 2001). News is emerging definitionally as timeous, accurate, socially significant, factual messaging at the 'hard' end of the media

content spectrum. In the terms set out above, it could be said that there is a growing recognition that there should be a prescriptive quantity and quality of news, that news diffusion is a necessary component of a normative theory of the information society (cf. Tumber 2001, for the normative role of media in cyberspace).

This is not to imply that the claim that news somehow contributes to social welfare is unproblematic. A plausible intuitive argument can be constructed that news, even hard news, can be detrimental to social welfare. If wellbeing is given a simple Benthamite formulation as the 'felicific calculus', one might ask how much pleasure or happiness is gained for the average consumer by news of state-sanctioned paramilitary atrocities in South America or, to take a closer harrowing example from the 1980s, by reports that the Yorkshire ripper stabbed his victims in the genitals repeatedly with a screwdriver. Leaving aside the quite separate issue of taste, it could be argued that publicising that particular unit of information does not actually contribute to 'the greatest happiness of the greatest number'. Today, some Florida hotels screen local crime reports out of the television news precisely because tourists are likely to be made unhappy by such news, not least because it is more or less true. Nevertheless, if one moves away from the microlevel and refocuses on welfare as a macrolevel social totality, it is very difficult to escape from the intuition that news, or at least hard news, is a necessary aspect of the good society. And this will presumably be true *a fortiori* of the information society.

4. THE WELFARE ECONOMICS OF INFORMATION QUA NEWS

However, all of this bequeaths a methodological problem. How does one *quantify* or otherwise prove the intuition that news is a vital function of the information society? How might 'informatisation' be thus measured? One possible line of approach is welfare economics, the modern discipline devoted to the quantitative study of the optimal allocation of resources in society. There are grounds for hope that information *qua* news could be theorised as one such resource and its contribution to a social welfare function in some way mapped out. It must immediately be recognised that welfare economics has long been under attack, impaled on the horns of the following dilemma. If Pareto-optimality is assumed then social welfare increases when the rich get richer while the poor stay poor. But if Pareto-optimality is not assumed then apparently unscientific comparisons of interpersonal utility have to be indulged in. In short, critics hold that welfare economics cannot deal satisfactorily with substantive issues of social justice (Bell and Kristol eds 1981; Garmham 1999; Sen 1973). Given the empirical evidence that the rich are indeed getting richer while the poor fall at least relatively even further behind, as documented by Nobel prize-winning economist Joseph Stiglitz (2002), this problem is far from being purely academic. Nevertheless, welfare economics may yet be a fruitful line of inquiry for the methodological problem, although probably along non-mainstream (i.e. non-Pareto) lines. After all, it cannot, surely, be a coincidence that some of the top economists of our era, including not just Stiglitz but also Sen, Arrow and others have been interested in both welfare economics and the economics of information. The trick will be to bring the two contemporary fields together, using news as a potentially rewarding 'case study' of socially important hard information. The present paper does not pretend to contain any solutions. Its role is instead exploratory and suggestive, indicating a possible line of inquiry as a contribution to the wider research and policy agenda surrounding 'new IT and social inequality' in the information age (Patterson and Wilson 2000).

5. CONCLUSION

Certain propositions have been set forth in the foregoing paragraphs. Information societies are coming into being. Information and its communication is particularly important in such societies. Social democracy is as valid a political ideal in the present era as it was in the industrial past. News, especially hard news, is a form of information. Hard news is vital to the fulfilment of social goals. Finally, the contribution of news to social welfare may be divined by a judicious application of the economics of information and welfare economics. Is it too much to hope that the beneficent role of news could be thus measured? And would that not be a small step towards a normative theory of the information society?

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DEVELOPING A PORTAL FOR IMMIGRATION: THE CASE OF “CASA DO BRASIL”

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ABSTRACT

In this paper we identified the main methodologies, analysis and design techniques used to develop Websites. We also briefly report our difficulties in using them in the development of a Website. In fact, the uses of structured and object oriented approaches in small sites whose main purpose is supplying information seemed not to very adequate, specially when we are not dealing with e-commerce or the site is not supported in dynamic data structure. Main decisions in the development of a Website are: resource management decisions, content decisions, navigation structure and design. In order to support decision taking in those areas, we propose the use of PMI, data collection and prototyping.

KEYWORDS

Website development, case study, usability approach

1. INTRODUCTION

The development of Websites, like the development of other software, presents some difficulties and challenges. In order to tackle those challenges, either researchers or practitioners have proposed development methodologies. First, structure approaches were developed and then object oriented approaches were proposed. Those approaches were proposed to develop software, but they also were adjusted or used to inspire WEB approaches. Nevertheless, there are many small sites whose main purpose is to present information non-dynamic information. In such situations, a more pragmatic tactic needs to be adopted.

In the following section, we present a small literature review. Then we describe briefly the case of “Casa do Brasil”, where we developed a Website. In the development process, we attempt to use structured approach and an object oriented approach, whose results are briefly reported. Then, we identify the main decisions concerning the development of a site. Accordingly to the literature review and suggestions of the development team, we proposed a set of guidelines to the decisions.

2. LITERATURE REVIEW

In order to support the development of Websites, several methodologies have been proposed by several researchers. Those methodologies were generally based in information systems development ones and may be grouped in methodologies that incorporated techniques based in structured techniques of functional decomposition paradigm and methodologies that incorporated techniques based in the object oriented paradigm.

The methodologies have, by nature, a general scope; that is, they can be applied in different types of projects, different industries and in a variety of organizations. Many of the methodologies are relatively rigid,

as long as they are based on a philosophy of development as standard, with uniform techniques and procedures, without any possibility to make structural alterations or configurations to the proper methodology.

In order to tackle this problem some organizations developed skills in variety of methodologies, in order to be able to select the most adequate for each concrete project. One of the dominant ideas for the improvement of these methodologies is the need of applying a process with well-defined phases that may subdivide in more specific operations, based in elementary concepts.

During the 90s, the advantage of objects orientation paradigm became obvious for many software engineering academics; they started to develop methodologies that integrated techniques and languages supported in this paradigm. But the large number of methodologies that had been proposed reminded the negative experience that had already occurred with the structured methodologies. Consequently, the idea of creating a unified methodology seemed to be the most adequate to the case.

During the 1980 and 1990 innumerable proposals had appeared. These had been called object-guided methodologies. (Table 1):

Table 1. Methodologies used in the information systems development

Methodology	Reference	Paradigm
SSADM	Weaver (1998)	Structured
Yourdon System Method	Yourdon (1993)	Structured
Engineer Information	Martin (1989)	Structured
Stradis - Structured Analysis, Design and Implementation of Information System	Gane & Sarson (1982)	Structured
Booch	Booch (1994)	Object Oriented
OMT-Object Modelling Technique	Rumbaugh et al. (1991)	Object Oriented
OOSE - Object Oriented Software Engineering:	Jacobson (1992)	Object Oriented
OOAD - Object Oriented Analysis and Design:	Coad & Yourdon (1991)	Object Oriented
RUP	Rational (1998)	Object Oriented

With the vertiginous growth of web software development, the existing methodologies were tested. But, they did not deal adequately with the problem of complexity and the increasing size of the systems for the Web. Consequently, new methodologies for the development in the web appeared. Those methodologies were either supported in the structured paradigm or supported in the objects oriented paradigm.

Table 2. Methodologies used in Web development

Methodology	Reference	Paradigm
RMM Relationship Management Mode	Isakowitz, T. et. al. (1995)	Structured
ERMIA – Entity Relationship Modelling for Information Artefacts	Green & Benyon, (1996)	Structured
RUP - Rational Unified Process	Rational (1998)	Object Oriented
OOHDM – Object-Oriented Hypermedia Design Method	Schwabe & Rossi (1998)	Object Oriented

Other methodologies or methods for development appear as an alternative more adjusted to the web environment. Some of those approaches are listed in the Table , but others may complete this list like Martins et. al. (2001), Diniz & Vieira (2001) or Lynch & Horton (1997).

More recently, some authors consider the Usability as a methodology of site construction with rose potential of success (Nelson, 2000, Brinck et. al. 2002). The definition of Usability is used to implement not only the inherent tests of evaluation but also the implementation of Website (Pinho 2002).

3. THE CASE OF “CASA DO BRASIL”

Since 1996, the Ministry of Foreign Affairs of Brazil has developed a survey to analyze Brazilians living abroad. According to the Office of the Attorney General of the Republic in the Federal District of Brazil¹, there were no official statistics about Brazilians living abroad, but the estimate was between 2 and 3 million people, and the estimated number of Brazilians living in Portugal was around 70 thousand.

One of the biggest problems related to the immigration process is the specific information available concerning each foreign country. The Brazilian Consulates, responsible for this information, give priority to the formality, regulations and are concerned with law enforcement than solving problems. The immigrants who search for support and aid are, in their majority, in an illegal situation, but the Consulates are more concerned with the ones that are in a regular situation.

A lack of policies and practices that support the integration of the immigrants in the national life was observed. According to this perception, the CBL (Casa do Brasil de Lisboa), association of Brazilian immigrants in Portugal, elaborated the “Brazil in Portugal Project”.

With ambitious objectives, the Brazil in Portugal Project presented the elaboration of a Portal, with the purpose of supplying essential information for the immigrants. For example, information concerning legislation and Brazilian and Portuguese government agencies were considered essential to be available. Frequent answers and questions about interpretation of the legislation were also considered essential. The exchange of information and discussion group was also considered very important.

However, after the elaboration of the project, it was evident that lack of financial, human and technological resources would be a great challenge or a crucial factor for the leverage and continuity of the project. Beyond the economical difficulties that the association faces constantly, for not being subsidized by any Brazilian governmental agency, its managers and collaborators are people concerned and educated in the areas of politics and social sciences, who possess only basic skills in the scope of information technologies. Consequently, the interface with users either at the requirements analysis or at the prototype approval is difficult.

Due to the lack of financial resources, the management decided to hire two people with elementary technical knowledge in what concerns Web development tools. The alternative would be hiring a firm specialized in Web development.

Besides the elementary knowledge in information technologies of the ones involved in the process, the reduced period of time was another decisive factor for the definition of the methodology, tools and software used for Web development.

Despite all difficulties, the project “Portal Brazil” is online, in the address www.casado brasil.pt, since October of 2002 and has a monthly average of 20 thousand pages offered to its visitors. This is an evidence of success of the project.

3.1 Using The Structured And Object Oriented Approaches

We tried to use the structured and object oriented approach. As consequences of this tentative, the following limitations were verified:

- The use of those methodologies leads to financial costs and time delay unsuitable with the project;
- The focus of the project is in the content. Those methodologies generally do not give enough emphasis to this dimension.
- The developers that were hired have no skills in what concerns the use of the methodologies and there was neither time nor financial resources to educate them.
- The CBL managers have no education in information technologies, hence the use of those methodologies, as a way of communication between users and developers is not adequate.
- In what concerns maintenance, it is not expected an improvement driven by the use of methodologies.

¹ In the First Iberian Meeting of the Brazilians Community, carried through in Lisbon, May 2002, with the co-participation of the Casa do Brasil de Lisboa-CBL.

With all the existing methodologies, either structured or objects-oriented, project Brazil Portal in Portugal demanded a new methodological approach. So, according to the aspects presented, we decided to identify items that had to be solved in order to develop the project.

3.2 Guidelines for the project's methodology

First, we identified the main items or guidelines to develop the project.

Those elements were the following: (1) Resource management: concerns the definition, acquisition and maintenance of hardware, software, also include personnel recruitment and work allocation. (2) Content: concerns the identification of the exact text content, its form and writing characteristics. (3) Navigation structure: includes the identification of WebPages as well as the links. (4) Design: involves decision related to colors, shapes, and images.

Those guidelines were the foundation for the definition of the project's methodology.

3.3 Main answers

Concerning each one of the items identified in the last section, we identified support either in the IT and management literature as well as in project documents existing in the CBL, or even in the experience and knowledge of the people involved in the project. In order to answer to the former four guidelines, the following tools were identified:

- PMI to support resource management decisions, including hardware, software and human resource definition, contract and maintenance.
- Need of information to immigrants was identified through e-mail available in the CBL, mail and knowledge of people involved in the project.
- The prototype of the navigation was developed through usability patterns and software tools most used, like Dreamweaver, Flash, Photoshop, Java Script, DHTML, PHP, among others.
- It was developed a prototyping approach for the site design, dividing each phase of the project in modules.

Through those tools and methods we elaborated a methodology used to develop the "Project Portal Brazil in Portugal" but the detailed description of this methodology is not the subject of this paper.

4. CONCLUSION

The use of structured and object-oriented approaches in small sites seemed not to be very adequate. On the other hand, there was neither need nor resources to implement a dynamic site. Main decisions in the development of a Website are: resource management decisions, content decisions, navigation structure and design. In what concerns those decisions, support was found either in structured or in object-oriented approach.

In order to support decision taking in those areas, we proposed the use of PMI, data collection and prototyping.

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WLAN ROAMING MECHANISM FOR CROSS-CAMPUS SERVICE

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ABSTRACT

Due to the vigorous requirement of the wireless service, many schools hope to build up a WLAN learning environment in campus. How to provide the convenient and secure WLAN environment in the campus becomes an important issue. In this paper, we did some feasibility studies for roaming mechanisms, including utilizing 802.1x authentication standard and compare with an in house designed web-based authentication system. The two mechanisms were processed in two different architectures and different conditions. The two architectures were practically experimented in five different universities to test the cross-campus roaming service. These two roaming mechanism and architectures will be used as references to implement in other universities in Taiwan.

KEYWORDS

Wireless Local Area Networks, Roaming, Authentication, RADIUS, 802.1x

1. INTRODUCTION

This paper focuses on the issue of the campus public WLAN (PWLAN) service and building up the cross-campus roaming environment. According to such purposes, convenience and secure service architectures will be a key issue. How to provide the management mechanism of WLAN to let user conveniently and securely access Internet become more and more important.

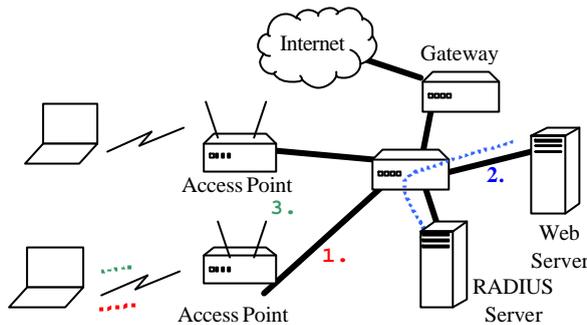
In this paper, we have done some feasibility studies for roaming mechanisms, including utilizing 802.1x authentication standard and an in house designed web-based authentication system. These two architectures have been experimented in five different universities and institutes to test the cross-campus roaming service. Any students who have a unique account, which belongs to one of these five universities, can be conveniently to roam in the other schools through the local WLAN to access Internet. This achievement can be a forerunner to promote to other universities for building up a WLAN campus.

2. CAMPUS PWLAN SERVICES AND CROSS-CAMPUS WLAN ROAMING ENVIRONMENTS

The PWLAN service and building up the roaming environment are two objectives. One is to build up a physical network environment, such that vendors deploy access points in the public site. When users use PWLAN environments, vendors need the user provide his unique authentication information (e.g. account and password, certificate, etc.) for connection. The PWLAN environment within this mechanism meant that it is a WLAN roaming environment. That is, the PWLAN service within the roaming environment will use the user's local authentication information to provide the roaming ability in the PWLAN environment. In the following, two popular methods will be introduced.

2.1 Using Gateway and RADIUS in the Web-based Authentication System

Using this method in the PWLAN and the roaming environment is the most popular one. The main component in this architecture is the WLAN Gateway (also called WLAN Access Controller), which is used to control all incoming and outgoing traffic of the WLAN. At the client site, all traffic of the user will be redirected to the authentication web page by the intercept packet. The user can input his account and password on the authentication page, then these information will be transferred to the authentication sever to be verified. This will complete the WLAN roaming mechanism. The operation of this architecture is illustrated in Fig. 1.



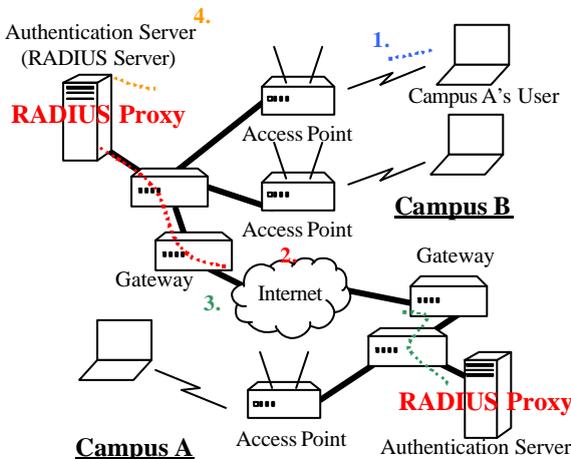
1. When users use browser to connect to Internet, it will redirect the traffic to our web server. Then users can input their account and password on this web page.
2. The web server will pass the authentication message to RADIUS; the RADIUS server will check authentication message.
3. After passing the authentication phase, the gateway will be open for the connection of this user. The user can connect to Internet.

Figure 1. Using Gateway and RADIUS in the Web-based Authentication System

2.2 Using RADIUS and 802.1x Authentication Protocol

Using the 802.1x and RADIUS protocol in the PWLAN is a new authentication method. The 802.1x standard, a port based network access control protocol, is a part of 802.11i standard and collaborated with the RADIUS protocol. In this architecture, every access points have to support 802.1x and RADIUS protocol.

The two architectures described above are two basic roaming mechanisms in the PWLAN environment. If the RADIUS Proxy function is executed, we can replicate this architecture to several locations with different individual WLAN. For example, each campus has its own WLAN, authentication mechanism, and RADIUS server. If the RADIUS server in any campus starts its Proxy function, the user in different campuses can use his own unique authentication information to pass through the ID verification by the information passing from the RADIUS server in the remote campus to the RADIUS server in his own campus. The campus environment with the RADIUS Proxy function can be called as a cross-campus or cross-area WLAN roaming environment. (Fig. 2 is an illustration of using RADIUS and 802.1x authentication method to achieve the cross-campus or cross-area WLAN environment.)



1. Campus A's user in Campus B to use wireless local area network. Campus A's user will send his authentication message, then through access point to Campus B's RADIUS server.
2. Campus B's RADIUS server find out this authentication message belong to Campus A, then using RADIUS Proxy function to forward to Campus A's RADIUS server to authenticate.
3. After pass authentication phase. Message will return to Campus B's RADIUS server.
4. Then, Campus B's RADIUS server will inform access point to open this user's connection port. And user can connect to Internet.

Figure 2. Cross-Area Authentication Architecture

3. EXPERIMENTAL ARCHITECTURES AND TESTING RESULTS

This section will describe the implementation of the experimental roaming mechanism and the corresponding testing results will be discussed. Because the possible architecture of the roaming mechanism will be referred to the university for providing the cross-campus WLAN service in Taiwan, we use two different authentication methodologies to build up the experimental roaming architecture. One is using the IEEE 802.1x standard to authenticate the roaming user. The other uses the proposed gateway, RADIUS, and web-based method instead of the IEEE 802.1x standard. These two architectures and their experimental processes are respectively introduced in the following.

3.1 Experimental architecture 1

3.1.1 Goal, Architecture, Process, and Condition

Goal - Build up a WLAN roaming architecture using IEEE 802.1x standard to authenticate the roaming user.
Architecture - The implemented experimental architecture is illustrated in Fig. 3. The appliance for the client user uses the Microsoft Windows XP as the operation system. The access point supported the 802.1x standard and the RADIUS protocol is needed. The chosen authentication server needs the proxy function to achieve the cross-subnet authentication. We use the free FreeRADIUS as our authentication server.

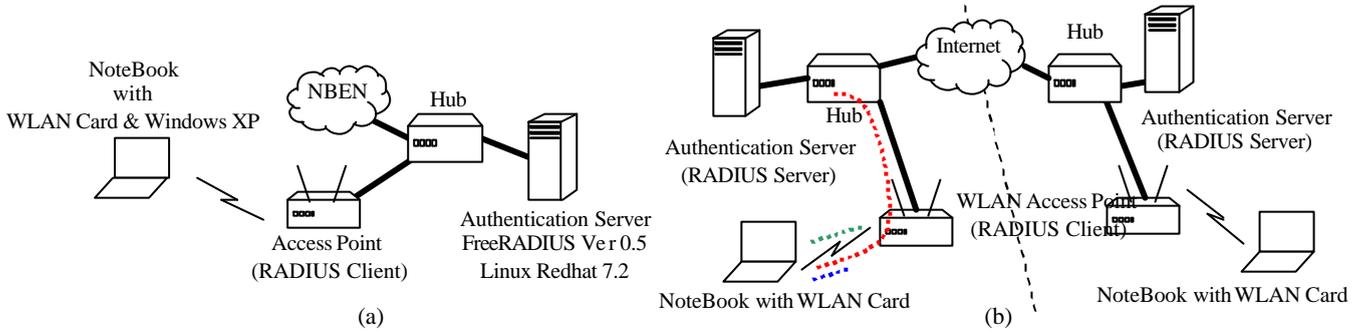


Figure 3. (a) Experimental Architecture 1; (b) Cross-Area Roaming Environment.

Process - The user will be authenticated through the 802.1x standard. At first, the 802.1x client needs the information of the user's ID and password to be input. The authentication message is transmitted through the WLAN access point to the assigned authentication RADIUS server. The access point will decide whether the user's packet can be passed or not according to the authentication result transmitted from the RADIUS server.
Condition - There are two conditions. First is the 802.1x client authentication software shall be installed in the access appliance. And second is The WLAN access point and the authentication server shall support the 802.1x protocol.

3.1.2 Experimental Result

Before using the RADIUS proxy function, the authentication process to login users in the local WLAN environment can be executed successfully. After executing the RADIUS proxy function, the cross-campus roaming service for the legal user can be successfully achieved. We successfully experiment this roaming mechanism on different universities, including National Chiao Tung University (NCTU), National Central University (NCU), National Cheng Kung University (NCKU), and Academic Sinica.

3.2 Experimental architecture 2

3.2.1 Goal, Architecture, and Process

Goal - Build up a WLAN roaming architecture in which any equipment does not support the IEEE 802.1x standard and any access point does not support the RADIUS protocol for authentication.

Architecture - The implemented experimental architecture is illustrated in Fig. 4. The user who will login the WLAN service just needs Web Browser and a WLAN interface card but any particular software. The access point does not need to support the 802.1x and RADIUS protocol. The FreeRADIUS is still assigned as our RADIUS server cause of his proxy function and freeness.

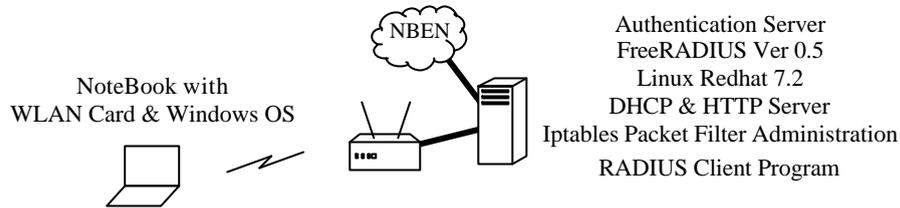


Figure 4. Experimental Architecture 2

Process - The user will be authenticated through the Gateway, RADIUS and Web-based authentication method described in Section 2.1. The gateway will judge the user is legal or not depending on the user's authentication information. The user's facility used to connect Internet does not need to install any authentication software like Experimental architecture 1. The user just needs to open the web-based authentication system. After the user inputs his ID and password, the authentication information verified by the RADIUS server. The Gateway open the connection between the legal user and the Internet according to the authentication result transmitted from the RADIUS server.

3.2.2 Experimental Result

As the result of Experimental architecture 1, the user can use the proposed web-based authentication system to get the connection to Internet. When the RADIUS proxy function is executed, the cross-area user through the local WLAN also can connect to Internet by the identity authentication in the original RADIUS server. The purpose of the WLAN roaming for the cross-area service can be successfully achieved. This web-based authentication system can be used to make up the inconvenience of the user's operation in 802.1x environments.

4. CONCLUSION

In this paper, the feasibility studies for roaming mechanisms, including 802.1x authentication standard and the in house integrated web-based authentication system were studied and discussed. The requirement of the equipment and the architecture condition are also proposed. These two architectures have been experimented in five different universities and institutes to test the cross-campus roaming service. Any student who has a unique account belongs to these five universities can be convenient to roam in the other schools through the local WLAN to access Internet, with the authentication of the user's identity. The proposed web-based authentication system has been successfully experimented. The architecture within this system can be used to provide the WLAN roaming service in the cross-campus situation.

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PROCESS-ORIENTED WEB CONTENT MANAGEMENT IN E-HEALTHCARE

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ABSTRACT

This paper focuses on integration in healthcare management on a presentation level. Often, there is no integrated view on all data about a patient in a medical environment. This is due to the fact that specific software and hardware systems specialized for a certain type of examination are often used. But for specific tasks (e.g. to do a finding) an integrated view on the data of a patient is needed. Exactly for this purpose an approach is presented, which visualizes patient data collected through the process of medical treatment. In order to select the relevant data, which is presented by a web content management system, medical guidelines developed for specific clinical cases are used and the user behavior is analyzed to gain process improvements.

KEYWORDS

E-healthcare, integration, process management, web content management

1. INTRODUCTION

Integration is a big issue in healthcare management [3] and integration problems can be solved on several levels, like data level, application level and presentation level [7]. In a typical medical environment a lot of data about patients is collected in several computer systems spread over a hospital and even over the whole medical supply system. This paper does not focus on the problem of integrating these computer systems on data or application level. We assume that the problem of integration on the data level is solved, e.g. by federated database systems [2], by a holistic central approach or by simple wrappers [10]. We set the focus to the problem of presenting data collected about a patient in an appropriate manner dependent on the context. Also data is not always fully integrated in hospital information systems nowadays, our approach can already assist physicians in creating better diagnoses and patient knowing more about their diseases.

This presentation of patient data is a problem because of the fact that a lot of the applications used for data collection and input are proprietary systems, which use proprietary hard- and software for the input and output of the patient data. So the visualization of this data is often limited to system-specific functionalities dependent on the treatment the system is designed for. A Heidelberg Retina Tomography (HRT) for example is able to store the data in a digital format and visualize this data. But all these proprietary systems do not give a solution to the following problem: If a physician has to do a diagnosis, he needs all the necessary information for this process step. He shouldn't be limited to the data of one specific clinical information system; also, unnecessary information should be filtered out. Additionally, in doubtful cases, nonstandard data should be accessible fast.

This paper focuses on exactly this problem. To illustrate this problem in a more detailed manner we present a use case in the next section. After this we introduce the basic technologies on which our solution is based upon. These are namely web content management, process orientation and medical guidelines. In Section 4 our approach of process oriented content management for the above motivated problem is described founded on the use case in Section 2.

2. USE CASE

The following sample use case will be applied on the one hand to enable a better motivation of the problem and on the other hand to clarify our solution in Section 4. Figure 1 illustrates this use case.



Figure 1. Use Case

A patient having problems with his eyes goes to a local ophthalmologist (A). This physician makes some examinations (B) but is not able to give an exact diagnosis. He requires an additional examination, e.g. an HRT. So the patient is sent to a clinic, which is equipped with special devices (e.g. HRT) for this examination (C). The examination is executed at the clinic and the clinician is creating the findings derived from the examination data. The local physician will receive these findings in form of a letter (D). With this data, he is able to make the final finding and thus order some treatment for the patient (E).

When looking at the patient data, all three participants - namely patient, ophthalmologist and clinician - have a very local, i.e. individual view. The clinician cannot see the information from the physician, except for the piece of paper with the referral. The same is true for the physician. He has only access to the finding of the clinic, but not to the data which leads to the finding (in case of an HRT, these are the images and the derived values). The patient will only see little information about his illness and treatment which is released to him by the doctors. He is far away from a well informed patient in a healthcare network.

The participants (physician, patient) should get the appropriate information at the appropriate time. For instance, in step D, the physician needs all the facts for a diagnosis. The patient in step E needs the diagnosis and some information so he can understand it.

3. BASIC TECHNOLOGIES AND APPROACHES

This section introduces the major technologies and concepts our approach is based upon. Whereas web content management and process management are really aspects of computer science, medical guidelines are a healthcare specific implementation of process orientation.

3.1 Web Content Management

Web content management systems are established tools for collecting, creating, editing, administrating and publishing content in the World Wide Web and over web technology. Good web content management systems are implemented on the principle of separating structure, content and presentation [6]. This separation has several considerable advantages: We gain better reusability of content because it is stored independent of presentation information. This concept is also basis for a content creation process based on division of labor. And last but not least it allows presenting the content in a more personalized way by selecting specific content and visualizing it in a specific format based on the users' needs.

Important components of web content management systems are: asset management, workflow management, user and access administration, interface component for importing and exporting content, interface component for functional extensions (API), personalization and a component for analysis of user behavior. The asset management enables the content authors to alter, delete or insert new content separated from the aspect of visualization and without having knowledge in a certain markup language, like HTML or XML. Digital assets are parts of a web publication (e.g. text, images or movies). Producing content is a complex and on division of labor based process where several specialists, like authors, lectors or designers

work together. To coordinate and support their work a workflow management component is very useful and absolutely necessary in order to cope with the complex process. The interface component for importing and exporting data can be used to import data from other sources or to export the data into several formats, for example for a CD-ROM production or a PDF book. Very often the functionalities a web content management system is offering are limited to content specific tasks. In practice this functionalities must be extended, e.g. to integrate a discussion forum or an online survey. This can be done by using interfaces for functional extensions. A component for personalization is useful, when content has to be presented in an adaptive way, dependent on the person using the system (e.g. physician, patient, and nurse). An analysis component helps to identify patterns in the users' behavior. Analysis plays an important role in our approach as explained in Section 4.

3.2 Process Orientation and Medical Guidelines

The workflow component discussed in the section above is an implementation for the aspect of process orientation in web content management systems. However, process management also has tradition in healthcare. At the beginning conventional workflow management systems have been used to support the clinicians work. Processes have been analyzed and enabled as workflows. But often the complexity and dynamic of clinical processes were underestimated and the clinicians felt more restricted than supported by the systems. To find a solution for this problem, adaptation mechanisms for workflow management were developed that allow physicians to alter workflows at run time and tailor them to their needs (e.g. ad-Hoc workflows) [4] [9]. But these concepts did not gain importance in practice since they often are too complicated to deal with.

An alternative usage of process management - which our approach is based upon - is not to use workflow management to support the clinicians work directly and lead them from activity to activity in a structured and predetermined manner. Instead, we use concepts of process orientation for an approach that is called 'secondary support'. Clinical processes are used to gather and present data in the context of a treatment process. Thus, not the guidance of the users is in the center of our interest but the provision of data for the users. For instance, in the scenario of Section 2 in step D the physician is presented all relevant patient information gathered in the context of the examinations he claimed interest for. This concept will be explained in more detail in Section 4.

To define processes we use an aspect oriented model [5]. Our processes are described by several aspects, namely functional, behavioral, informational, organizational and operational aspect. The functional aspect describes the parts or decomposition of a process, the behavioral aspect describes when certain process steps are executed (control flow), the informational aspect describes the consumed and produced data (data flow), the organizational aspect describes who has to execute a process step and the operational aspect describes how a process step is implemented (application integration).

Medical guidelines help us to find the right processes in healthcare applications. "Guidelines are instruments developed systematically to assist in decision making about the appropriate medical approach to specific health-related problems. Guidelines are scientifically justified, practice-oriented recommendations for action". Guidelines follow the criteria transparency, validity, reliability and reproducibility and multidisciplinary development. In our approach medical guidelines are used as the basic process patterns that give us the possibility to decide for which clinical picture which data and treatment steps are necessary. According to literature guidelines are not static, must be reviewed in regular intervals, and have to be updated if necessary. So our approach has to take care for this dynamics as well [1].

4. OUR APPROACH

Our approach is based on the linkage between web content management and process management. Web content management systems are providing a suitable means to define, collect, and display the different kind of patient data. One has to specify, which data have to be displayed and how it should be displayed. This is the point, where process orientation comes into the picture. In the process model (derived from the medical guidelines), we can find the information users need in a certain process step. For instance, in Section 2 step D, the local ophthalmologist needs information from step B and additionally the findings of the clinic

ophthalmologist. A web content management system is then able to display all this information in a comprehensive web page. Proprietary IT systems in a healthcare environment nowadays will only show the information from process step B, because they are concentrating on their devices and not on the complete health process.

However, sometimes the image from the HRT is also needed. The web content management system will create a link onto the page for step D to a page with the image. This link is based on medical guidelines. The same procedure and schema can be applied to the patient: e.g. if the patient is back home again, he connects to the web content management system via internet and wants to have a look at his data. In the first page, only some medical information is displayed, which is understandable with common knowledge. If the patient is interested in additional information, the web content management system provides links to this information with additional links to medical background information. Also, some pages about his treatment, relevant drugs etc. can be provided. The different view on the data is triggered by the different role (patient) using the system. Medical guidelines and clinic internal processes are used to extract the roles and data of a process step. This information is taken to select the assets and their composition in pages and links between pages.

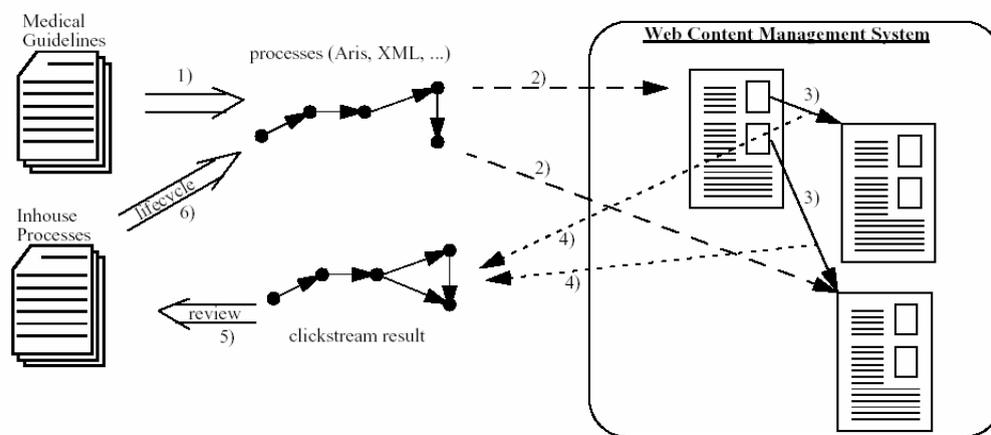


Figure 2. Our Approach

To enable the approach we use medical guidelines (Section 3.2) or clinic internal processes, often derived from these guidelines (Figure 2, (1)). This process models have to be comprehensive enough, so that the web content management system is able to get the information, which user (e.g. physician or patient) will need which kind of information at which process step. All this information has to be transformed into a computer interpretable format (e.g. XML), like it is done in the GLIF project [8]. This process information can then be used (Figure 2, (2)) by the web content management system for collecting the necessary assets for a page and also for the links between them. From the five process aspects described in Section 3.2 we focus three aspects within our approach:

- Informational aspect: This aspect provides the information, which data is (or could be) available at one process step. By using this description the concrete data items for one patient can be retrieved from the data sources and than be displayed to the user.
- Behavioral aspect: This aspect gives us the information how the steps within the treatment process are linked together. From these links within the process description we can generate links within the markup documents visualizing the patient information.
- Organizational aspect: From this aspect we can derive the different roles and groups taking part in the treatment processes. These roles and groups have different knowledge and requirements. The web content management system uses this information to generate web pages according to the users' needs.

Information about the data, the users and their contexts will be used to create pages and links between these pages in the web content management system (Figure 2, (3)). The involved persons can than navigate through this pages to get the information they need. If this information is not satisfying for the user (e.g. the

user wants additional information), the native tools of the web content management system can be used to change this very quickly and simply. New links and also new assets can be added. This can be done by a single user in a personalized way or for all users (in case of incorrect or changing processes).

As an additional feature of our approach the combination of web content management and process information is used to improve the processes: the click stream is recorded and later on analyzed (Figure 2, (4)). If some information on a page is often missing, this can be observed due to statistics like "80% of the physicians are viewing details information I_k in process step S_x ". Based on this statistics a proposal for changing and analyzing the processes can be suggested by the system. These changes can be reviewed by physicians (Figure 2, (5)) afterwards. They can select the useful changes in the processes (Figure 2, (6)). This process improvement is explicitly claimed by the concept of medical guidelines (cf. Section 3.2).

5. CONCLUSION

This paper presents an approach for process oriented web content management in healthcare. In contrast to many approaches for classical electronic healthcare records we gain one important advantage: in electronic healthcare records the users often get a very static view onto data. In our approach, the user gets a dynamic view onto these data depending on the process context he is currently in. Medical guidelines and clinic processes help to decide which data items along medical treatment processes are needed. Since the physicians are involved in creating and refining these processes, they determine what information they need in a certain context.

Web content management systems are used to visualize this medical information. A web content management framework gives us on the one hand the tool to simply present different kind of data for different users. On the other hand the framework already provides tools for analyzing the users data, thus enables us to simply create proposals for process improvements.

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INFORMATION LOGISTICS, E-HEALTHCARE AND TRUST

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ABSTRACT

Information and communication technology has influenced nearly every area of social life - even the healthcare system. Healthcare organizations use innovative information technologies in order to optimize internal communication and information processes and workflows as well as external relationships to other parties, e.g. patients. We introduce the information logistics concept and demonstrate the possibilities and advantages of a demand-driven and personalized information supply. A scenario describes a web-based portal with integrated information logistical applications. We illustrate how healthcare centers can use those “intelligent” concepts in order to improve the relationship to patients by providing personalized information before, during and after the medical treatment. The aim is to smoothly embed such technology in everyday life and processes. We therefore have to consider socio-technical aspects, e.g. trust, due to the impact they have on the acceptance of technology. Trust is a fundamental prerequisite for a successful patient relationship management (PRM).

1. INTRODUCTION

Within the past years information and communication technologies have caused various waves of innovation that have had a tremendous impact on our daily life. The internet has become the major integration platform that allows to access and to integrate nearly any kind of information that is electronically available. We theoretically have the chance to get information about every aspect of life even specialized information about illnesses, therapies and further health information. Furthermore, advances in telecommunication technologies lead to the availability of high speed data highways. This also comes true in the area of mobile communication and in the use of digital agents. Hardware miniaturization and the decrease of prices in these fields makes the development of new devices cheap and possible. This leads to various new kinds of appliances suited for dedicated information, coordination and communication purposes.

After the first internet euphoria nowadays the negative effects and problems of innovative technologies are discussed. In some areas the total supply of information has led to an information overflow rather than to the desired informedness. Enhanced information systems therefore have to incorporate concepts like context sensitive, personalized information supply that only deliver the information the user really needs. This becomes relevant in the area of health information, too. With an increasing number of internet health information patients are flooded with information often in a bad quality [De00] and need to be supported by “intelligent” information systems. Within this paper we focus on one such application, yielding to a demand driven information supply of patients before, during and after a medical treatment. We also discuss underlying sociological issues, e.g. trust as a fundamental prerequisite for the acceptance of such technology.

The organization of the paper is as follows. In the next section we shortly describe the concept of information logistics, a basic technology leading to a personalized, demand driven information supply. Section three then shows the possible integration of this technology within a web-based portal. We then analyze requirements onto such information concepts especially the sociological aspects. As patients have to rely on the provided information and services the aspect of trustworthiness has to be considered. Finally, we conclude looking the way ahead onto further steps to be done.

2. THE INFORMATION LOGISTICS CONCEPT

The information logistics concept [DLP 03] focuses on the idea of providing the right information at the right time and at the right location. This leads to a just-in time information distribution where in a given situation exactly that information that is needed is delivered to the user. Therefore information logistical applications are applications that “know” certain content sources (e.g. health databases) know a user’s information demand (e.g. from an electronic patient card), know the user’s location (e.g. at the clinic, at home) and provide her or him with the information she or he needs (e.g. allergic information, pharmacy services). Thus information logistical applications deal with content, time and communication management. Information logistical applications combine passive (i.e. the user queries for information) and active (i.e. information push by the system) supply modes. Like individually tailored suits they are individually customized towards a dedicated user. An intelligent way of information display and user communication supports the usability of information logistical applications. Various information logistical prototypes and projects have been realized, e.g. @ptus@-news, @ptus@-weather and Smart-Wear. These applications are based on the information logistics framework. Other scenarios are planned, e.g. the Smart-Patient scenario a personalized healthcare center portal that is described in the next part.

3. PERSONALIZED HEALTHCARE CENTER PORTAL

The Smart-Patient scenario is thought to support patients before, during and after a medical treatment, especially in the area of chronic diseases (e.g. diabetes, cancer) and the long-time-care. A healthcare center offers an information logistical web-based portal as an additional service and part of the patient relationship management (PRM). The portal is more than just another website with plenty of information. First, various information sources are gathered, edited and displayed consistently. Different databases, experts’ columns, forums and other online sources are used and integrated. Second, the information is filtered according to the patients’ profiles. Patients can choose a profile according to their personal situation (diagnosis, planned treatment, condition, knowledge, medication, experiences). The interface adapts to the patient’s profile and only shows information that fits to the profile. Furthermore it automatically checks new information and sends notifications about interesting news. These notifications can be send via e-mail, SMS, fax or phone. A relevance level assesses the information in order to reduce the provided information. The concept of patient life cycle shall facilitate and improve the definition process and automatically change according to a patient’s career. At the “beginning” of a disease a patient needs a lot of basic information, has to learn new behavior and to integrate new behavior patterns in everyday life. Then she gets used to the new life but still needs help and information. Treatments such as operations, changing medication or a diet mark milestones and bring changes that have to be considered in the supply of information and services. Later on many patients are “experts”, know their illness and are able to support other “beginners”.

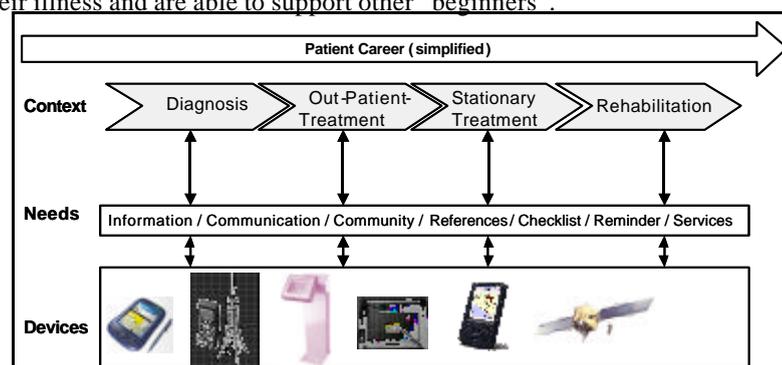


Figure 1. Patient Career

As patients shall be assisted regardless of their actual location the infrastructure may be amplified by using mobile or even wearable devices (e.g. a PDA) in combination with wireless technologies (Wireless LAN or UMTS). Those digital assistants increase the patients’ mobility and autonomy. Patients can move

freely at the healthcare center or in larger areas while still having access to the portal and are automatically informed about important dates.

In resume information logistical application support a demand-driven, personalized information supply and can become an active partner that may improve the personal wellness and health. To realize this, a good and trustful relationship between technology and patient has to be established. In everyday life such relationships are based upon a stable and long established network of social patterns. Normally, this aspect is not considered by information technology. In the next section we will discuss how those patterns can be transferred to the “virtual” world.

4. TRUST REQUIREMENTS

Planners of innovative information technology have to consider various requirements not related to technological but to sociological or psychological issues. This implies a new way of thinking and an interdisciplinary approach. Although we have to be aware of genuine human characteristics that limit the use of technology, it is nevertheless possible to systematically consider social aspects, e.g. trust. As mentioned above, a trustful relationship between information logistical applications and patients has to be established. In order to realize this, we need a broader understanding of this complex phenomenon called trust and should regard it from the patient’s point of view. Second, a model of trust has to be developed that allows to analyze a situation and to reveal weak points in the technological concept.

The easiest way to detect the relevance of trust is to look for complaints about missing trust. Related to internet based health information we find many so called trust problems. First, people don’t trust a medical platform in general and just explain it with a queer feeling. Second, the concrete fear of violation of privacy and data by the platform provider or third parties is relevant. Third, the invisibility of the counterpart and missing orientation towards the behavior of others makes patients unsure how to act. Fourth, the problem of information quality has to be considered [ED98]. Looking for solutions for those problems we find a lot of measures, e.g. seals, experts, forums, call center, PR-action, legal regulations. But a systematic approach or tool for detecting trust problems and for deciding which measures to take or an instrument to asses a trust level is missing. This results from the complexity of trust or better the widespread and heterogeneous use of the word in everyday life and science. Trust as the willingness to make oneself vulnerable to others and their actions should be understood as an inter-subjective reality and collective phenomenon [Ba83; LW85; Lu80]. Perhaps we should speak of different types of trust and distinguish between trust as concrete action and trust as an underlying attitude and emotion towards something. People trust abstract systems (system trust), a concrete organization or group (organizational trust or trust in groups) as well as a concrete person (interpersonal trust). This differentiation regards the aspect of the addressee or trustee. Furthermore trust involves various forms of risk, e.g. the risk of being hurt, of financial loss or shame. If we want to leave the reductionist perspective and meet the realistic understanding of trust, the perspective of human beings, we have to cover the entire complexity of trust.

In the case of internet based health information trust is often reduced to objective and cognitive aspects such as security, data protection or information quality standards. These aspects are important elements in a more complicated building and miss the subjective and individually ascribed side of trust that is elementary for understanding the power and problems of trust. Although objective criteria may improve the trust-level they cannot be the initial element [La02]. In order to explain trust, its objective and subjective side, we have to develop a framework of trust that fits to all facets of trusts. A strategy could be to consider the micro-level by investigating trustful relations and describing characteristics that enable trust. Second, we have to use sociological theories at the macro-level. Put together we can formulate a framework of trust compounding of processes that can be adapted to many scenarios. Next, it is possible to define general requirements according to the trust framework that is founded on sociological concepts of social action and relation. If we understand social relations, how they erase and sustain and how trust is embedded we do not only better understand trust but we are also able to systematically define design and concept rules for establishing a trustful virtual relationship.

From the definition of social action as human behavior to which the acting individual attaches subjective meaning and takes account of the behavior of others and is thereby guided [We30] we can derive the necessity of mutual understanding, of calculation processes, of integrating the individual in greater social

forms and of guaranteeing a certain continuity. These social prerequisites can be formulated in a more detailed way by using further sociological theory. The aspect of understanding and explaining the world by organizing various facets of reality can be explained with theories of constructivism and frame analysis [BL75; Go81]. Managing risk and describing calculation processes can be explained with rational choice theory [Co90]. Structuration and network theories as well as group theory help detecting aspects of integrating individuals in larger social forms [Gi84, Go81] and establishing order that guarantees a certain continuousness. Finally we are able to formulate a list of concrete issues and after that find technological substitutes. The trust model works like a translator between the sociological and the informational world. It tends to reduce the diffuseness of trust in order to formulate practical measurements and helps integrating social aspects of life into information systems concepts.

5. CONCLUSION AND FURTHER WORK

Further work will be two-folded. First, the information logistical portal concept shall be integrated into a healthcare center portal. In order to reduce the information available a specialized healthcare center is chosen (a cardiology clinic and rehabilitation center). We mostly focus on the process of profile definition as the successful information and service filtering is based on an appropriate profile. In order to support the patient and to attain a good acceptance it is thought to define amplified roles according to the patient life cycle concept. Those shall be defined using well-known social patterns. Patients therefore do not have to answer many questions but only to choose a role. Parallel to the information logistical application the trust framework is used to optimize the portal concept. First, we use the framework in order to detect possible trust problems. Then we focus on one aspect and integrate additional functions into the portal, e.g. special group functions meeting the aspect of integration. Like it is in real life patients shall be enabled to help each other and exchange experiences. Group functions tend to overcome trust problems resulting from the invisibility of the others and the isolation of the individual that dominate the internet. Tasks are the composition of groups according to similarity. In order to achieve this the profiles can be used. Second, the building of a group identity via symbols and virtual borders has to be supported. Third, continues interaction has to be initiated, e.g. through notification mechanisms and reminders. The technology needed to realize those functions has already been implemented into an intranet portal. Finally, the functionalities have to be combined, to be linked to information and to be embedded to everyday routines and processes. The trust framework has already proved as a facilitator for planing and implementing more complex information technology concepts.

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CONCEPTUAL MODELLING OF AN EPIDEMIOLOGICAL INFORMATION SYSTEM

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ABSTRACT

An Epidemiological Information System is proposed for potential use in a European project. The principles underlying such a system are examined and a model, based on one developed in a high energy physics experiment at CERN, is described.

KEYWORDS

Antibiotic resistance, nosocomial infection, epidemiological information systems

1. THE ROLE OF AN EPIDEMIOLOGICAL INFORMATION SYSTEM

A critical element in the strategy to decrease antibiotic resistance in pathogens is based on prevention and intervention at the level of medical practitioners and clinical care centres and is predicated on decreasing antibiotic consumption and implementing adequate infection control policies [1]. This may be possible if information flows between microbiology laboratories and clinical care centres are managed in a global, consistent, reliable, and timely manner, i.e. through the use of an information system. The proposed Epidemiological Information System (EIS) is a network of clinical care centres, microbiology laboratories, and biomathematics or biometry units, sharing an information system to automate the integration of data acquisition, management and analysis of epidemiological data. It was specifically designed to monitor and identify risk factors associated with carriage of antibiotic resistant bacteria in human populations. However, the proposed design may well be of wider applicability to other epidemiology surveillance programmes, e.g. bioterrorism and catastrophic animal diseases.

The need to identify antibiotic resistant pathogens arises because there are already bacteria resistant to the majority of clinically relevant antimicrobial compounds and the pharmaceutical industry seems to have reached almost standstill in antimicrobial R&D. Indeed, several previously contained infectious diseases, such as multi-drug resistant tuberculosis, are now making a worrying comeback [1]. For the first time in 35 years, in April 2000, a completely new antibiotic compound (Linezolid) reached the pharmaceutical market [2], but a few months later, the first cases of microbial resistance to the drug were reported [3] [4].

Consequently, the control of infectious diseases relies increasingly on monitoring outbreaks and timely intervention. Accordingly, the EIS proposed here was designed to enable a 'Bioinformatic Sentinel System' intelligently to manage and respond to submitted clinical data within a framework of evolving epidemiological models. In addition to bringing together comprehensive data on patients and pathogens, the provision of an EIS enables the deployment of effective data mining tools. In extending conventional statistical analyses, the large amount and diversity of data that need immediate incorporation into predictive models requires rigorous modelling through the use of artificial intelligence algorithms [5]. Those algorithms must probe the constant influx of demographic, geographic and clinical data for risk factors related to the carriage and infection by antibiotic resistant bacteria. A critical feature of the proposed EIS is that it will be configured to send warnings/alarms to medical practitioners in the clinical care centres upon

reaching a predefined threshold value for associations of risk factors to disease or carriage status. For example, a warning could advise on conducting further tests on one patient or quarantine for a cohort of patients, further hygiene measures in medical units or even a vaccination campaign.

2. AN ARCHITECTURE FOR AN EPIDEMIOLOGICAL INFORMATION SYSTEM

The EIS architecture proposed in this paper is derived from a model developed at CERN, Geneva, to manage and monitor the construction of a detector for the forthcoming 'Large Hadron Collider' (LHC) experiment known as the Compact Muon Solenoid (CMS). This section of the paper gives a brief description of the model. It is argued that the model is appropriate for an EIS. This has been developed through a set of 'use-cases' that detail the interactions of certain key actors with the proposed EIS. We suggest that the distributed nature of the system, and the requirements for flexibility, scalability and relative independence of the components of the system, justifies the adoption of the model-driven approach.

An EIS is implicitly a distributed system that integrates different forms of data varying over time and geographic area. The need, therefore, is for a flexible, reliable and responsive system to handle large and diverse volumes of data. CRISTAL [6] is just such a distributed and integrated data management system. CRISTAL enables the tracking of product and process evolution in a distributed environment. It is based on an enterprise model and a middleware, which is flexible enough to adapt and integrate multiple product and process systems. The data model underlying CRISTAL is open and self-describing in nature and provides the ideal management environment for large-scale enterprise information systems. The power of the CRISTAL data model lies in its ability to capture not only instances of data items (in the case of an EIS, samples, isolates, strains, etc) but also information about how these instances are related and described i.e. metadata. Moreover, CRISTAL maintains descriptions and instances of 'objects' in a way which allows independent evolution of each without losing valid links or imposing any where none exist in reality [7].

Epi-CRISTAL, the proposed EIS, aims to customize CRISTAL for use in the tracking of strains having antibiotic resistance in Day Care Centres (DCC) throughout Europe. CRISTAL's data model can readily be adapted to implement the anticipated EIS data model and to prepare the data for artificial intelligence techniques to enable epidemiologists to track the effects of (and ultimately to predict) the presence or infection by antibiotic resistant strains. The ultimate goal of the EIS is to provide a bioinformatic epidemiological monitoring tool that can be integrated with model-based decision algorithms to make up a fully automated so-called Sentinel System.

Although Epi-CRISTAL has been conceived as a general logical model for epidemiological information systems, it was designed using as a case study the data management aspects of the EU Fifth Framework Programme project EURIS (*European Resistance Intervention Study - Reducing Resistance in Respiratory Tract Pathogens in Children*) [8] currently underway between organizations in Europe and in the United States. The primary objective of EURIS is to develop and test the efficacy of intervention strategies by which the prevalence of resistant strains of *Streptococcus pneumoniae* colonising children attending DCCs could be reduced. Since the nasopharynx of children is the major reservoir of these dangerous pathogens, it is expected that successful intervention at the level of the ecological reservoir will also have major impact on the prevalence of pneumococcal infections by resistant strains, both in paediatric and adult disease [9].

2.1 Use-Cases

In order further to understand and capture the intended behaviour of Epi-CRISTAL, a use-case model of this system has been developed. This captures certain functional requirements of the system as a whole and in addition some use-case specific non-functional requirements. This also provides a basis for studying the dynamic aspects of the anticipated system. The use-case model then became the basis to describe and validate the CRISTAL-EIS system architecture, in addition to developing the test case specifications.

Each care centre has a coordinator, one or more 'operatives' and a manager. The most important use-cases for these actors are: the coordinator (CCC) evaluates the need for intervention at the level of the Care Centre based on analysis of the data provided by the Epidemiological Information Centre; an operative manages the clinical and demographic data about the Attendee, the Care Centre and the Care Centre Unit.

S/he also handles the data that is attached to the sample and can interact with the Attendee to ensure the quality of the data.

Each microbiology centre has a coordinator, one or more operatives and a manager. The most important use-cases for these actors are: the coordinator (MCC) monitors and evaluates the need of intervention at the Microbiology Centre level based on the results of microbiological analyses. S/he also monitors the work of the Microbiology Centre Operatives and manages their accounts; Microbiology Centre Operative (MCO) is responsible for updating the sample entries with the results from the microbiological tests (Antibiotic Susceptibility Testing and Microbial Typing).

Each Epidemiological Information Centre has a manager, one or more analysts, one or more operatives and an epidemiological campaign organizer. The most important use-cases for these actors are: the analyst (EICA) develops data analysis algorithms for the Epidemiological Information Centre. To accomplish this, the EICA has access to views of the database and to various online queries and performance monitoring; the operative (EICO) is in charge of implementing the algorithms developed by the EICAs in the Epidemiological Information Centre. S/he can also add extra queries, requested by the CCCs and the MCCs, with the approval of the EICM; the organizer (ECO) is in charge of scheduling the sampling periods and deciding what kind of bacterial type tests should be done in each sampling period.

We describe only the more important use-cases for the EIS. At the Care Centre level, the coordinator (CCC) is the key actor. S/he is responsible of setting up local alarms based on an analysis of local data and reports or when a bacterial strain is put on surveillance. The CCC can place additional analysis requests to the Epidemiological Information Centre if new situations arise or additional insights are needed. In the Microbiology Centre, the coordinator (MCC) can also query the data to verify microbiology test results. This may be for data quality control or because some operational problem occurred.

The definition of the sampling schema by the Epidemiological Campaign Organizer is the primary step in the choice of the data analysis methods and for setting the EIC alarm process. Process Additional Analysis Request involves the creation/tuning of additional data analysis algorithms that will be implemented by the EIC Operative. Also, if a new care centre and/or microbiology centre wants to join an ongoing study, the EICM will create the Care Centre Coordinator and Microbiology Centre Coordinator accounts that will be linked to the creation of the Care Centre/Microbiology Centre classes in the logical model.

2.2 Logical Model Description

Like the proposed Use-Case model, the Logical model is divided into three parts: EIC, MC and CC. Three classes depict the data flow between them: SampleBatch, Sample and TestResults. The class name is preceded in each level with the initial of the level name (i.e. CSampleBatch for Care Centre level), to identify it. The Sample class holds information relative to the collected microbiological sample and also some information about the attendee at the time of the sampling (i.e. antibiotic consumption, disease status, etc).

The SampleBatch class aggregates the samples and holds information about who collected them. The information contained in these two classes once filled at the Care Centre is sent to the Microbiology Centre, where, after microbiological analysis is performed the class TestResults is filled in for each sample. The information contained in the TestResults class is then sent back to the Care Centre. The Epidemiological Information Centre also receives a copy of the information contained in these three classes and integrates this information in an Epidemiological Campaign. At the Care Centre, Periods are defined for sampling and Samples are Batched and sent to Microbiology Centre. The Microbiology Centre regroups Samples Batches into Sample Analysis Groups, selects appropriate tests and characterizes the bacteria in the samples. The Epidemiological Information Centre is a strategic level entity determining campaign strategy (e.g. Periods, Tests, data analysis protocols, etc) and propagates alarms when necessary.

3. CONCLUSIONS

We have adopted a model-driven approach to the design and implementation of a scalable, evolvable distributed system. It is anticipated that structural changes in the organization of centres, campaigns and protocols will require to be tracked while existing results remain faithfully linked to descriptive metadata. The implied requisite characteristics of the software have been demonstrated in the CRISTAL model in its

original context. It is structured with a middleware kernel of great generality around which are built domain-specific applications. This is itself a complex process requiring a highly managed approach. The Rational Unified Process has been found to provide an appropriate framework for such development.

With recent advances in biological sciences areas such as genomics and proteomics, new monitoring techniques are being developed that in the near future will be used for diagnostic and prognostic tests [10] [11]. Information systems capable of handling large amounts of data are required, but simultaneously being able to cope with the variations in test protocols and local adaptations at different institutes and organizations, characteristic of collaborations in which several groups are involved in a study.

Another key advantage of the system is that data is collected and stored in a way that can be easily accessed by Biomathematics / Biometry units to test new algorithms and analysis techniques, whose results can be automatically provided to the Care Centres and Microbiology Centres. The design captures the main actors, use-cases and logical model necessary to different epidemiological studies types (Cohort, Cross-sectional and Follow-up studies) and areas of concern (Antibiotic Resistance, Infectious Diseases, Hereditary Diseases, etc).

The Epidemiological Information System presented in this paper has been designed with these important points in mind. It is argued that CRISTAL technology will provide the flexibility and data-management aspects needed. In particular, the added capability of capturing processes can present new possibilities in data analysis and performance monitoring.

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THE CLINICAL TRIAL COLLABORATIVE WRITING: A NEW FUNCTIONALITY OF THE WITH SYSTEM

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ABSTRACT

The paper deals with the analysis of requirements which are going to improve the facilities already available in the WITH system (Write on Internet clinical Trials in Haematology). These requirements allow a virtual community of researchers/physicians geographically distributed to write a clinical trial (CT) collaboratively. We have taken into account the characteristics of the writing process of a CT, analysing the writing activities, the writing strategies, the role subdivision and the document control methods. The kernel of the collaborative system is based on the data model of the workplan activity.

KEYWORDS

e-health, collaborative writing, virtual community, clinical trial

1. INTRODUCTION

Writing is a cognitive and creative activity, even if the text has to follow an almost predefined structure and has to contain well-defined and coherent information. This is the case of a clinical trial (CT), which has to describe a clinical or diagnostic procedure on the basis of the standardised rules of “good medical practice” [1, 2]. This standardised reference scheme facilitates the evaluation by an ad hoc committee, which has to approve the clinical test to be carried out. Moreover, the definition and writing of a new CT is carried out by a team, which comes together when there is a consolidated need to test a new medical procedure. During the entire process of the CT writing this team works under the supervision of someone in charge of planning and co-ordinating the editing of the different sections of a CT. It is therefore a virtual community composed by experts, coming from different clinical centres that share a common objective to be reached within a predefined period of time.

The GIMEMA (Italian Group for Haematological Disease of Adults) involves about 100 Italian geographically distributed centres and joins EORTC (European Organisation for Research and Treatment of Cancer). GIMEMA defines and manages several CTs active at the same time. Based on the experience of GIMEMA we have developed the WITH (Write on Internet clinical Trials in Haematology) system which supports the collaborative writing of a CT in: a) editing the document text according to a predefined but changeable structure; b) controlling the consistency of content information through the use of an XML scheme; and c) re-using the text through the storage of the different sections in a RDBMS [3].

In this paper we focus our attention on the system requirements closely linked with the functionalities of a collaborative CT writing of a virtual community of researchers/physicians geographically distributed. After a brief review of the literature on collaborative writing, we describe the CT writing process, and give the conceptual scheme of its functionalities.

2. COMPUTER SUPPORTED COLLABORATIVE WRITING

Computer supported collaborative writing, or the different tools which facilitate co-authoring, is based on various studies resulting from different scientific fields contributing to the wider research area of computer supported co-operative work (CSCW): cognitive psychology, information science, study on organisation and on communication, etc. The existing theories on collaborative writing are focused on the categorisation of the organisational patterns used by the collaborative writers. To summarise, the categorisation distinguishes between the following patterns:

- Writing activities, that is the cognitive process involved in the entire process of writing. Some authors [4] distinguish between three phases: *planning*, *drafting* or *translating*, *reviewing*, others [5] also include pre-writing activities in this process: *brainstorming*, *researching*, and then describe the other ones as *planning*, *writing*, *editing*, *reviewing*.
- Writing strategies, that is division of writing tasks assigned to a group or to a single writer. Ede and Lunsford [6] describe the tasks of *planning*, *outlining*, *drafting* and *reviewing* given to a group or a single writer during the pre-writing, writing and re-writing phases. Posner [7], on the other hand, focuses the attention on the activities performed by single writers, separate writers, joint writers or *scribe* (i.e. the person who records the group discussion with minimal guidance from the group).
- Role subdivision, that is the role played during the entire process of writing. According to Posner [7] the main roles are *facilitator*, *scribe*, *consultant*, *editor*, *reviewer*.
- Document control methods, that is how the group is organised to control the writing process and the different versions of document. According to Posner [7] there is a centralised, independent, shared or a relay way to circulate the document and control its content.

Another very important distinction is that related to time, traditionally divided into two categories: the *synchronous* (taking place at the same time) and *asynchronous* (happening at different times). This distinction has influenced the development of systems designed to support collaborative writing.

3. THE CT WRITING PROCESS

In order to define the requirements which improve the WITH systems in terms of a computer supported collaborative writing functionalities, we have analysed the writing process of a CT and identified among the patterns mentioned in the literature, the ones which are more appropriate to our environment. Based on the GIMEMA experience, the process of the definition of a CT is described in figure 1 using the Atrius Model [8].

The proposal outline of a new CT, drafted according to the EORTC scheme, is presented to the Scientific Committee, which has to evaluate it. With respect to the *outlining* reported by Ede and Lunsford [6], it is to be noted that both the proposal outline and the CT follow a standardised scheme with precise rules regarding the type of sections and their information content. The proposal outline contains fundamental information, such as the objectives of the trial, the specification of the patient population to be studied, inclusion and exclusion criteria, statistical considerations. This information permits a first evaluation on the feasibility of the test and provides the basis for the draft, so that we can consider it the kernel of the CT. Once the proposal is approved, a writing committee begins to write the final document according to the international rules for the issuing of a CT, which suggest a minimum set of information. This is carried out performing the following work items:

- Definition of a workplan to draft the CT, in which the division of tasks between the writing committee, the scheduling of the draft and the identification of people responsible for each section is agreed upon.
- Writing of the single sections, based on a co-operative process which involves the drafting of a section, commenting and reviewing by the writing committee until a draft of the final version of each section is agreed upon.
- Composition of the final draft through the integration of the single sections. This work item can involve the revision of some sections of the CT.

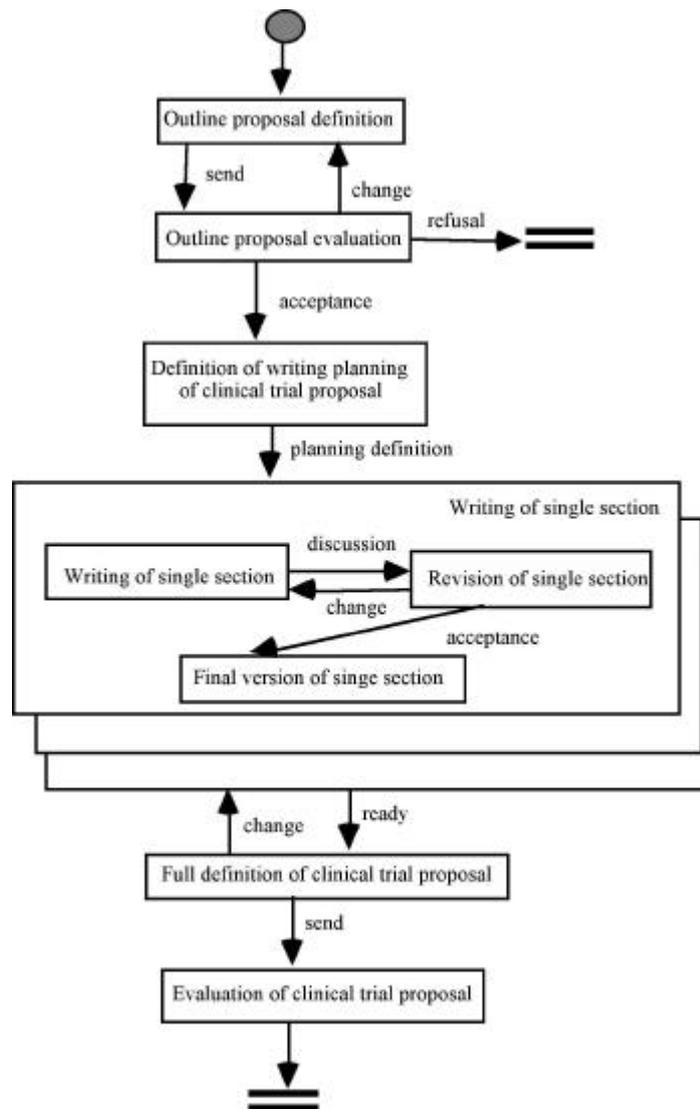


Figure 1. The definition process of a CT

Following this scheme, the definition activities of a workplan are carried out during a face-to-face interaction, which, as proved by many studies on human-computer interaction [9, 10, 11], allows the team to reach an agreement easier than a computer mediated communication and to define a workplan in less time. The writing of the CT sections is an asynchronous activity, each author works on the single section in both remote and co-located modes. These activities follow the agenda defined in the planning phase. The comparison of the final draft is carried out through the reviewing activities, which are based on the management of the different versions and on the use of annotations and comments and/or message via e-mail.

4. THE WORKPLAN ACTIVITY OF A CT WRITING

The workplan activity of a new CT is agreed upon by the Writing committee, composed by researchers/physicians with different roles (editor, reviewer, supervisor) and skills (clinical, biological, statistician). The workplan foresees the organisation of the writing activities and establishes the procedures for the communication activities among the writing committee, as well as the procedures for the revisions of the single sections.

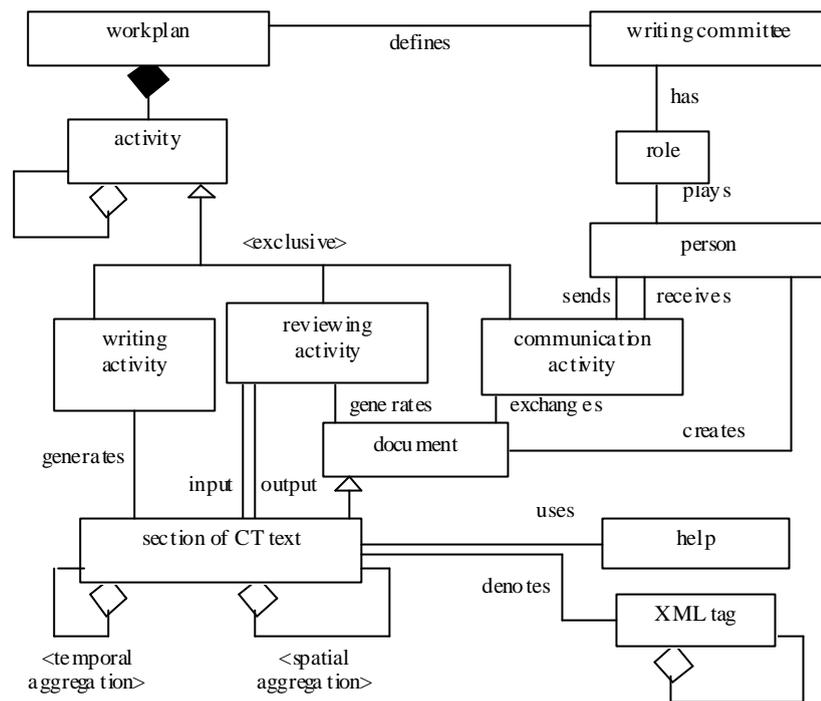


Figure 2. Data model of the workplan activity

The writing activities are based on the workplan: a) specific sections are assigned to single writer or to a group of writers, following the predefined schema of a generic CT; b) the order of writing of the single sections is also defined according to the information content of each part; and c) deadlines for the completion of the sections are agreed upon. The set of writing activities has as a result the single sections with a specific structure (corresponding paragraph and subparagraphs) and a coherent information content. They are written also using the help facilities of the system (databases of CTs and/or single sections, standard texts, etc.).

The reviewing activities, also based on an agenda, create a new version of a section with the correlated annotations, which explain the text changes. This is described in the scheme of fig. 2, which represents the data model using UML. Through the transaction on this database it will be possible to manage the collaborative writing functionalities. In fact it will be necessary to:

- manage the agenda through the data available in the workplan;
- monitoring the state diagram of the writing and reviewing activities (written, to be reviewed, reviewed, completed) based on the deadlines as well as on the information (attributes) associated with the entity *section of CT text*;
- re-using the parts/sections already written through the management of help facilities;
- managing the different versions of the single sections through the association *temporal aggregation*;
- managing the communication activities which make it possible to exchange messages; allowing the text coherence obtained through the management of XML tags as well as a related data dictionary.

5. CONCLUSION

The aim of the developed WITH system is to help the end-user to write the CT document guiding him/hem in the preparation of standard and/or mandatory sections, controlling the internal information consistency of the text and supporting the collaborative writing. This system is based on technologies integrating Relational Data Base Management System (RDBMS) with the XML mark-up language. This choice is mainly connected with the need of an efficient management of CT libraries in terms of efficient storage, fast access, data integrity, security, etc. The system is composed by function libraries, developed using Microsoft, ADO™ and

XML-DOM™ components. The content of a generic CT is represented using a XML schema, composed by about 150 element types. The WITH system is available on the GIMEMA Intranet by Explorer™[3]. The WITH system guarantees: a) the process standardisation; b) the process management; and c) the efficient delivery of information-based tasks, the explicit focus on process design. We are now working on the extension of WITH functionalities improving in particular the development of collaborative writing facilities and the workflow editor to describe the "trial design" section.

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SAFEGUARDING PERFORMANCE AND QUALITY OF CULTURAL WORK BY ICT – NON-TECHNICAL ASPECTS

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ABSTRACT

vertikult is an innovative German research and application project with a three year timeframe at the interface between culture and the arts and the new information and communication technologies. The target is to offer those working in cultural activities an internet-supported platform – an „internet portal“ – as an innovative working tool for project work. Via the portal, services can be offered and accepted. Two aspects are new here: this is the first time that such a portal is available in the cultural field covering a complete state and also, further functions will be offered to support the work organisation in projects.

KEYWORDS

e-Government, virtual organizations, cultural field

1. INTRODUCTION

vertikult has been developed on the background, that a fundamental change is taking place in our society. Our society is evolving into a society characterised by knowledge and services, which has far reaching effects on the economic and social structure. The cultural field is no exception here. The notable features of this change are more intensive competition, continuous qualification needs in handling the new information and communication technologies, the changing roles of men and women in the working world and the replacement of fixed organisational forms by flexible contracts and time-frame structures. The realisation of projects within a limited time period will definitely characterise the future of cultural work. *vertikult* offers an instrument with which these changing requirements can be mastered and used productively.

2. THE INITIAL SITUATION

On the one hand, in an increasingly flexible employment market, the cultural field can be considered as playing a pioneering role in the transformation of work. This is because the new occupational circumstances which are currently being established in the European employment market are typical for cultural work: project work, short term employment, part-time or small-income jobs, multiple jobs, high rates of self-employed persons and patchwork careers.

However, on the other hand, one can claim by no means that the new information and communication technologies (ICT) are being adequately exploited in the cultural field. We can already say that the self-employed persons in the cultural field are on their way towards exploiting the possibilities of ICT, however

cultural institutions – particularly those in public ownership – are just beginning to learn what possibilities are available.

Therefore, it becomes all the more important to present a differentiated picture of the user requirements in such a heterogeneous field as culture. The state of research on user prerequisites and applications of new media and telecommunications in the cultural field is very limited to say at least. Apart from one or two isolated publications, currently, neither a sound data base nor a research approach appear to exist with regard to the question as to why the new media have not imposed themselves in the cultural field in the same way as in other areas where they are now taken for granted.

Research work increased over the last ten years only concerning the aspect of „the culture industry and employment“; the central role played by ICT is stressed here. The buzzwords here are „economisation of culture“ and „culturalisation of the economy“.

To sum up one can say: Over the last years, researchers have published numerous problem descriptions and, in a series of studies, repeatedly demonstrated the necessity for the implementation of new technologies – even demanding this (please see references). A characteristic feature is that there are studies on individual aspects on national level but hardly any comparable data.

Even though the number of Internet connections has grown continuously over the last years and the demand for Internet services is also increasing, the cultural field is certainly not characterised by a particularly innovative approach here. The „digital gap“ between users and those who only use the Internet in a very limited manner or even refuse to have anything to do with it (onliner – nonliner) also exists in the cultural field as well as in other walks of life and occupations.

However, today, one can definitely say that the new information and communications technology is changing the nature of occupations in the cultural field wherever it is used, experimented with or employed as an additional working tool. Here, one must agree with Zimmermann/Schulz who came to the simple but equally correct conclusion: „that the changes are less marked concerning the actual cultural work itself and that they are all the greater when mediation and utilisation work is concerned“. This is where **vertikult** is implemented.

3. THE VERTIKULT BACKGROUND

What characterises the field where **vertikult** is positioned?

- The cultural field is a work and service environment which is dominated by two types of employment: (a) regular positions, principally in public institutions, and (b) to a much greater extent, free-lance experts who offer their services temporally and project related.
- The standard („regular jobs“) working relationships are proving to be increasingly difficult for the organisation of (principally public) cultural work: The fact is that there are more and more tasks which are limited both in scale and time and for which standard work organisation methods are too inflexible. Of course the demand remains for highly qualified experts with a solid academic background but today these candidates must be able to provide further skills as well. They must have competence in:
 - Information management = obtaining information from many different sources also using new technologies;
 - Communication capability = interdisciplinary working within changing conditions of time, place and personnel;
 - Team capability = cooperation with experts from different disciplines.
- For these forms of working, there are no adequate institutionalised structures to bring together clients and employees under the new requirements. There is also a lack of scenarios which display the possible chances open to previously marginalised groups (handicapped persons, elders who wish to organise their work around the needs of their children) in the employment market who are apparently in an increasingly insecure and incalculable starting position.
- In some respects, the cultural field lags behind in the use of new technologies. These are often only used as aids and not incorporated in the work organisation and work requisition. One significant indicator: in contrast to a host of other working areas, there is no internet employment broker for the cultural field Europe wide yet.

vertikult takes effect exactly at the point where the value of using new technologies is most obvious: in work structuring. This is where there are chances for employment development, for a more human organisation of the working world and an improvement of competitive edge of the (small) companies and persons involved. The focus is placed on questions and problems in a „virtual enterprise“, i.e. a working situation without traditional work forms such as a fixed work location and defined working hours. The necessary qualifications and skills, aspects of social and cultural integration in the enterprises involved as well as questions of motivation to perform self-reliant working are taken into consideration.

4. WHY IS AN INTERNET PORTAL NECESSARY?

The latest technology can support new working requirements and types of activity – starting with telework, via flexible organisation concepts right up to technically controlled networks and information flows. An internet portal allows the exploitation of the new technologies for the safeguarding of working performance and quality in cultural activities. It opens up new working opportunities for those actively involved in cultural work and thus enriches the cultural landscape.

vertikult appeals to all involved in cultural activities and the arts in public and private institutions as well as all persons who provide services within the scope of cultural activities. Those people who are only interested in part time or temporary activities are also a target group - for example men and women with young families. The requirements of handicapped people will also be taken into account.

The portal will offer to these culturally creative professionals new opportunities by bringing together employers and employees in the cultural field. It will make a contribution to transparency in the contract award process of publicly funded projects. It will include both offers and requests for temporary services. It will simplify and support the search by employers for qualified contractors. It will provide those searching for work with access to contracts and tasks suitable for their skills. It will allow the users to actively contribute to the changing processes in the world of work and permit them to improve their own qualifications.

5. THE SOCIO-ECONOMIC / SOCIO-CULTURAL APPROACH: RECOMMENDATIONS FOR EMPLOYMENT MARKET POLICY

Within the scope of an accompanying socio-cultural / socio-economic research program, part of the research will be the estimation of the effects of the project, the provision of consulting services for IT development and the evaluation of project results so that concrete recommendations can be made for the transfer as a business model.

Employment market policy aspects are particularly relevant here because the need to justify public budgets is increasing and cultural budgets are certainly no exception here.

The subject of the research is:

1. The effects in the cultural field on the quality of working conditions (coping with the lack of „structural security“ and the corresponding insecurity which results, conditions for the acceptance of new forms of work supply and demand, new forms of coordination, generation of new networks, coping with the dissolution of traditional fixed employment relationships, preserving and increasing efficiency in spite of higher organisational outlay, positive handling of the new flexibility potential, consideration of employee interests)
2. Effects on the legal framework conditions of the new work relationships as well as definition of limits (employment law, contract law, representation of interest)
3. Effects on level of employment, economic development and competitiveness of the individual employee (questions of continuous further qualification and self-motivation)
4. Effects on the working conditions of handicapped persons (work organisation which is not dependent on a specific location can be a chance for physically handicapped employees)
5. Effects on the working conditions of women during and after the family phase (Flexible work possibilities increase the compatibility of family and occupation and allow highly qualified women to stay in contact with their expert fields or ease the new start after the family phase.).

6. CONCLUSION

The development of the internet portal of **vertikult** is a research project of the Federal German Ministry for Education and Research (project title: “Development of a vertical portal for cultural tasks”). The realisation of the project takes place in the German state of Rhineland-Palatinate (project title: “Mediation of services and transfer of information for cultural work”) and is financed by means from the European Social Fund. By the application part, the Rhineland-Palatinate Ministry for Science, Further Education, Research and Culture will find out how the portal can support and safeguard cultural work in the future. To safeguard the European dimension of this project, at the research level, **vertikult** is also integrated into projects at five European research and cultural institutions. The purpose here is to develop **vertikult** as a transfer model with its implementation throughout Germany and Europe.

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6. The basis in this thematic connection is provided by a “Status Report on New Ways to Work in the Information Society”, a report about the status of “eWork”- Developments in Europe” (2000, supported by the European Commission within the scope of the IST program). Here, one also finds the evidence for the relevance of a gender-specific access for IT solutions. In Germany, the percentage of women working in individual areas of the cultural field is as high as 72% therefore the **vertikult** project will specifically take this factor into account.

CITIZEN ACTIVITY ARENA ENABLED BY AMBIENT INTELLIGENCE

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ABSTRACT

In this short paper we present our architecture for ambient society. It consists of virtual forums that enable variable citizen activities in networked environments. For specific scientific purposes a target group, young citizens, was chosen. The architecture is built on state-of-the-art networking access and is an empirical field for multidisciplinary scientific research. This paper points out the state-of-the-art multidisciplinary scientific research aims, such as ambient networking infrastructure, digital social environments and virtual communities in the information society context.

KEYWORDS

Ambient intelligence, Networking infrastructure, Projection technology, Information society

1. INTRODUCTION

Digital environments are characterized by the multiplication of content in different environments. In the near future, the number of immersive and senso-motoric three-dimensional interfaces in homes and workplaces will increase greatly and create the need to study the usability of digital environments and the services embedded in them. Our approach is based on the idea that as intelligent solutions and environments increasingly become a part of our world, they will touch all citizens and they will be specifically oriented towards different users and user groups. The design of the digital democracy intelligent environment and the integrated web portal will be based on ease of use, user-orientation, social acceptability, and phenomenal qualities. The design of such a public service calls for an interdisciplinary approach in which the user is recognized both as a cultural-social and cognitive-psychological being. Operating at the junction of art, social science, and technology, the project must take into account the future scenarios of web services and digital democracy as well as trends in *design know-how* and *design pedagogy*.

When talking about the virtual activity forum for citizens, we refer not only to the new technological equipment and its uses but also to the concrete change in the usage-space of media. Like never before, virtual techniques allow the mixing of the public and private space when it becomes possible to participate in a public event from the private space of a home. In the information society, the influences and choices the youth face are no longer easily managed by the school or home; rather, the youth themselves find what interests them from the mass of virtual entertainment. However, the significations of media are not found in the products of popular culture; rather, these significations are constructed during reception. Therefore, it is essential that homes and schools can provide the youth with the means to recognize different options and become an active citizen. This is not an easy task, since the youth's personal development requires testing boundaries, acting against the adult world, and questioning traditional, stable structures.

The project studies and develops content and new technology as well as new utilization methods. Using the latest technology, we create a forum of digital public services and social activities that interest youth. Our

aim is to develop an interesting and usable intelligent environment which gives youth a chance to participate in society without compromising their adolescent need to rebel against it. Available through schools and homes, the environment will serve as a virtual activity forum for the young community member. For schools and learning purposes this environment serves as an excellent arena for subjects like e-democracy, participation, interaction and dialogue both on local and also on EU-level. Young school children have opportunities and technology based support for co-operation with adults (e.g. parents, teachers and politicians).

2. AMBIENT ARENA TECHNOLOGY

With ambient intelligence we understand ubiquitous computing with social user interfaces that have built-in intelligence; this is the cornerstone of our empirical arena. Building a 'ambient intelligence' testing environment makes it possible to study how changes in the media space affect the usage experience and how well an intelligent environment as a medium serves public discussion. As a form of spatial media, an intelligent environment is well-suited for analyzing the concept of space in relation to democracy. Indeed, an intelligent environment brings out space as an idea on all levels - from hardware architecture and placement to the question of human-machine relationship. The ambience within arena can be articulated through ubiquitous localized service access in either wired or wireless hot spot.

Intelligent environments give rise to not only the need for theoretical reflection and conceptualization, but also the need for practical applications. The user-oriented development and design of a spatial intelligent environment requires, first, the construction of criteria for aesthetic and information usability and, second, the ability to analyze the research results and to write recommendations as the basis of design. These recommendations will provide the basis for utilizing intelligent interfaces and interactive materials in the youth-oriented online services and technological applications of the future. In terms of applied research, the project aims to find a functional model for *turning a youth-oriented digital democracy web portal into an intelligent environment that is approachable and usable both in physical space and online*. The aim of the project is to develop theories and methods for designing public online services and intelligent environments especially in the fields of the design process, design products and services, use(r) profiling, and research of context and communication.

The design of the digital democracy portal is based on the objective of developing democracy so that the decision-making process and the chance to influence it would be a part of the everyday life. The idea is not to by-pass the traditional representative democracy as such, but rather utilize new technology to provide more people media to influence it. The focus is on facilitating and encouraging citizens' discussion on social issues. From this point of view, information technology can be evaluated based on, for example, its ability to satisfy expectations or its accessibility, i.e., how widely different technological media, forums, and communications connections are available. The project's intelligent environment and the integrated portal serve as tools for youth's voice; therefore, the ethical goal of the design is to develop a technical product that helps us achieve commonly-agreed social goals and solve the ecological, financial, and cultural issues we must face in an information society. The moderator task in the arena is a key point, because being too conservative or without rule set the arena and its portal will either be insignificant or in little use or will act as a channel non-fitting to educational purposes. The actuality level of moderating data in the applications is a challenging task and is for the moment undefined.

To produce the digital democracy service in an intelligent environment a road show –type movable space called UbiComp will be constructed. It combines virtual and material space to study and experiment with projection technologies. The hypothetical concept is a session hall reminiscent of *Westminster Hall* that houses the meetings of the youth parliament. Representatives can attend meetings by being physically present or virtually present via their home terminal. The virtually present representative has his or her real-time image projected on his or her seat in the hall; a 3-D model of the entire hall with the virtually projected members can be viewed on the home terminal. The youth parliament's functions will be integrated with social sciences, arts, and mother tongue education in local schools as well as with youth-oriented information services provided by local libraries. This offers the youth a forum for discussing social issues not only through text but also through multimedia applications that combine visual and textual aspects. The first physical location of the movable UbiComp will be the Kasarminmäki area of City of Kouvola in Finland.

2.1 Arena infrastructure networking

The networking architecture uses state-of-the-art networking technologies; for both scientific purposes and target E-citizen needs several access possibilities (wireless or wired) to the virtual community possibilities will be available (see Figure 1 below). In the approach an operator-neutral broadband access is offered to E-citizen arena and virtual community. This access enables both local and global ambient services focusing on community services.

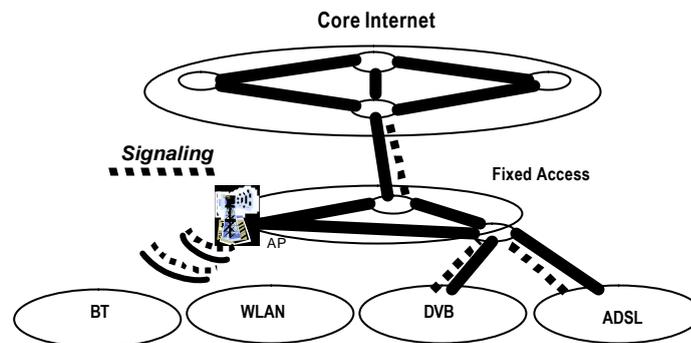


Figure 1. Arena networking technologies

The equipment of network infrastructure consists of end-user terminal (i.e. laptop, PDA, etc., set-top-box or PC), wireless (in pilot hot spot areas) and wired access points, gateway reference point, application (service) servers and core Internet network devices (i.e. router). In our scientific research we study Bluetooth technology (e.g. PAN profile) and WLAN technology and their applicability for virtual communities and their operation as E-citizen access technology for ambient services. WLAN is already widely used as an access method in office environments and in hot spots (e.g. airfields, hotels etc.). WLAN technology offers capability to prioritize/differentiate users or services through MAC layer functions. For our purposes we could for example give projection data coming from ambient service environment (i.e. virtual parliament) a higher priority in data transfer. In our approach, for the management purposes, the most important point is the reference gateway. It operates as an interface between research network and Internet (i.e. access from an operator or organization). Its functionalities (e.g. security, privacy, personalization etc.) are fundamental in piloting different ambient services. The reference gateway is not dependent on the technology, so it could be inserted into any wired or wireless environment. The scientific research will focus on the functionalities of the reference gateway [5] while integrating the networking infrastructure to ambient service environments.

2.2 Virtual parliament technology

We combine different tools in creation of the virtual parliament; using projection of *mixed reality / augmented reality* to create an ambient environment, PDA equipment to control the participation (i.e. voting) and to see the semantic data of the ambient environment and technologies (polarization) that add 3D effects to the environment. The mixed reality environments can be divided into three basic concepts and to combinations of those; projection through optic equipment, adding video data to the mixed reality and monitor-based projection. To the PDA equipment personal displays can be attached. In research plenty of examples [1- 4, 6] of projection technology can be found.

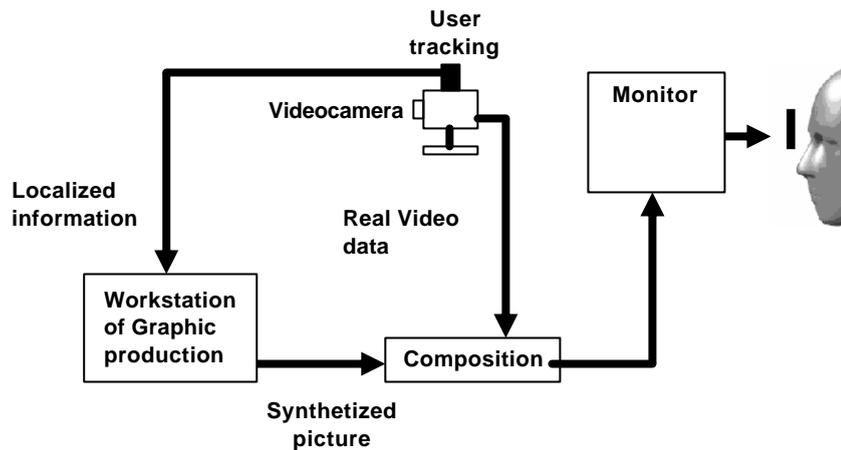


Figure 2. Sample of mixed reality projection technology (monitor-based)

3. CONCLUSION

We demonstrated a multidisciplinary approach for an e-democracy arena. As a target group young e-citizens were chosen. Digital web environments and music video- and game-like qualities are an essential part of the active living environment of today's youth. New equipment can bring out the youth's empowerment in the society. The project facilitates the youth's active participation in the discussion about the society and creates the UbiComp-space and portal as a tool for the youth to have motivation to become citizens in the information societies. Importantly, the tool shares the essential qualities of the world of today's youth.

The UbiComp -space represents the spatial media of tomorrow. The need for the research of intelligent environments has been brought about by past and on-going changes in our information environment. As environments and products are increasingly run by digital, programmed "intelligence," we need interdisciplinary research on how cognitive, social, ethical, and aesthetic needs can be recognized in the virtual design of services by considering, among others, cultural communication. The meta-design of the UbiComp-environment is an example of usability and user-friendliness research on an as-yet-non-existent product. The approach brings new real information to the field of youth and democracy studies that can benefit future applications.

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ALBACETE E-GOV: A PROJECT FOR E-ADMINISTRATION IMPLANTATION IN ALBACETE TOWN-HALL

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ABSTRACT

In this paper, e-administration tools and methods are studied in order to carry out a real project inside the Albacete (Spain) Town Council. The results show a set of tasks and a methodology, defined to implement on-line services successfully.

1. INTRODUCTION

Information technologies have changed govern methods in all levels: national, regional and local. The structure supports action govern, that is the administration, has been forced to improve information systems quickly.

Terms like e-administration and e-government are emerging topics among different research lines from software engineering to politic sciences. This paper offers the software engineering point of view of e-administration.

In this paper we show a real project orientated to implant new technologies in the Albacete town Council. This project is known as “Albacete e-Gov” and began in July 2002. The project will finish in four years. Up to then, the town Council will be progressively transformed into an on-line town Council.

Our Project has been designed to offer three main functions: Information services, communication services and transaction services. Information services collect all kind of information and show them in a well arranged way. Communication services provide tools for people interaction like e-mail, forums or messenger services. Transaction services provide on-line services.

The paper is structured in this three sections. In section 2 we describe the main ideas of the project. In section 3 we describe in detail the tasks of the action plan. Finally, in section 4 the conclusions are presented.

2. PROJECT BASES

The new information capacity makes it possible for governments to collect and integrate huge amounts of data and information. If they would be able to meet two basic conditions, it could vastly increase their capacity to do effective program evaluation and policy development [Len02].

Albacete Town Council main goal is to implement the emerging issues of e-government progressively according with national and European recommendations [COM98] [COM99] [COM02] [MAP00].

We have defined a number of actions lines:

- Knowledge Society infrastructures.
- Electronic Administration: administrative processes and services reengineering.
- Citizen participation.
- Municipal Management diaphanouness.
- Citizen proximity.

- Accessibility for all social groups, CIT (communication and information technologies) formation and e-government.
- Useful information and geographic location of services (digital diary of Albacete services)

These main principles are implemented in a number of tasks.

3. PROJECT TASK DESCRIPTION

Knowledge Society infrastructures: the goal is to improve the communication and information infrastructures from personal computer to broadband communications network. Emerging technologies like PDA and WAP are very important. Electronic administration: e-government is focused on developing electronic administration and the main goal is to improve electronic services inside Albacete town Council. The e-administration tasks are the next:

- The management of Albacete web site (www.albacete.com): With this task we want to plan the integration of old web pages with the modern services. We intend to introduce reengineering processes to create a real software infrastructure of information and content delivering, including the new software reengineering concepts and techniques to integrate data and administrative processes (workflow) in an object oriented approach.
- Technical study of the e-administration Albacete town Council: In this task a detailed study of the e-administration will be performed.
- Corporative data model: In this task the corporative data model analysis and design is performed. The model designed will have to incorporate the needs from both internal needs (in different organizative units) and service to citizens as well as management, from an information technology perspective.
- Internet authentication and security: to study the different models and Internet authentication and security projects.
- Administrative Information Hipercenter: In this task an administrative information zone will be created to offer all kind of information related to administrative procedures.
- Information and administrative transaction hipercenter: At the end of this task a number of on-line administrative services will be offered.

Citizen participation: In this task a town Council services catalogue will be developed.

Citizen proximity: the idea is to extend the use of Internet in educative centers and e-learning.

Accessibility for all social groups, CIT (communication and information technologies) formation and e-government.

Useful information and geographic location of services (digital diary of Albacete services)

4. CONCLUSIONS

This project is contributing to information technologies **deployment**. The project has been detailed in several action lines: infrastructure of Knowledge society; administrative processes and services reengineering; citizen participation; municipal management diaphanouness; citizen proximity; accessibility for all social groups; CIT (communication and information technologies) formation and e-government; and, finally, useful information and geographic location of services (digital diary of Albacete services).

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DIGITAL IDENTITY: HOW TO BE SOMEONE ON THE NET

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ABSTRACT

Personal communication and collaboration has been and still is a major driver of the Internet. A severe drawback in human centric electronic interaction is the fuzziness of the image that the co-operation partners have of each other (i.e. their respective “identities”) – especially in different and varying application contexts. This uncertainty adversely affects increasingly important “soft” co-operation factors like, e.g., trust and social behavior, and should therefore be minimized whenever possible. In addition, the lack of a homogenous representation of digital identities results, even at the system-level, in many cases in increased and unnecessary administration tasks – like, e.g., keeping track on user-ids and passwords or typing the same information several times. This makes communication inefficient and error-prone and may introduce various privacy threats. On the other hand, neither the minimal identity representation which is already used at the system’s level (e.g. a user-id used for security reasons), nor the emerging proprietary efforts for identifying users uniquely at the application level (e.g. for “single sign on” purposes) suffice for comprising the user’s identity fully as needed for co-operation of individual human beings.

In order to cope with such problems of proper electronic user “identification”, we propose an open and generic notion of a *digital identity* that is generally applicable and includes an extensible set of identity facets on the system- as well as the user-level. Such a unique digital identity for all possible Internet communication and co-operation tasks enables users to recognize distinct co-operation partners uniquely in many different contexts – but also allows for revealing individual (i.e. only partial) views on such information whenever necessary. Therefore, such a facility enriches communication by semantic information about co-operation partners and thus enables faster, more secure and trustworthy collaboration.

In summary, this paper proposes the concept of a *digital identity* and specifies what challenges are to be met when building an open, distributed, decentralized *system infrastructure for digital identities*.

KEYWORDS

Personal Communication, Distributed co-operation, Digital Identity, Virtual Communities

1. INTRODUCTION

Twenty years ago, the Internet started out as a collection of technical infrastructure mechanisms that enabled data interchange between networked machines. As a fundamental aspect, the technological simplicity of TCP/IP as well as the basic infrastructure that was granted by institutional organizations resulted in a healthy size from the start and fostered immense growth. But most important, standardized means of personal communication (e.g. email and Web) that were both uncomplicated and useful, introduced a real world appliance from the very beginning that soon turned out as what marketing people call “killer application”. It is important to note that personal communication is a major factor for Internet growth.

Together with the expansion of the net, its utilization went forward. The initial means of personal communication were applied to various domains like Electronic-Commerce, -Government, -Learning, -Marketing and -Publishing just to name a few. Moreover, personal communication evolved. The replacement of “snail” by “electronic” mail and publishing of brochures by Web pages was just the beginning. Meanwhile we are used to electronic forums, instant messaging and personalized Portals. And the end isn’t reached yet: we are on the way to advanced interaction concepts like virtual communities and also virtual reality (VR).

However, in all the development there hasn’t been much evolution of infrastructure to directly support application-level- communication. The net stopped at the border between technical communication and its

applications. For example, the only common denominator for the network representation of users in personal communication is given by email addresses – unsuitable because insignificant and ambiguous. Anything else has to be taken care by specific applications.

As a basic requirement, most applications depend on a representation of users that enable authentication or authorization of some kind, and most of them deliver an own implementation of access control. While there have always been attempts to realize a single sign-on mechanism for various fields (e.g. Kerberos, Plan9, Microsoft .NET passport or Liberty Alliance), none of them had a major breakthrough in terms of multi-application, multi-platform, multi-media or multimodal usage. Furthermore, users often want to share additional information about their identities. For example, users of an online store might want to expose their preferences for products and users of multiple web forums might want to reveal facts of their curriculum or association with other virtual communities. This information is sometimes stored in directories (e.g. LDAP), but hardly usable in a homogenous way all over the net.

Considering personal communication and an image of the other side, one could speak of *Identities* (written with upper-case “I” to separate it from other meanings, described in chapter 3). An Identity in this context not only represents a uniquely identifiable person, but also additional information characterizing it. “Character” or “personality” are other words with a similar meaning. This can include contact- and curricular-information, but also application or services related configuration or profiles and even transient information like the current interest or task. Another part of Identity is given by social affiliations to certain groups, which is also called a *social identity*. This could include sport interests (“fan clubs”), religious beliefs or adherence to philosophical positions.

There is currently neither a standard which solves the problems of authentication and authorization, nor identity information retrieval/supply (Identity management), let alone both, for the entirety of the Internet. As indicated above, both are wanted and needed, though. In this paper we argue that authentication/authorization should be combined with repositories for personal information to what we will call a *Digital Identity Infrastructure (DII)*. It is the aim of the research project “onefC” (*open network environment for Citizens*) to realize this.

The remaining parts of the document are structured as follows. In chapter two, an example scenario is given that shows how an ordinary situation of today's net-life translates into our proposed infrastructure. Chapter three outlines the main problems that have to be tackled and works out requirements for their solution. Chapter four contains a discussion of related work. Finally, chapter five closes with a summary and conclusion.

2. EXAMPLE SCENARIO

In order to outline a user centric scenario that includes several aspects of personal communication, virtual communities and electronic commerce we use the following application example:

Consider a chess enthusiast – let's name her Elli – using the Internet to follow her passion. In order to play chess, she is using a dedicated service which provides a chess client as well as a server where other players can be met and challenged. The server computes an ELO rating¹ from games against rated players. The ELO is visible for others too and also used to mutually compute new ratings when Elli plays against them. As this is a valuable service, she has to pay for it. Furthermore, Elli also participates in a web-based discussion board about chess that is free of charge. It's an open forum where, once you applied, you can post articles, share chess transcripts and read or comment articles of others. Finally, she likes to buy books and software about chess at various online stores.

Given today's technology, this usually works as follows: First, Elli has to apply for the chess-service via email, including her credit card information. Eventually, the provider grants her access to software and server via username and password. Next, Elli has to get another username and another password for the blackboard system. While she can try to get the same username, this it is not likely to succeed. Even if it works, she is well advised not to reuse the password because of security risks. Anyway, the virtual community in the forum can't be sure that this is the same Elli they might have met on the chess server. Finally, a set of username/password combinations originate from the online stores. Initially, Elli is anonymous for each store

¹ ELO: A method of rating chess players named after its inventor, Arpad Elo

and all contact- as well as payment-information need to be entered again. Certainly, the stores have no information about her chess passion, which could result in a specialized personal offering of books or software.

Now let's imagine that a general Identity Infrastructure is in place which is used by Elli, chess-service, blackboard and stores. In this case, Elli possesses a digital identity that she can use to identify herself at all services. While authentication could be done differently for each service, identification can be done via Elli's identity in all cases. This identity also contains credit card information and Elli can grant access to this information to anyone she likes – that is, chess-service and stores. The blackboard system would not gain access to this information, though. The ELO rating, computed by the chess server, is also transferred into Elli's Identity. It's signed by the chess-server, so it's assured that she doesn't change it herself.

Moreover, the Digital Identity has social effects too: Elli is recognized as an individual personality all over the network! Let's assume Elli is shy and doesn't want everyone to know her ELO rating, so when she enters the blackboard system, other users can see that she is a chess player, but not her ELO rating. Other subscribers of the chess server though will be able to associate the ELO rating they know from playing against her on the server (or just seeing her playing there) with the postings she makes on the blackboard. They will be able to utilize this recognition to personalize the forum, maybe sort the entries not by date but by "trust" in committers which was not only gained on this board. But not only in virtual communities but also in electronic commerce digital Identity can act as a vehicle to carry trust. For example, a couple of successful commercial transactions with various stores documented in the identity could result in Elli, being treated as a first class customer with discount and premium service by the next store she enters.

This example shows that Elli surely wants to be private in certain parts of the net, or with certain parts of her Identity. But in other situations, she wants to share information about herself. She wants to make herself visible to other chess players. Consider she finds a new web forum concerning chess, would she want to introduce her to the same people she met before? Consider an instant community that is initiated by a certain chess event, wouldn't she like to be known there at once, without entering information over and over?

3. MAIN CHALLENGES AND REQUIREMENTS

The main question that naturally emerges when exploring digital identity is certainly about the notion of identity itself. Research in philosophical, psychological or social science bring some clues, some of which can help to understand how a DII should be built. In mathematics, identity is a relation where each element is only with itself. So x is identical with exactly this x and nothing else, even if it equals something in value. In more common terms, it could be said that identity is the means that distinguishes one from anything other. So if you ask someone what constitutes an identity, he is likely to list a number of attributes by which one can be distinguished from others: name, date of birth, place of birth, parents. Obviously, the word identity can be used in many different meanings. The formal, mathematical meaning is opposed by the more social meaning as personality. A personality is a (logical) identity together with a set of characterizing attributes. In this text we will write Identity with a capital "I" if we use it in the sense of personality, to distinguish it from the logical meaning.

In order to find how an Identity is further structured, one has to consider the requirements of what we want to accomplish. The example scenario comprises identification, authentication and authorization as well as sharing personal information. In fact, sharing information about one's Identity on the net is a process of self-portrayal. Images of Identities can never be complete, and in most cases certain parts of the Identity shall be hidden, generating different images. Linking these images to a more complete view on the Identity is a process of recognition, but also a major privacy threat.

Identification is the method of recognizing someone as a specific individual, maybe associating him or her with an image one already holds. Authentication is the process of making sure that the identification is valid. It gets obvious that identification is the base for anything else: Neither authentication nor the other applications can go without it. While identification is apparently straightforward (e.g. universally unique identifiers), authentication can be done in many different ways. A general *DII* should enable users to choose between different authentication methods.

Further on, more than identification and authentication is needed since we want to share *general* information about an identity. The requirement to represent personal information like address, credit card number or size of shoe in one uniform format leads to the second main problem: semantics. On the one hand

predefined schemas of what can be represented by an identity are clearly not open enough. The ability to represent everything that could be required by future net-applications is vital. On the other hand it has to be assured that Identities are universally “understood”, that is, semantics are preserved. But not only semantics of attributes is a problem, metadata has to be considered too. Information associated with an Identity can originate from its owner but also be added by someone else (as seen by the ELO rating in the example). So the origin of data makes a difference. It has to be assured that the source of any information can be located and proved.

Ensuring security and privacy is crucial like in all distributed communication systems. Generally, it's imperative that disclosure of identity is fully controllable by its owner in a fine granulated way down to single pieces of information. An Identity contains a variety of information about users that they certainly don't want every communication partner to see at once. Elli would not want the blackboard system to see the credit card number she entered into her Identity but the online stores are granted access. Subsequently, there needs to be the possibility to show certain information to some communication partners and hide it from others. The more this differentiation can be mended, the better privacy can be assured. It has already been shown that sophisticated Identity management can have positive impact on privacy [Berthold, O. and Köhntopp, M. 2001]. The problem is about doing this securely. Deception and Identity theft are major threats that could lead to severe social problems. It has to be assured that Identities and even certain attributes cannot be stolen or counterfeited. Moreover for most communication acts it must be certain who is communicated with, even if this is often application dependant. If there is no trust in system security, communication partners are not trusted either.

Fine granulated information disclosure bears another problem, though: the management of Identity and access control might become a very complicated task, even with sophisticated tools. Authorization of information access cannot always be done by direct interaction. The use of rules or policies can become hard to handle too. An integration of general privacy systems like the Platform for Privacy Preferences (P3P) project [Cranor, L., Langheinrich, M. et al 2002] could make this task more flexible.

Nevertheless, too much automation in privacy control leads to another problem: the more information is exchanged automatically, the less the user is *aware* of what others know about her. The term awareness in computer science is most commonly attached to *presence awareness*, for example in CSCW or instant messaging applications. We will use the term in a more common sense: awareness is the consciousness of what is happening; in this case awareness is about the consciousness of the communication partner's identity as well as how much information is given out. Today, most Internet users are not aware of what information about them can be seen. Using the internet generates traces, but these traces are rarely visible to the user. For example, the search engine Google (www.google.com) keeps track of every search term which is entered, and also the IP address the search was originated from. The awareness problem has to be reflected in computer-human-interaction (CHI) of communication- and administration applications, taking into account questions of usability and ergonomics. Especially CHI aspects of Identity management applications that control information associations and the access, is a very important matter for awareness and therefore for privacy. By improving awareness digital identities contribute to a major problem of privacy. A general *DII* together with ergonomic software should aim at detailed control of information spread (e.g. traces). Logging and analysis of information access and communication is an important matter here.

Another aspect of Identities is not directly shown by the example scenario, although it could be indirectly derived. Sometimes people do not just identify themselves as unique individuals, but rather as part of a group. While this seems to be just another label, it is rather a true part of personality, described in detail by the concept of “social identities” [McGarty, C., Haslam, S. A., Hutchinson, K. J. & Turner, 1994]. In the example, Elli could feel herself belonging to certain social groups, namely that of chess players or that of the blackboard community. While digital representations of social identities ease assigning oneself to a certain group, they also ensure a certain level of anonymity. This can be done by uttering affiliation to a social identity while hiding personal information.

A more general problem which applies to all collaboration systems is the need for a broad user base. In the example scenario it would be of little use for Elli to maintain her Identity if she cannot use it in all the places she visits on the net. The more places one can use an identity, the more useful it is. And the more users a system has, the more useful it gets too, because more peers can be identified. Therefore, a general approach to *DII* has to foster its wide adoption by maximum openness, effectiveness and efficiency.

Finally general requirements for successful distributed systems apply that have been extensively discussed and will only be sketched here. Security has been mentioned already and is very important.

Reliability of service is also very important. For reliability the system should be kept simple enough so it can be administered easily and doesn't break down from maintenance overhead. Decentralization also is a crucial point for an Identity infrastructure. A centralized system that holds all Identity information of all users in one place would not only be a single point of failure and a bottleneck, but also a non-acceptable security risk.

4. RELATED WORK

The open network identity infrastructure we are proposing revolves around issues of security mechanisms and data repositories. In our approach to support open systems for personal communication, we target most directly on global user authentication and open distributed directory services. In this section we will outline related work in those areas and compare it to our approach.

Since multi user capabilities were introduced to computing systems, users had to authenticate themselves before being granted access. This became more complicated when computers were interconnected via networks. There have always been efforts to make authentication easy and transparent to the user, but secure and reliable for the system. However, most of the mechanisms which evolved, like Kerberos [Kohl, J. and Neuman, B. C., 1993] or more recently Plan9 [Cox R., Grosse, E., et al, 2002], were bound to one computing architecture though and therefore not applicable to the entire Internet. Recent development shows that two main players compete for single sign-on dominance on the Web: Microsoft's ".NET Passport" and the Liberty Alliance led by SUN Microsystems.

The .NET Passport System by Microsoft [Microsoft Corporation, 2002] aims to achieve single sign-on for web sites using only standard protocols and no extra software components on the client side. When a user tries to log into a passport enabled web site, she is redirected to the .NET Passport Server (www.passport.com) on an encrypted connection (HTTPS) and asked to authenticate via email address and password. If succeeded, the Passport server redirects the user back to the original site and sets a cookie on the client host that the server can read to see who is logged in. This architecture has several flaws and has been hacked or broken several times already [Electronic Privacy Information Center, 2002].

The Liberty Alliance Project [Liberty Alliance, 2002] aims to establish another single sign-on infrastructure for web applications. The proposal focuses on federations of web services and applications so, once granted, they can share user information, including authentication. Like in Passport, a change of client applications is avoided, so users have little control over what is communicated between the federation partners – all personal information is stored on server side.

Open distributed repositories provide mechanisms to store specific aggregations of data (e.g. user information) in an organized way and access them for multiple purposes throughout large networks like the Internet. They are based on the concept of designing the repository as a collection of open systems that cooperate to hold a logical database of information.

Specific repositories for personal data are known as directory services. Directory services provide names, locations and other information about people and organizations. Directory information may be used for personal communication (e.g. contact information), user authentication (e.g., logins and passwords), network security (e.g., user-access rights) or various other purposes related to a specific application context.

While early network directories were mostly designed for specific applications, the first standard for an open directory service was defined in the ISO Open Systems Interconnection (OSI) model where directory functionality (directory administration, authentication and access control), is defined as ITU-T Recommendation X.500 [ITU-T, 1995]. X.500 describes a client/server architecture in which the client (directory user agent DUA) queries one or more servers (directory service agents DSA) using the directory access protocol (DAP).

Though X.500 offers a comprehensive solution for open directories, its complexity hindered widespread use – especially in the global context of the Internet. This led to the definition of a simpler TCP/IP based standard for the DAP called Lightweight DAP (LDAP) that offers comparable basic functionality and quickly evolved to the de facto directory protocol of the Internet [Yeong, W., Howes, T., et al, 1995]. While being lean, LDAP misses certain important features like full-grown security mechanisms. This fact again initiated discussions about changes and a possible return to X.500.

While directory services like X.500 and LDAP aim to be generic, domain specific (but still open) repositories try to address specific needs of dedicated application areas. An example of such a repository within the specific domain of electronic business services is Universal Description, Discovery and

Integration (UDDI) which was defined by the UDDI consortium [UDDI ORG, 2002]. The UDDI repository offers a tailored schema, protocol and architecture that allow describing and classifying business services in a natural way and accessing this information from a globally unique entry point.

Similar to the UDDI concept of a specialized global service repository, our concept could be seen as a specialized global repository for personal Identities. Among other aspects discussed in the previous paragraphs, such a tailored repository needs to combine global single sign-on mechanisms with the functionality of an open directory service. To the best of our knowledge there is currently no working system which offers authentication and directory services bundled. However, efforts in this field are done in various points. Most notably the XNS Project (eXtensible Name Service) works on protocols and XML schemas to communicate identity information over the network [XNSORG, 2002]. However, they focus on web services and therefore gain a different scope. The commercial effort PingID.com [PingID.com, 2002] tries to establish an infrastructure – again focused on web services – to share user information, but the effort is still young and unfinished, and it lacks scientific background.

5. CONCLUSION

In this paper, we showed how a general Digital Identity Infrastructure can remarkably enhance “living”, i.e. communicating and co-operating on the (inter-) net. This doesn't only result from providing specific capabilities like ‘single sign-on’ or ‘automatic form-filling’ but rather from real recognition of communication partners as personal characters that can be shown to or hidden from other co-operation partners – together with all their possible aspects, fine-tune as needed in many possible fine degrees. As opposed to proprietary, application bound systems which yield only enhancements to their special area, our open Internet-wide approach to Digital Identities aims at supporting all kinds of arbitrary virtual communities with a rather generic mechanism.

Building the corresponding system infrastructure bears several technical challenges (as outlined); some of them have already been investigated in the context of the OneFC-project, others still present material for various future work. Our focus of such work will include technical aspects of identity management, identity building, identification and information exchange protocols, anonymity issues, image tracing and integration of proprietary systems.

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QOE IMPROVEMENT IN MULTIMEDIA TRANSMISSION

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ABSTRACT

This contribution presents a Quality of Experience (QoE) framework. It evaluates QoE using QoS metrics, network feedback, and dynamic user requirements, and proposes a definition for QoE. It is believed that a better QoE can be achieved when the QoS and its interaction with the network and application layers is considered as a whole rather than a single entity. A QoS Arbitration Algorithm is presented and is driven by QoS RT tables and tuneable weighting factors to manage the QoS mechanisms.

KEYWORDS

QoS, QoE, Multimedia Transmission, Arbitration,

1. INTRODUCTION

Different solutions have been proposed to provide Quality of Service throughout the Seven Layer OSI Reference Model. A further general classification can be made to the different QoS mechanisms and solutions where this is considered as two layers: the application and the network layer. Above these layers it is possible to imagine a perceptual pseudo-layer, which is concerned with the end user experience. A metric used for measuring the performance of this perceptual layer is Quality of Experience (QoE) (Alrich S. et al. 2000; O'Neil).

This work focuses on arbitration applied at the network layer but subsequent experiments are being defined for the Application Layer. Prominent results illustrate that by using network arbitration the Quality of Experience is improved. This implies that a better QoE can be obtained by the interaction of both Network and Application Layer arbitration as described in the following sections.

2. THE QOE FRAMEWORK

The term QoE is relatively new to multimedia understanding. It finds common use in company white papers related to systems, web and network services (Alrich S. et al. 2000; Empirix's White Paper). Further more it has also been used and referred to as a metric for evaluating the Internet Services as a whole (Moorsel 2001; Abdesalam 2002). O'Neil defines the QoE as "the totality of the Quality of Service mechanisms, provided to ensure smooth transmission of audio and video over IP networks". QoE is also considered as what a customer experiences and values to complete her/his tasks quickly and with confidence (Alrich S. et al. 2000). In Empirix's White Paper, QoE is referred as all the perception elements of the network and performance relative to expectations of the users/subscribers.

It is inferred that the origin of the QoE metric is what was previously considered as the user perception of the total Quality of Service provided by the different layers of the OSI model (Nahrstedt and Smith 1994; Chen et al. 1996; Guo and Pattinson 1997; Richards et al. 1998). The QoS required and perceived by the user can be specified as a single parameter; low, fair, good and excellent (Guo and Pattinson 1997). However, the

user requirements can also be specified by several parameters such as resolution, height, width, colour, etc. and are directly linked to the application layer. The specification, translation and mapping of these parameters to be meaningful on the under layers has been a very active research topic on its own (Campbell et al. 1994; Mosse and Ly 1996; Richards et al. 1998).

The author proposes a QoE definition as; “the user’s perceived experience of what is being presented by the Application Layer, where the application layer acts as a user interface front-end that presents the overall result of the individual Quality of Services”.

3. QOS ARBITRATION

This framework is based on the hypothesis that a better QoE can be achieved by considering the network and application layer QoS when arbitration is used. The QoS at each layer is managed and controlled by an entity referred to as the “Layer Arbitrator”. The interaction is provided by the feedback passed between each layer.

Within the new experimental framework existing guidelines for end-to-end QoS parameters are considered as a benchmark in subsequent experiments (ETSI TR 102 049 V1.1.1 2002; ITU-T Recommendation H.323 1998; ITU-T Recommendation I.350 1993). Ultimately QoS is governed by the arbitrators (see figure 1), which control the existing and standardised QoS mechanisms (DiffServ, IntServ, IPv6). The decisions taken by the arbitrators are based on look up tables or by implied intelligence derived from feedback.

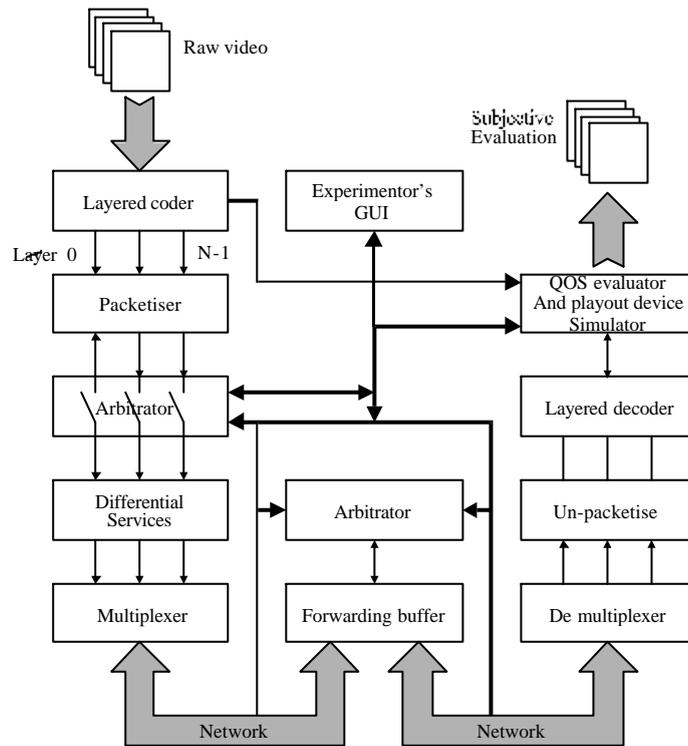


Figure 1. Experimental QoE Framework

These decisions are based on the subjective results obtained in previous iterations of the experiments, and are dynamic entities, which are changed by the experimenter as in figure 1. The result of Network and Application QoS metrics are weighted and represented by an ‘overall single factor’. The metrics are referred to as AQoS and NQoS for application and network respectively. The QoE relation to AQoS and NQoS is considered and described as a “QoE to Layer Relationship, Q” (QoEtoL). It is defined as follows, where QoE is defined as some function *f* of AQoS and NQoS:

$$QoEtoL \Rightarrow Q = f(AQoS, NQoS) \quad (1)$$

An experiment is performed where the ideal QoE using all available resources is compared with a compromised service and the differences (ΔQ) reported back to the arbitrators and used to adjust expediency, layer generation, and coding parameters. The end user is asked to vote using DSCQS (subjective testing) (Watson and Sasse 1998) to show their pleasure or displeasure at the presentation as shown in figure 1. An attempt is made to correlate the observed QoS and the subjectively generated ideal QoE measure. This empirical analysis is used to derive the function in equation 1.

The overall network QoS (NQoS) metric defined within the QoE framework is considered as the sum of the weighted factors given by three network metrics: *delay, jitter and packet loss*. The overall Network Arbitration Algorithm runs to provide maximum QoE as defined by the QoS RT or user specifications:

1. The Network QoS metrics are measured and fed into the network arbitrator.
2. The Network Arbitrator applies the initial weighting factors according to the QoS RT tables.
3. The overall NQoS metric is calculated.
4. The highest default weighting factor in the QoS RT Tables (first time) dictates the QoS mechanism to be implemented e.g. DiffServ or IntServ.
5. The QoE metric is measured as defined in the framework. If no AQoS metric is calculated then it is set to a fixed value of 0.5 reflecting its maximum influence on the QoE.
6. Available ΔQ metric is fed into the arbitrator.
7. The weighting factors are tuned as new values are calculated.
8. Go to 1 and try to improve achieved QoE.

The weighting factors represent the effect of each QoS metric and the NQoS overall effect of the network on the end user QoE. The tuning is done using two metrics; the QoS network values (delay, jitter and packet loss) and ΔQ . The QoS metric with the highest weighting factor is considered. If the metric value is increased then its weighting factor is proportionally decreased. The decrement applied is then inversely applied to the other two weighting factors as described below.

Let H be the highest weighting factor, M the middle and L the lowest. On the other hand, let mH, mM and mL be the individual QoS metric (jitter, delay and packet loss) associated to the highest, medium and lowest factor respectively. Let *i* represent the iteration number.

$$NQoS = H+M+L = 0.5 \quad (2) \qquad \Delta H_i = 1 - (mH_i/mH_{i-1}) \quad (3)$$

$$H_{i+1} = H_i + \Delta H_i \quad (4) \qquad M_{i+1} = M_i - (0.5 + M_i) \Delta H_i \quad (5)$$

From equation 3 (mH_i/mH_{i-1}) relation is limited to 1.99. The term ΔH_i is referred as the Memory Factor (MF). The M_{i+1} and L_{i+1} values are calculated as follows:

$$L_{i+1} = L_i - (0.5 + L_i) \Delta H_i \quad (6) \qquad \beta_i = \Delta Q_{i-1} - \Delta Q_i \quad (7)$$

When the ΔQ metric is available then a β_i factor replaces the ΔH_i in equations 4 to 6. The defining factor is the difference between the ideal and real QoE metric. The β_i is defined in equation 7 and is the difference between the previous and the current ideal and real differences. When β_i is positive the QoE has improved whilst negative it has degraded.

4. EXPERIMENTAL WORK

Three experiments are introduced 1) simulated prioritised intra-coded video 2) network arbitration using DiffServ and 3) using DiffServ and IntServ. For the simulation, media streams are generated using standard audio, video and still codecs and interacted in the same network. Preferential IPv6 prioritisation is applied to the intra-coded video packets. The PSNRs are compared both with and without such mechanisms as shown in figure 2. I packets are being prioritised and sent over the same path as their corresponding best effort delivery B packets. As expected improved quality is observed in the video whilst the services of the other media are degraded. These results show that improved quality can be achieved using crude arbitration mechanisms. In this scenario video is considered to be more relevant than the other media for the end user (e.g. tele-surgery). As better quality is provided for video the QoE is improved. As the transmission proceeds the ΔQ_{i-1} and ΔQ_i values are calculated and β_i is obtained. β_i is made available and fed into the arbitrator. Experimental scenarios 2 and 3 are implemented using the obtained β_i values.

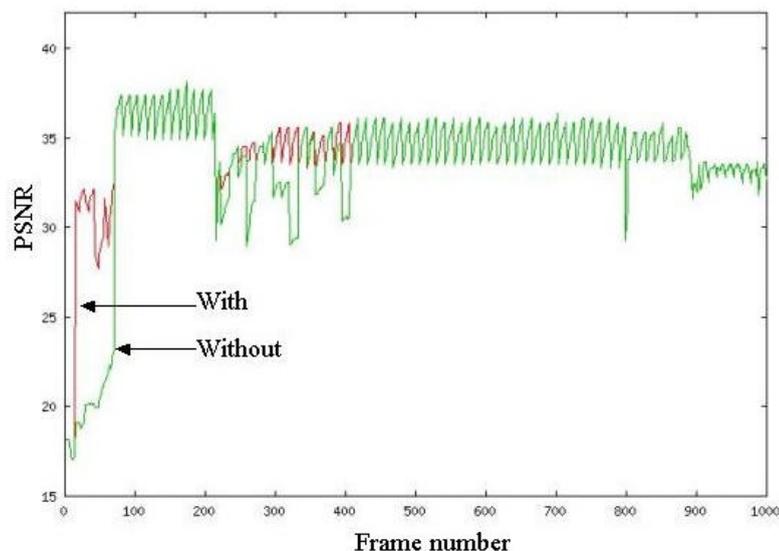


Figure 2. PSNR with and without prioritising intra-coded packets, buffer 50kbits & still image transmission 10 secs

A QoS enabled real network is used in scenarios 2 and 3 to perform the DiffServ-IntServ arbitration experiments to compare the real world with the simulated. Audio and video are generated on a high end dedicated PC running an H263+ codec producing a CIF size image, and audio is generated using an MPEG-2 audio codec. A set of end user requirement scenarios are defined, ranging from single layer video and low quality audio for use on a PDA or cell-phone, to multiple video layers and high quality audio for a set top box or Personal computer. In Scenario 2 DiffServ is applied to the media streams as dictated by the QoS RF tables defined in section 3. Weighting factors are also introduced into network arbitration decisions according to the QoE framework. Scenario 3 employs IntServ as well as DiffServ.

5. CONCLUSION

A QoS Arbitration Algorithm based on the QoE framework is introduced. It considers QoS RT tables and tuneable weighting factors to manage the QoS mechanisms. The weighting factors represent the QoE effect of the network's *delay*, *jitter* and *packet loss*. The tuning is done based on the memory factor η and the QoE metric β_i . The QoE framework is based on the hypothesis that a better QoE can be achieved when the QoS interactions of the network and application layers are considered as a whole rather than a single entity.

Three experimental scenarios are presented using the QoS network arbitrator 1) a simulation of prioritised intra-coded video packets 2) network arbitration by controlling DiffServ alone and 3) network arbitration by controlling DiffServ and IntServ. A real network with QoS enabled is used for scenarios 2 and 3. Scenario 1 obtains β_i values which are used for the arbitration used the other two experiments. These are under current analysis.

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APPLICATION AND NETWORK LEVEL ARBITRATION FOR DEVELOPMENT OF QUALITY OF EXPERIENCE METRIC

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ABSTRACT

This paper examines an arbitration mechanism where redundant video packets are selectively removed, resulting in an improvement in the video quality whilst freeing up resources for other interactive traffic. The interaction between multimedia streams is investigated, where video and a still image are apparent simultaneously, and the effects of transmitting these media over the same channel examined. Network and application level arbitration policies are examined for a simulated and real network. The relationship between the objective quality of service metrics available from the network & application, and the subjective perception of quality of experience are considered, and used to develop the end-user's quality of experience metric. The findings are consolidated and used to derive policies for network and application level arbitration, to provide maximum quality of experience to the end-user.

KEYWORDS

QoS, QoE, Multimedia Streams Interaction, Video coding, arbitration.

1. INTRODUCTION

There has been an increase in Internet multimedia applications over the past few years for use in education, business, health care, etc. The main problem with the Internet is the lack of guaranteed Quality of Service (QoS), hence various techniques have been developed to enhance its functionality, in order to provide and improve the quality of multimedia application services.

In a multimedia application, a number of media streams, such as video, audio, still, text, etc exist simultaneously. These have differing characteristics and require different QoS guarantees from the network [8]. Degradations occurring in one media are primarily due to the characteristics of the stream with which it interacts [10].

Non-real time data applications do not set a specific delay requirement on the network although a timely response is always desirable. Multimedia applications on the other hand have a maximum end-to-end delay requirement [9], where packets exceeding this limit become useless for play-out of the application media.

In terms of loss, isolated data traffic is more sensitive to packet loss than continuous real-time traffic. Packet loss in real time media such as video can generally be tolerated, but can have a 'knock-on' effect to subsequent frames. This is more severe when lost packets belong to intra-coded frames, which form the temporal references [7]. It is therefore important to ensure that intra-coded information is protected from loss and errors, or ignore packets which use them as a reference in the event of loss.

The transmission of video and still images over bandwidth-constrained channels causes complex interaction between the media. A still image represents a short duration of high-bandwidth burst, whose interaction with the video can cause considerable delays and/or losses to the video packets for the duration of its transfer, therefore degrading the quality of the presented media. In this work, video packets which are excessively delayed are discarded since they will be of no use to the real time application. With this in mind, consider how to transmit the still image with video across a shared medium for a particular application such

as distance learning. In this application, when a lecturer changes the overhead slide, disruptions are likely to occur in the video.

This paper examines an intelligent arbitration where losses are minimized; improving the user's quality of experience (QoE) [11] and at the same time freeing resources for other interactive traffic. The arbitration utilizes the resources freed by temporal compromise and selective removal of predicted packets whose reference packets are lost. This policy can also be applied at the network layer for packets which are excessively delayed to free buffer space. The resulting video quality is subjectively and objectively assessed, and the relationship between these metrics used to develop a QoE metric, based on the network and application level policies adopted.

2. BACKGROUND AND RELATED WORK

The Internet was not designed for handling real-time, but rather data traffic. The emergence of real-time multimedia applications required an integrated network that would support transmission of data as well as real-time video and audio. The ITU recommended a standard protocol, RTP [13] to support transmission of real-time traffic over the Internet.

Multimedia applications require guarantees on network performance, such as limits on throughput and packet loss, delay and jitter. This is currently supported by resource reservation [2], and guaranteed service classes, but these mechanisms consume a lot of resources when providing services to multimedia applications. In addition, multimedia traffic exhibit different characteristics and requirements, and this requires the network to have ability to provide different service levels.

The provision of best quality of service for multimedia applications over the Internet therefore requires service differentiation and QoS control mechanisms, and have received considerable interests over the past few years. The IETF recommended the DiffServ protocol [1] to support service differentiation in the Internet. This protocol aggregates traffic streams into different traffic levels, based on the information given in packet headers. DiffServ uses the IPv6's differentiated services (DS) header field [12] to provide scalable service discrimination in the Internet. In [14], the differentiation of services in the Internet is presented. In particular, the work evaluates multimedia traffic streams and their characteristics when mixed together over various network scenarios. It is concluded that it is difficult to mix traffic that require high bandwidths with those requiring low bandwidth when link speeds are low. In [6], the characterization of video and audio traffic transported over the Internet using H.323 standard is presented. The work studies multimedia packet format parameters and multiplexing issues of audio and video traffic at the transport layer before reaching the network. It is concluded that packet size places a compromise between induced latency (and therefore the quality of the received media) and network utilization.

During adverse network conditions, performance improvement of multimedia streams is achieved by using control techniques. Rate control mechanisms [3][4][5] are a common example, where applications adjust the sending and encoding rates according to network conditions. Applications can also drop layers in video streams or temporarily suspend entire streams to cope with available resources. However, these decisions should be made with application level considerations in mind.

This work examines the use of the combined network and application level control/arbitration mechanisms, together with end-user considerations to develop a quality of experience metric.

3. SYSTEM ARCHITECTURE AND EXPERIMENTAL SET-UP

Figure 1 (left) shows the architecture for evaluating end-user's quality of experience (QoE) metric using arbitration mechanisms. These mechanisms can be classified into two levels: application and network-level arbitration. Application-level arbitration is concerned with managing QoS based on the end-user's perception of spatial and temporal quality and how it meets the requirements. Network-level arbitration is based on QoS management in terms of resource reservation and prioritisation, such as marking, classification, scheduling, etc. The use of two-level arbitration allows the end QoS to be judged not only in terms of network performance, but also in terms of the application performance.

Experiments can be carried out in a simulated or a real network. In this work, experiments are simulated to emulate a real network. The simulation involves a simple leaky bucket (figure 1, right), which performs the forwarding mechanism. Statistics from the sources are collected and used in the evaluation. The resultant interactive effects are examined by reconstructing the media, and comparing with the original. This allows iterative development of arbitration methods to be achieved quickly, with improvement of overall end-user quality of experience as the goal.

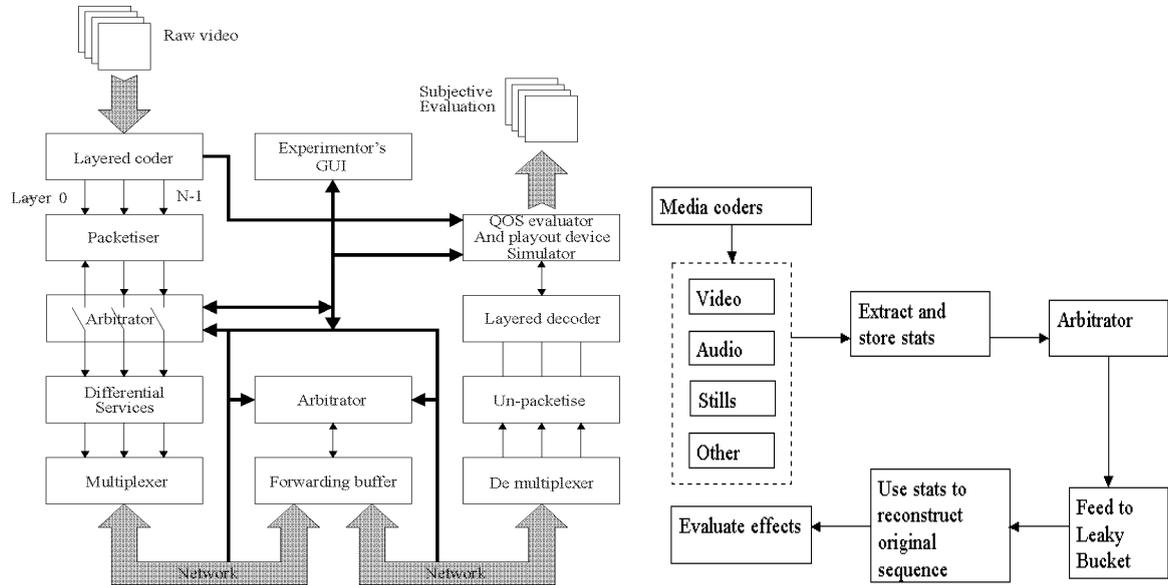


Figure 1. Network-Application level QoE architecture (left) and experimental set-up (right)

4. EXPERIMENTS AND RESULTS

A number of simple experiments are conducted. The first experiment involves a video stream and a still image, where the effects of a still image as a long-term burst [10] on the video are examined. The experiment presents an arbitration mechanism where the video stream is compromised by dropping excessively delayed packets. This is because the delay induced in the video packets by the still image may cause the packets to be discarded if they exceed their maximum delay threshold. Also, due to the inter-dependency of video frames, a discarded packet may affect the decoding of subsequent packets; therefore dependants of lost intra-coded packets are also discarded.

The experiment is analogous to a remote lecture, which contains video and still image/overhead slide information. When the lecturer changes the overhead slide, a data burst occurs which has potential to interact and disrupt the video stream. This is illustrated in the following: an H.263+ coded video, 'Gene' at 384kbps and I-frame refresh rate of 10 is interacted with a 57KB baseline JPEG still image, using a buffer size of 80kbits and throughput of 384kbps. The still is transmitted for 20 seconds; therefore the average generation rate for the two media is 410kbps.

Table 1. Number of received and lost packets for video and still with and without arbitration.

Arbitration	Video		Still	
	Received	Lost (I/P)	Received	Lost
Without	14467	149/0	278	12
With	12486	24/2106	283	7

Table 1 summarises the results of the interaction. Losses in the video I packets are observed when arbitration is not used. These losses occur when both media are coincidental in the buffer, causing buffer

overflow, and when a scene appears in the video stream. It is therefore essential to ensure that these coincidences are avoided, to make buffer occupancy more consistent.

The same experiment is repeated, but with packets that exceed maximum delay discarded. In addition, dependants of lost intra-coded packets are also discarded. As seen in table 1, the arbitrator has performed most of the discards because either the packets have exceeded their delay limit or they are dependants of lost intra-coded packets. It is observed that, selectively removing redundant packets provides more space in the buffer, and reduces loss in the video intra-coded packets, as well as from the still image.

The received packets for the video stream are reconstructed, and the resultant PSNR values computed, as shown in figure 2. It is observed that the overall objective quality of the video has improved when predicted packets whose lost reference ones are removed. This has created extra buffer space which has reduced losses in the intra-coded packets, hence better PSNR values. Moreover, due to increased buffer space, losses due to excessive delay and in the still image are minimised. This suggests that, when transferring bursty streams such as video with long-term bursts such as still images, the video quality can be improved by selectively discarding redundant packets, and at the same time freeing resources for other traffic.

The quality of the video is also assessed subjectively using 10 subjects. As predicted, most subjects rated the video with predicted packets discarded as 'better' than without discards, even though temporal rate was sometimes low. These results show that the policy used yields acceptable quality to the end-user, and objective and subjective assessments correlate.

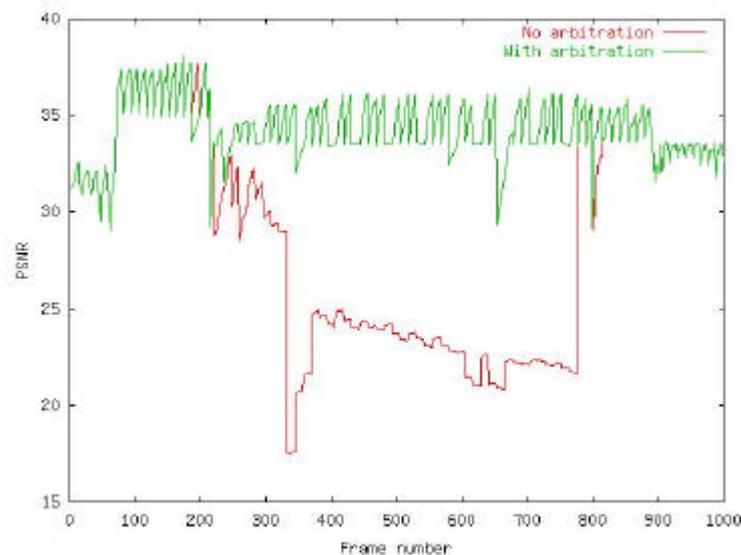


Figure 2. Video PSNR with and without arbitration.

5. CONCLUSIONS

From these experiments, it is concluded that: (i) For a fixed buffer size there is an upper bound to the delay, but at the expense of increased packet loss. This idea can be employed to selectively discard packets that exceed their maximum delay limit, therefore creating more space in the buffer for other streams. (ii) In the presence of a long-term burst such as a still image, significant degradation in the accompanying video stream is observed. If Iframes are lost but predictive frames survive, an objectively offensive reconstruction is produced where the predictions are based on erroneous milestones. The alternative of compromising the temporal rate by discarding predictive packets that have no associated I-frame is presented, and have shown to produce better quality as rated by users, compared to when predicted packets are transmitted without their references.

As a general note, it is important to consider both application and network level QoS metrics when determining the end-user's QoE. Future research is developing QoE metric rules and look-up tables for various application and network level arbitration policies.

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ROBUST STEGANOGRAPHY USING SELF-SYNCHRONIZING CODES

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ABSTRACT

Steganography is the art of hiding messages within some cover media. The word “steganography” derives from Greek, and literally means “covered writing”. Messages can be hidden in any media. Typical media include digital images, sound, and video. Unfortunately, the hidden message is not resistant to media operations. For example, cropping an image that has a hidden message can result in corrupting the entire message beyond recognition. This paper proposes a scheme that permits hidden messages to withstand some simple media operations.

KEYWORDS

Steganography, watermarks, LSB insertion, self-synchronizing codes, T-codes.

1. INTRODUCTION

A Steganography is an ancient art of hiding messages in some cover media so that it is not easy to spot that such messages are hidden in the media [Artz 2001, Johnson and Jajodia 1998]. In modern steganography, the media is typically an image, sound, or a video file. Figure 1 illustrates a typical steganography system.

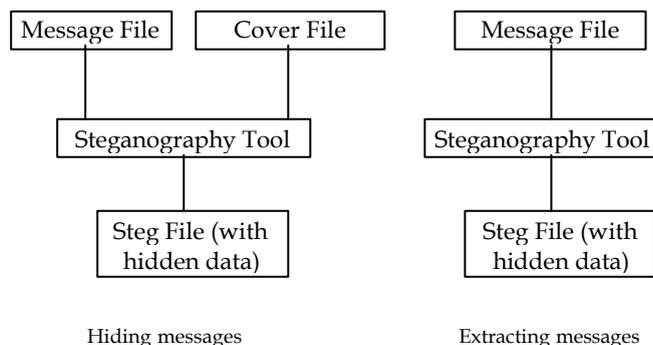


Figure 1. A steganography system

In LSB steganography, the least significant bits of the cover media's digital data are used to conceal the message [Johnson and Jajodia 1998]. Consider an 8-bit grayscale bitmap image where each pixel is stored as a byte representing a grayscale value. LSB steganography changes the last bit of each of the data bytes to reflect the message that needs to be hidden. Suppose the first eight pixels of the original image have the following grayscale values: 11010010 01001010 10010111 10001100 00010101 01010111 00100110 01000011. If we were to hide the letter A whose binary value is 10000011, we would change the first eight pixels to have the following new grayscale values: 11010011 01001010 10010110 10001100 00010100 01010110 00100110 01000011. The change in the image will be hardly noticeable to the human eye. See

Figure 2 that shows a cover image and a steg image (with the message “hello world” embedded); there is no visible difference between the two images.

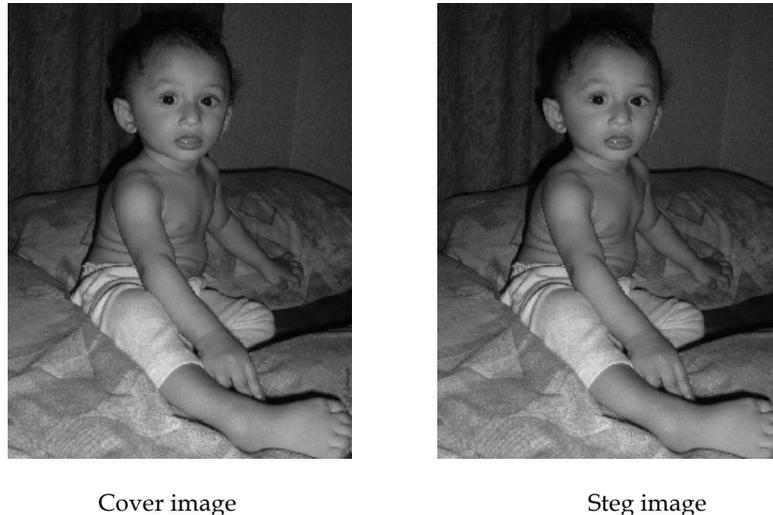


Figure 2. A cover image and the result of embedding a message

LSB steganography is easy to implement, but it is vulnerable to almost all media transformations. For example, cropping an image that has a hidden message can result in losing the entire message. There are other algorithms, transformations, and masking and filtering techniques one could use for hiding messages that are less vulnerable to media transformations [Johnson and Jajodia 1998]. Yet, depending on the size of the hidden message and depending on the media transformation, the possibility of losing the message under media transformation always exists.

Consider a hidden message ABC, which is 10000011 10000100 10000101 in binary. Assume that a crop operation on the image file resulted in losing the first two bits. In this case, we have lost the character A, but the characters B and C are intact. Still, since we do not know about the bit losses, we may incorrectly end up with a wrong grouping of bits: 00001110 00010010 000101. This will result in a totally corrupt message. The solution to this is to introduce synchronization characters in the message stream. Losing bits within two synchronization markers will mean losing only that part of the message. There is, however, a considerable overhead in using synchronization characters. Another solution is to use self-synchronizing code sets [Freiling 2003] to encode the message. This, as we will see, has little overhead.

The rest of this paper is organized as follows. Section 2 introduces T-codes [Titchener 1996], a self-synchronizing variable length code set. Section 3 proposes a steganography system using T-codes. The final section concludes with a summary.

2. T-CODES

T-code is a subset of all possible Huffman code sets [Titchener 1996]. T-codes can therefore be used for compression. In addition, T-codes are self-synchronizing, so if some bits are lost in a T-code encoded stream, the decoder will regain synchronization automatically.

The construction of T-Codes is done via a recursive copy-and-prepend process called T-augmentation. Let us build a T-code set to understand the process. A simple T-code set consists of the alphabets. With a binary alphabet, this is $S = \{0, 1\}$. We then remove one of the elements of the set and use it as a prefix to extend the initial set so that we get more codes. In this example, let us use the first element 0 as the prefix. The new code set therefore is $S_{(0)} = \{1, \underline{00}, \underline{01}\}$. For the next level, if we use 1 as the prefix, we get the set $S_{(0,1)} = \{00, 01, \underline{11}, 100, \underline{101}\}$; and if we use 01 as the prefix, we would get the set $S_{(0,01)} = \{1, 00, \underline{011}, \underline{0100}, 0101\}$. Short code words make better prefixes, for they result in shorter codes in the resulting code set.

The total number of elements in the T-code set at T-augmentation level n is $2^n + 1$. This property allows us to find out the T-augmentation levels required for encoding m symbols.

2.1 Self-Synchronization

T-codes self-synchronize during decoding, so if some bits are lost in a T-code encoded stream, the decoder will regain synchronization automatically. Let us illustrate this through an example.

Consider the message *helloworld!* that contains 8 different characters {h, e, l, o, w, r, d, !} with frequencies {1, 1, 3, 2, 1, 1, 1, 1} respectively. Encoding this message requires constructing a T-code set with T-augmentation level 3. Using short codes as prefixes at each T-augmentation level, we arrive at the T-code set $S_{(0,1,00)} = \{01, 11, 100, 101, 0000, 0001, 00100, 00101\}$. Assigning short codes to those characters with high frequencies, we get the following dictionary:

Character	h	e	l	o	w	r	d	!
Code	100	101	01	11	0000	0001	00100	00101

With this dictionary, the string *helloworld!* will be encoded as 100.101.01.01.11.0000.11.0001.01.00100.00101.

Typical errors one may encounter while decoding a bit stream are bit losses, inversions, and additions. Let us examine how the bit stream representing *helloworld!* will be decoded in each of these cases..

Bit loss. Assume that the two underlined bits in 100.101.01.01.11.0000.11.0001.01.00100.00101 are missing. The bit stream will then be decoded as 100.101.01.01.100.01.100.01.01.00100.00101, or *hellhlld!*, where underlining shows the errors.

Bit inversion. Assume that the two underlined bits have been inverted in the bit stream 100.101.01.01.11.0001.10.0001.01.00100.00101. The bit stream will then be decoded as 100.101.01.01.11.0001.100.00101.00100.00101, or *hellorhd!*, where the underlining shows the errors.

Bit addition. Assume that the two underlined bits had been added to the bit stream 100.11101.01.01.11.0000.11.0001.01.00100.00101. The bit stream will then be decoded as 100.11.101.01.01.11.0000.11.0001.01.00100.00101, or *hllelloworld!*, where the underlining shows the errors.

Note that if the message is large enough and the bit errors are small enough, a considerable portion of the message will be correctly decoded.

3. STEGANOGRAPHY USING T-CODES

We propose the use of T-codes to encode messages prior to embedding the messages in the cover media. The extracted messages need to be decoded before use. Figure 3 illustrates the extended steganography system that uses a T-code encoder and decoder. This system will be more tolerant (than the basic system of Figure 1) to media transformations that result in some bit losses or inversions in the hidden message.

In order for the message to survive operations such as cropping, we use start and end delimiters for every message, and where possible the message is embedded multiple times. Parts of the extracted messages may be corrupt, but a best match will give us the full message in most cases. Even if the full message cannot be obtained, the partial message can give some meaningful indication of the original message.

If we use an LSB steganography, rotations and flipping of the media can corrupt the message. The system can be made resistant to these operations with some slight modification. For instance, rotating or flipping of an image results in changing the origin and scan directions; when extracting the message, we therefore check all the possible combinations of the origin and scan directions.

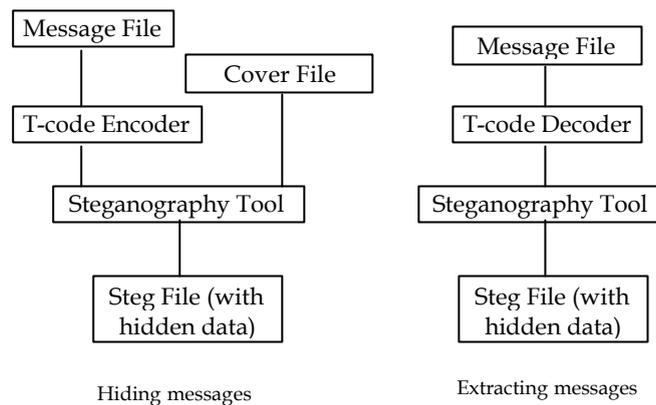


Figure 3. A steganography system using T-codes

Note that the dictionary for the codes needs to be either fixed or embedded along with the message. The system we implemented only deals with plain text messages, so it uses a fixed external dictionary.

4. CONCLUSION

This paper presented an extension to a simple steganography system so that the hidden messages tolerate some of the media operations to some extent. The central idea here is to use T-codes, a self-synchronizing variable-length code set, to encode messages prior to embedding the messages in the media.

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CONTENT-BASED INTERACTIVE MULTIMEDIA SYSTEMS FOR RHEOLOGICAL SCIENCE

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ABSTRACT

Multimedia environments are utilised to construct presentation systems, introducing some advanced interactive features. Aspects of this research involve the organisation, presentation and interaction of complex industrial case-study data, arising from Computational Fluid Dynamic simulations and experimental trials (multimedia streams and static instances). Also, the development of rheological courseware is addressed. Modular interface constructs are employed to facilitate rapid and sound system-development. Object-oriented practices are deployed, based on underlying graph structures. The multimedia nature of the implementation promotes interaction with synchronised animated flow-visualisation data and enhances understanding of the underlying data. The resulting implementation can be ported to a variety of computer-platforms, or streamed over Internet connections without compromise in quality or interactivity. Such flexibility of distribution renders these systems ideal for publishing scientific content between virtual research communities and industrialists, making e-Learning and e-Research widely accessible in a media-rich interactive form. It is shown how distinct individual multimedia implementations are constructed and utilised, through a range of industrially-based and educational case-studies. In addition, the semantic linking of content is discussed. Multimedia systems may be linked externally, locally (single computer), or via Internet, aiding presentation and detailed data interrogation.

KEYWORDS

Multimedia, interaction-graphs, CFD, experimentation, industrial applications

1. INTRODUCTION

Four distinct multimedia systems (MMS) are chosen (Contraction-Flows CF [2], Dough-Kneading DK [6], History of Rheology [1] and Non-Newtonian Fluids [3]), to demonstrate the power of multimedia environments (MME) for research/industrial and educational-content distribution across virtual scientific communities. All four systems are developed under a single programming environment (Macromedia Director 8.5, Macintosh), which supports multimedia objects, scripting, remote data-access, and stream-synchronisation. Different data-oriented interfaces, novel to each case-study, enable customised data-interaction that reflects data-properties and characteristics. The underlying graph-structure mirrors the interface-organisation and data-connectivity. In this manner, distinct organisation is demonstrated across each implementation. Table 1 summarises the type and volume of information contained within each case-study, and is ordered (top-to-bottom) in terms of implementation-complexity (directly relating to data-complexity).

Common delivery modes/methods for MMS are video, CD and Internet media. Integrated implementations are not easy to achieve using propriety software, such as Microsoft PowerPoint (PPT). Typical reasons for this may be attributed to the large data quantities involved, the inability to detect data-duplication, and the default linear-access of proprietary software. Partitioning of the data, into separate thematic entities is the favoured resolution, commonly adopted within such conventional implementations.

In the present study, a novel feature is the use of Multi-menus [3] to enable navigation between related data instances within each MMS. These menus are a concrete realisation of the underlying graph structure (representing sub-graphs). They facilitate data access, interrogation, and interpretation through direct interaction. More-complicated systems include navigational aids, one being the pre-determined mode of

interaction, termed “cruise-control” (cc), a chosen route often with a Voiceover (VO) stream. This renders the MMS meaningful to audiences of wide knowledge levels, including non-experts. It engenders flexibility of use, where a single MMS may meet the needs of many distinct presentations. A further advantage is that within any presentation instance, one may digress at will, and return to the cc-tour, through active frame links. Navigation and system-functionality are specified using the Scientific Interactive Multimedia Model (SIMM) [3]. Multi-level linking and interaction, may be introduced through these graph-based “multi-menu” constructs. This permits direct interfacing with underlying content-structures, illustrated through typical examples involving parameter-adjustment (DK-MMS, CF-MMS). Higher-order linking and interaction across MMS-sections is facilitated via direct frame-linking. Content-connectivity over various abstraction levels, and particularly linking between external MMS, has been addressed within our earlier work [4]. There, we dealt with the construction of super/master-MMS structures. Such structures permit disparate content to be linked effectively over various media (CD/Internet), whilst system-functionality is preserved.

Table 1. MMS classification and complexity

Name of MMS	Industrial	Data-instances	Delivery media
CF-MMS	Yes	O(150) video streams, O(150) slides	Internet/CD
DK-MMS	Yes	O(50) video streams, O(100) slides	Internet/CD
History of Rheology	No	O(10) video / animated streams, O(70) slides	Internet/CD/DVD/Tape
Non-Newtonian Fluids	No	4 main streams	Internet/CD/DVD/Tape

2. INTERACTION WITH THE DATA

Each case-study has different requirements with respect to interaction and navigation. This is determined by the data-relationships and the target-audience. For straightforward case-studies, advanced navigation is not essential, so therefore system design is based on sequential story-telling, and an ordered linear-path through the content is normally adequate. If a higher-level of interaction is required, then additional links may be programmed into an appendix, for example, or other related sections within the MMS.

2.1 Educational MMS: “Non-Newtonian Fluids” and “History of Rheology”

The “Non-Newtonian Fluids” MMS¹ is split into four main sections: “Introduction to Non-Newtonian Fluids”; “Rheometry”; “Viscometry”; and “Other Non-Newtonian Effects” (Figure 1). Each of these sections contains a number of sub-sections, all depicted with a characteristic icon within the multimedia menu. Here, interaction can be represented via a directional, fully-connected, five-node graph. Such a basic structure is considered sufficient to meet the needs of this educational presentation.

Passing from one node to the next is a fully-automated procedure. The MMS, in play-mode, runs without further user-communication, once a stream has initially been selected. At the same time linking to other sections is permitted. A pre-rendered, single-clip approach is adopted in this case, as the content is rich in audio/visual material and requires precise timing in presentation-mode. Such a consideration is difficult to achieve precisely within a MME. This level of timing accuracy (to one twenty-fifth of a second) may be achieved when high-end computers are employed. Nevertheless, here, the main concern is delivery of the MMS over a variety of platforms and to various hardware specifications.

Passing next to a slightly more demanding case-study, allows us to demonstrate how MMEs handle high content-volume with ease. In terms of interaction, the History of Rheology MMS, uses a similar organisation to the foregoing, with a main-menu of six options: “Introduction”; “Some Highlights”; “Controversies”; “Friends and Disputes”; “International Meetings” and “Lessons from History” (Figure 2). This approach is frame-based, originating from a lecture presentation, constructed around static slides [1]. The underlying VO is inserted within each slide and the user can navigate forwards, backwards, or via access to the main menu. This organisation enables editing, in modular-fashion per-slide. Transition and sprite movement are implemented at the MME level. This is a computationally intensive process at runtime. Therefore, only a limited number of such features, are incorporated per multimedia frame. Onemore, presentation mode is

¹ Distributed by Institute of Non-Newtonian Fluid Mechanics (INNF), University of Wales, <http://innfm.swan.ac.uk/>

automated, and the MME is programmed to detect VO termination, so as to proceed to the next frame directly. The associated graph structure commences from a cyclic-form graph, and is extended with links, to and from the main menu-node.

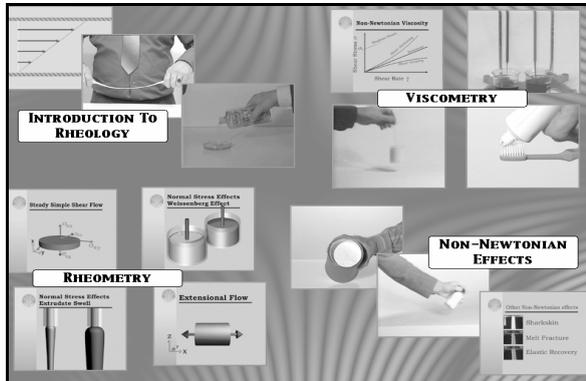


Figure 1. Non-Newtonian Fluids MMS, Main Menu.



Figure 2. History of Rheology MMS, Main Menu.

2.2 “Dough-Kneading DK-MMS”

Moving towards non-linear content-organisation, one faces complex interaction, illustrated via an industrially-based case-study. Simulation and experimental data, are taken comparatively and evaluated using the MMS. On-demand interaction is the default mode. The main-menu provides a number of features, including links to a study overview, animated introductory clip, access to viscous and viscoelastic sections and “cruise-control” mode buttons. Voiceover is included per slide throughout the MMS (bottom-left, slider-bar, media-controller). An initial frame displays images relevant to the industrial process, including a model mixer, two states of kneading, and the final product (Figure 4). The underlying structure used within this case-study is a multiply-connected graph. Commencing with a tree, and multiple geometry options at the top node, lower-level additional links are added across branches, that relate experimental and simulation results. In addition, this structure includes sub-graphs of various types: fully-connected (dense) for slide-sorters, or of cyclic-form for cruise-control. Data organisation is optimised for the current case-study, allowing hierarchical access.

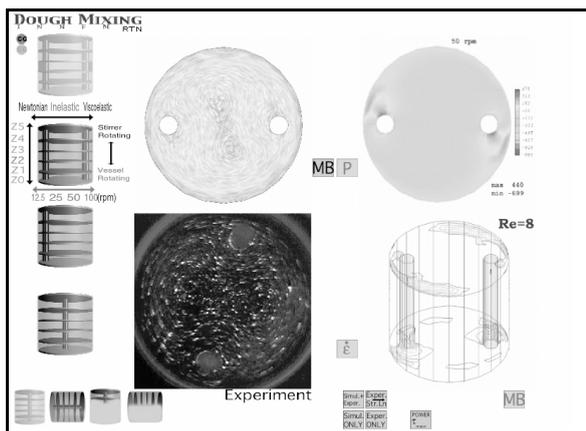


Figure 3. Four video through speed, 2D and 3D.

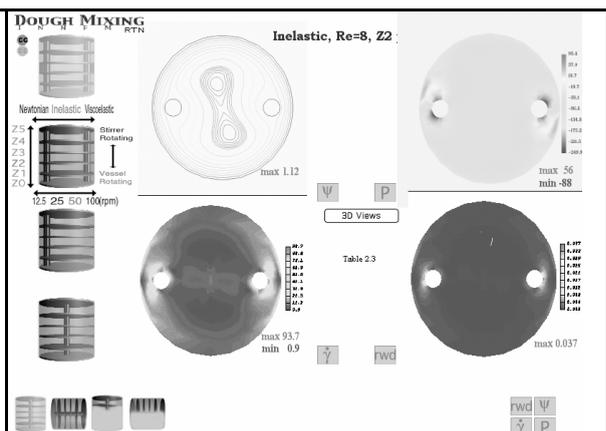


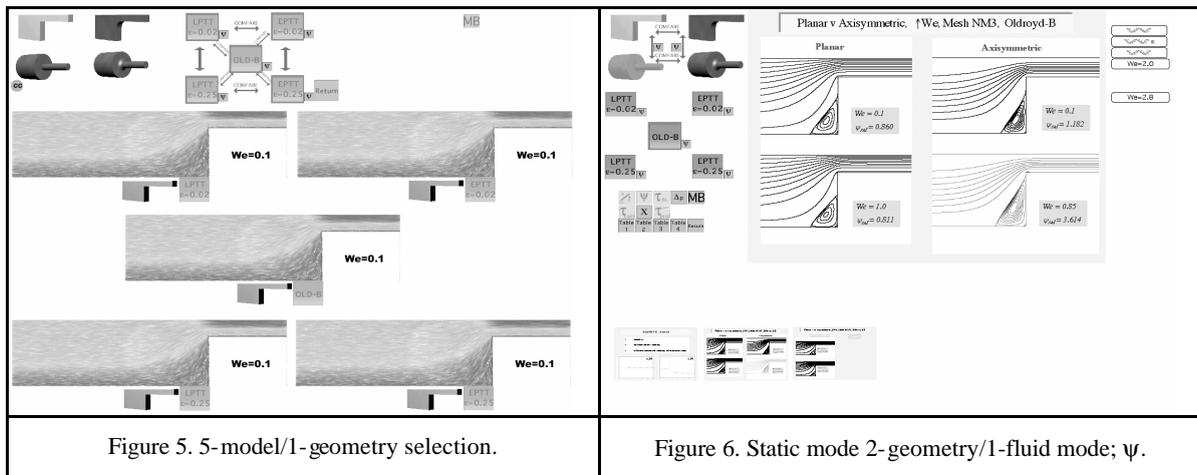
Figure 4. Four static 2D fields, Z2, 50 rpm.

The multi-menu utilised is unique to this case study. It tracks the geometric steps in modelling (Figures 3, 4). Starting from bottom-left, and rising upwards, increases the modelling complexity in stirrer positioning and number: single-stirrer concentric; single-stirrer eccentric; two-stirrers eccentric; and two-stirrers with

baffles. Each multi-menu offers four basic aspects of comparison: below, through speed; left, through vessel depth; top, through material type; right, through rotation-type. Arrows, for each case, cover full ranges. Horizontal-menus (lower-left of screen-shot), enable selection of mixer orientation for fully-filled or part-filled cases, relating to industrial settings for bread (vertical) and biscuit (horizontal) mixing. When a particular stirrer-complexity setting is selected, the multi-menu displays satellite iconised options that relate to information presented on screen. The same can be used to switch between settings. Red indicates current selection, black possible selection, and dimmed unavailable options. The multi-menu provides the “variable priority” feature, that ensures the MMS retains the currently-selected option. This aids visual comparison upon change in setting. A characteristic interactive example would be a geometry switch between two-stirrers to one-stirrer eccentric instances, respectively. The information visualised in Figure 3 is detailed in animated field variables (2D motion-blur, top-left; pressure, top-right; experimental laser flow visualisation, bottom-left; extension-rate, bottom-right). Such a mode of advanced interaction enables effortless data evaluation, through visual comparison and field adjustment. The static variable fields displayed are labelled, both on-screen and by palette reference (bottom-right of screen). Views in 3D of this data may be accessed through the corresponding button-icon. The multimedia interface provides synchronisation options for animations. This enables tight-synchronisation and concurrent presentation of multiple data streams.

2.3 “Contraction Flows CF-MMS”

The Contraction Flow case-study [2] is intricate, in terms of interaction and underlying graph structure. An investigation tool-set emerges, based on simulation data alone. Reference is made at the entry window, to a historical review sub-section (slide-sorter mode), and an animated short introductory sequence (flyer). Two connected, dual-graph menus are presented within the main-menu. One offers choice over model-fluid type, the other over geometry-type. Both aspects may be found in many common industrial processes. In contrast to Dough-Kneading, base-data units are uniform of type (animated Motion-blur and static plots).



Two modes of presentation style are adopted and intermixed, dynamic and static, for which a number of data-combinations are considered. Possible combinations include: all five fluids for any particular geometry (Figure 5, “All-Fluids” icon); all four geometries for any of the five fluids (“All-Geometries” icon); any valid two-fluid combination (arrows); and any single-fluid for a single-geometry (fluid/model icons). For the latter instance, the space below the Motion-blur image (animation clip) is utilised to display related static information. These options are all available from the multi-menu instances shown in Figures 5 and 6. Interface instructions, to aid user-selection, are provided below each menu. At lower system-levels, rheology and other static results are accessible through iconised menus, which adjust dynamically, according to geometry and model selection. This is a two-stage process, where, if a more detailed view of static data is required, further slide-icon selection actions a zoomed, slide-sorter mode, departing from the animation-view. Selection is indicated by red colour and/or a bounding-box, about each slide icon.

The programming approach to construct the multi-menu structure is modular. Each group of options above has been programmed separately, and superimposed onto the menu. This approach enables component re-use. System development is simplified when object-oriented techniques are employed. For example, each multi-menu component, when copied, preserves its links, icons and attributes. Icons can be adjusted globally, with a single replacement edit. Links can be re-programmed using general conditional statements, identifying where and when to inter-link the MMS, as certain states are encountered (justified by user-selection and current-data). Precise animation timing enables simultaneous display of a variety of non-uniformly constructed animation clips. Under proprietary software, this would require rendering data-streams into a single, combined stream to ensure precise timing.

Motion-blur (MB) [5] visualisation is used to represent dynamic flow states, in a space-filling manner, covering a range of elasticity settings (Weissenberg number, We). Use of MB gives an animated graphic-feel for fluid flow, but may not provide precise localised flow-representation. The simultaneous availability of streamline data (Figure 6) addresses this shortcoming, accessed through menu selection, via the ψ option-button, within top-level model- or geometry -menus (graphs). Three images are displayed bottom-screen, each representing a streamline plot, adopted at a particular We -setting. This context combines a slide-sorter mode (as found in PPT edit-mode), which utilises selectable iconised slides, here over a brief slide-set. Upon selection, the corresponding slide is zoomed, centre-screen. Deselection is actioned by navigational progression, either within the slide-sorter, or via alternative multi-menu options.

3. MMS CROSS-LINKING AND DELIVERY

To this point, frame-linking has been performed as standard, using the underlying graph structure to specify data-relationships. The example of the Contraction-Flow static presentation, accessible from the main-menu of the case-study, demonstrates how different presentation-styles can be merged. At a higher organisational level, there is clearly merit in linking two or more individual MMS together. In this manner, content with relevant context may be linked directly to a specific frame of interest, even for distributed MMS [3]. This may arise when related content is to be accessed, and to avoid duplication, when copying content from one MMS to another. Linking may be implemented at a higher level (MMS to MMS), ensuring data merges, without replication and may be achieved in a number of different ways. One approach is to merge presentations together under the same organisation environment. This is a time-consuming process, as each MMS must be individually merged within a single super-MMS file-structure. Practical impediments may be introduced in terms of file-space, and development time and effort, required to complete this procedure. Even after completion, the complexity of the new super-MMS may require a high-end computer to handle the vast amount of data involved. Utilisation of this technique is advisable only for small multimedia entities, to avoid system-overload.

An alternative strategy is to individually access the required MME, using either hyperlinks programmed in HTML, or batch files and shortcuts within the operating system. This is an efficient approach, but one notwithstanding its drawbacks. The MMS is accessed at the top-level and further user-interaction is required to reach particular items of data sought. This method is appropriate when a series of MMS are to be accessed sequentially.

A third method involves MMS-linking internally, employing a scripting language provided by the MME. MMS-connectivity is similar to HTML-type linking, with the added advantage that direct links can be programmed to specific frames within the target MMS. In this case, appropriate links, and a frame-based HTML structure would be programmed (where the menu-frame consists of an MMS designed to call other MMS, on-demand). These links would appear in other frames and the design integrated under a common interface, see <http://innfm.swan.ac.uk> for example with two frames. Here, the left-frame (menu) reacts to user-choice and queries the underlying "Microsoft Access" database of multimedia objects, to retrieve data-fields or links to data, that are displayed, centre-frame. The data of the frame are automatically compressed and transferred, using SHOCKWAVE streaming technology, reducing download time still further. One may export Java versions and set the image-compression to JPEG (trading quality for faster transfer rates), or to the maximum possible compression without loss of quality. JPEG is useful when data access is by mobile devices, with limited visual capability and bandwidth.

The power of MM implementation is demonstrated when various delivery modes (through a range of operating systems) are demanded within a limited time-frame. Delivery must be consistent across various platforms, and utilise stream-compression to tackle content-delivery efficiently, transcending network bottlenecks [3]. Our favoured option, is to generate a downloadable client-application, to communicate with the server, and access the underlying multimedia-database. As data-streams are requested from the server, they are transferred automatically, *on-demand*, in compressed format. Data instances, pre-delivered, may be re-used, providing a significant upgrade in speed and system-response. Again, SHOCKWAVE streaming technology is utilised to fulfil the above data-transfer and component re-use requirements. Certain data-instances may be pre-loaded, to reduce response times still further; in other instances, the same data may be unloaded (on-demand) to recover memory resource. Some characteristic examples of such an implementation, are available over the Internet (<http://innfm.swan.ac.uk>). Such examples utilise the database to dynamically request the content for each case-study.

4. CONCLUSIONS

A data-presentation and multimedia development environment has been utilised to construct highly-interactive content-delivery mechanisms. Intelligent interaction and interrogation of the data is key. This has been proposed and implemented at different levels: within a single presentation environment, and across multiple instances. Desirable end-system characteristics include stream-compression, advanced-interaction, multi-platform support and multiple media delivery. A factor restricting the use of MME for the development of interactive multimedia presentations is the programmability aspects required to build a functional end-system. To aid in this direction, object-oriented techniques have been utilised to build component-based interactive (multi) menus. These techniques once invoked, may be re-used, reducing programming effort. For example, appealing aspects of these MMS include negation of data-duplication, and their design to handle large content volume. Overall, we believe that the advantages outweigh the disadvantages, particularly as the volume of content increases in size.

Furthermore, a major underlying theme throughout has been the development of graphs to invoke interaction and guarantee link-integrity. The application of these technologies has been described, having introduced some of the MMS-capabilities, in terms of content-management, interaction, navigation and deployment over various media. The end-systems have actively been deployed in over fifty instances worldwide [3], including conferences, industrial/academic presentations, and courses on rheology, provoking both commendation and commercial interest. On-line delivery is supported actively, often allowing MMS-update to be viewed directly over Internet communication channels. Beyond intrinsic academic interest, and active use of such MMS in scientific research, ingenuity alone will restrict the future use of these technologies, to promote research and learning within the e-Society.

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WEB-SERVICES FOR E-GOVERNMENT – A MARRIAGE FOR INTEROPERABILITY

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ABSTRACT

eGovernment is an exciting area for applying Information and Communication Technologies (ICT). ICT can improve the efficiency and effectiveness in the provision and delivery of citizen services. A critical issue for the eGovernment implementation is the interoperation problem among heterogeneous legacy government systems. In this aspect, the universal system interoperability supported by the XML-based webservices technologies can be an useful components in a holistic eGovernment infrastructure. In this short paper, we review the specific requirements for the webservices infrastructure in the government domain. Based on this, a number of webservices models that are appropriate for the eGovernment infrastructure are presented.

KEYWORDS

eGovernment, webservices, XML, component

1. INTRODUCTION

A glance at the economic statistics of a modern country reveals that a substantial proportion of her GDP is being spent to provide her government services. As a result, it is not surprising that a government is always looking for ways to make better use of the public resource [Gore 1993]. To this end, information technologies that have been successful in improving the efficiency and effectiveness of the private sector have long been applied in governments. In many modern countries, this has resulted in digital governments with a collection of heterogeneous government information systems which exchange a high volume of information with the private sector (citizens) [Schorr and Stolfo 1997].

The recent rapid development of eCommerce has demonstrated how the advancement in data communication technology (in particular the explosion of Internet connections) can enable business transactions to be conducted electronically and in a more efficient way. The success of the eCommerce projects naturally lead to expectations to apply the same technology to government systems. eGovernment projects may be viewed as the answers to meet these expectations.

A critical issue for the eGovernment projects is the interoperability problem between heterogeneous legacy government systems [Arcieri et al 2001]. To address the problem we need effective tools and methodologies to provide easy and seamless connections between systems that were developed by different people, running in different environments and under different software/hardware platforms. Although there have been a whole family of distributed computing solutions developed by different software vendors and standard bodies, none has received sufficient acceptance to ensure that eGovernment systems building upon which can ensure universal interoperability.

Thanks to the wide acceptance of the webservices interoperability standards, at last we now have the core technologies to achieve universal software interoperability on the Internet. As a tool to solve the interoperability problem, it is not difficult to see that the Web-Services technologies can serve as a useful component in eGovernment.

Since the expectations on and the nature of the organisations in the public sector and private sector are different [Traummuller and Wimmer 2000], there are different requirements on eGovernment projects as compared with the eCommerce projects. As such, application of webservices in the eGovernment environment should merit a study on its own. Nevertheless, to the best of our knowledge, the application of the webservices technologies in an eGovernment context is a subject still largely untouched. It is thus the objective of this short paper to provide an overview of how we can apply the webservices technologies in the eGovernment infrastructure.

2. WHAT IS WEB-SERVICE?

The Web-Services technologies provide a suite of XML based interoperability standards for software deployed on the Internet [Graham et al 2001]. The core of these technologies include the following:

- Simple Object Access Protocol (SOAP) is an XML-based protocol for exchanging structured information in a decentralized, distributed environment. SOAP provides a “http-friendly” protocol for systems to talk over the Internet, to request and to serve for Web-Services;
- Web Service Description Language (WSDL) is an XML format for describing network services. WSDL allows the client to understand how to invoke a Web-Service;
- Universal Description, Discovery, and Integration (UDDI) is a Web-Services based standard for registration and search of network services. UDDI provides a Web-Services discovery platform on the Internet.

The non-proprietary and XML-centric natures of the Web-Services technologies make them truly platform and language neutral. Each vendor can have a different Web-Service architecture, which is the most appropriate to its proprietary platform, while adhering to the same XML standards to facilitate successful interoperation with any service consumers sticking to the same standards. This enables each vendor to incorporate Web-Services support seamlessly in its platform products.

3. WEB-SERVICE REQUIREMENTS FOR E-GOVERNMENT

Government is always expected to be “more efficient” and this can be achieved with application of the Information and Communication Technologies. Within a government body, Web-Services can be implemented to facilitate intra-department process reengineering and back-office integration to eliminate the manual transmittal of data between system components. The large number of government processes requiring collaboration among different departments and the duplication of citizen data among the legacy database systems [Virili 2001], however also presents opportunities for streamlining and process reengineering beyond the boundary of a single department. This is made possible with the implementation of G2G Web-Services.

The expectation of a “citizen-centric” government calls for the delivery of most government services over the Internet, which provides around the clock access to the eGovernment in any location with an Internet connection. In particular, government portals which integrate all the government services in a manner based on need and function and not on department and agency are required to provide access points on the web to the services. Moreover, as shown in the access patterns in eCommerce services, there will sooner or later be expectations to access the eGovernment over electronic devices like smart mobile phones and PDAs. Finally, a truly citizen-centric government needs to achieve a “joined-up government” structure in which the citizens requiring government services does not need to care about which department does what. All of these require additional, and sometimes non-trivial, connections to or between the legacy government services and implementation of Web-Services can significantly simplify the integration efforts to build these connections.

On the other hand, there are security expectations on the eGovernment systems. The expectation for confidentiality requires protection of the government resources from unauthorised access. The establishment of an appropriate access policy for the eGovernment Web-Services implemented can be a tricky exercise [Wimmer and Bredow 2001], however, due to the inherent conflicts between the need to protect the citizens’ data privacy and the expectation to achieve eGovernment service personalisation and joined-up government.

To address the issue, we need to have appropriate models for user identification and authentication to cater for the different preference of individual citizens. The legal framework can also play an important role to resolve the conflicts.

Availability of the government services has recently been catching increasing attention, as people start thinking about the possible fatal consequence of a breakdown of the critical public services during crisis situations. In terms of eGovernment access, the expectation will be that a wider range of channels should be supported to provide mutual backup of access. Connections of the legacy government services over wireless communication channels and through alternative devices such as the smart mobile phones and PDAs are required to meet the expectation.

Lastly, modern governments have economic policies to safeguard the economic well-being of society and promotion of IT adoption is pursued by most governments as one of the economic goals. In this aspect, the government can have at least two roles to play with the application of Web-Services technologies. Firstly, as the government is a provider of large number of business services, efficient delivery of the eGovernment functions in the form of Web-Services can greatly enhance the eCommerce infrastructure. Secondly, being a major player in the economy, the government can act as a leader in adoption of the technologies, and set good examples on the application of Web-Services technologies to solve software interoperation problems.

4. AN E-GOVERNMENT WEBSERVICES FRAMEWORK

With the requirements in mind, we will provide the outline of a framework to apply the webservices technologies in the government domain. Such a framework should provide the answers to the following questions:

- what functions should be exposed as eGovernment webservices?
- what is the right access means to each eGovernment webservice?
- what is the right access policy for each eGovernment webservice and the appropriate security mechanism to implement it?

In addition, the framework should also address the transactional requirement of eGovernment webservices. Such a framework can be presented with a number of models:

- the system component model;
- the system access model;
- the security model;
- the transaction model.

The system component model describes the individual eGovernment webservice: to build an eGovernment infrastructure, we need to turn the legacy government applications into service components that are to be deployed as webservices and a reasonable approach is to extract the existing business functions provided in the legacy systems. In the government context we will have internal services provided within a government body, inter-department services provided across government departments and public services provided to the citizens.

The system access model covers how the webservices will be accessed and addresses both the network environment and the way the service is exposed to the end user (direct or indirect via a consumer system). While the internal and inter-department webservices will likely to be accessed within the internal government network like the department LAN or the government intranet, the bulk of the services provided to the general public will be deployed over the Internet. This model is important since there will be different issues to tackle for eGovernment webservices deployed under different network environment. For example, for the more critical public webservices deployed over the Internet, the limitation of the current Internet in quality of service is an important consideration.

The security model addresses the protection against unauthorised access to the eGovernment webservices. There are two major components of the model: access right and authentication. For the access right, there are different access levels possible for the webservice consumer: no access, limited access and full access. In addition, in case the consumer is not the same as the end-user of the webservice, end-user authorised access right may also apply. To enforce the access policy, authentication is required to identify the consumer and sometimes the end-user of the webservice. There can be different needs including no authentication required (anonymous access), consumer authentication only and both consumer and end-user(s) authentication. The

challenge here is to provide an authentication mechanism that works without a direct connection between the webservice and the end-user, and to allow webservice personalisation without forcing the user to give up his/her anonymity.

The transaction model is to address the transactional nature of the integrated webservices. Specifically, we need a mechanism to ensure that the work done by the individual webservice components of a composite webservice will always complete in a consistent state. Due to the loose coupling nature and the potential long elapsed time, the traditional distributed transaction model is not well suited to webservices and it is preferable to address the requirement with an alternative model based on compensating operations [Korth et al 1990].

5. CONCLUSION

In this short paper, we have examined the key requirements of the eGovernment. Not surprisingly, most of these requirements call for a more integrated and well-connected government infrastructure which can now be achieved within a webservice eGovernment framework. We have also attempted to provide an outline of such framework with the four eGovernment webservices models. To summarise:

- Most of the problems faced by eGovernment are about integration and inter-connectivity;
- Webservices technologies, which is a tool for universal interoperability, should present as the solution to most eGovernment problems;
- We have provided the essential reference models for a webservice eGovernment framework to demonstrate how the webservices technologies can be applied in the government domain.

Looking forward, we firmly believe that the webservices technologies should have a key role to play in the eGovernment infrastructure. The right application of the technologies should be able to bring out a more efficient and citizen-central eGovernment that is better for the societies.

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THE VIENNA M-PARKING PROJECT

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ABSTRACT

One of the emerging areas of e-government is e-parking, or – as the service is accessible via mobile devices – m-parking. Up to now motorists pay for their parking tickets by cash, whereas the traffic wardens manually prepare the parking fines. However, thanks to recent technology evolution, the parking process is expected to change in the near future. Drivers will no longer toil at coins, instead they will use their mobile devices for booking virtual parking tickets. Similarly, traffic wardens will have no paper work, but will apply a PDA with network connection to check the validity of tickets and to print fines. In the present paper we give insight to the vision and solution for m-parking in the City of Vienna. The first part discusses the business case, the second part summarizes the features of the SMS-based realization, while the third part gives a technical overview of the implementation.

KEYWORDS

e-administration, e-governement, e-commerce, m-commerce, e-parking, SMS

1. INTRODUCTION

Today's public parking systems are characterized by two drawbacks: firstly by a lack of convenience from the driver's point of view and secondly by considerable administrative overhead in enforcement processes.

In most public urban parking areas, motorists need to buy parking tickets and attach them behind the windscreen. Parking tickets are distributed at points of sale like shops or slot machines. Thus, buying a parking ticket may be time consuming or just inconvenient. Moreover, outside hours of opening, parking tickets may be not available at all.

On the other hand, wardens enforce parking areas by checking parking cars for valid tickets. On illegally parking cars they manually create parking fines. While the parking fine goes to the windscreen, a carbon copy goes to the enforcement back-office and must be scanned for further electronic processing - an inefficient and error-prone procedure.

The m-parking system has been designed to resolve both problems, i.e. to make parking more convenient to the driver and thus increasing his willingness to pay, and to improve the enforcement process, resulting in cost reductions in the local government.

In this paper we show, that m-parking meets both requirements. The first section gives an overview of the business case. The second section introduces to the features and scenarios of the m-parking system, while section three gives insight into the technical solution.

2. M-PARKING IN VIENNA

2.1 Business Case

In this section we give a general description of m-parking and outline the benefits of the system.

2.1.1 Concept

m-parking (www.m-parking.at) allows motorists in the City of Vienna to pay for parking using their mobile phones. Customers pay for parking by sending an SMS message including their intended parking duration. The system places the ticket on debit of a virtual account identified by the originating mobile number. The customers pay into their virtual accounts on debit of their phone bills or credit cards. Wardens enforce payment by checking parking cars for valid virtual tickets and creating fines on an online handheld device.

2.1.2 Benefits

The key advantages of m-parking are

- m-parking eliminates the need for cash based parking meters or parking ticket points of sale
- m-parking increases revenue collection for parking
- m-parking offers a viable and working m-commerce opportunity for operators, which has been proven in operation and can provide arguments for loyalty.
- m-parking is easy to use and customer friendly.

m-parking increases revenue and reduces costs. The reasons are

- many drivers are too lazy to go to their car and extend the validity of their parking ticket. When parking with a mobile ticket, those drivers are willing to pay for a new ticket because of convenience. We suppose, that within the volume of mobile parking tickets, the sales will increase by 5 percent.
- m-parking enhances the enforcement processes by eliminating the media rupture from paper to electronic systems. This yields revenue increase and cost reductions (see Table 1).
- Credit card costs are less than costs in the points of sales.

2.2 Features and Scenarios

In this section we describe the ways in which users interact with the m-parking system. In operation, m parking involves three roles: the driver intending to park his car, the warden enforcing rules and fees of a local parking system, and the administrator representing the local government responsible for parking.

2.2.1 Driver

Being based on a virtual parking account, mparking requires the driver to open such an account by registering to the system. Moreover, prior to parking the driver must charge his account, i.e. the driver has to pay money into the account. When the driver books a virtual parking ticket, the respective fee is placed on debit of his parking account. Here are the processes in detail:

Registration: The driver registers to m-parking on a web interface, providing personal data like address, a favorite car number, and his mobile phone number. The system opens an empty account, generates a PIN, and sends this PIN via SMS to the driver. The driver responds via SMS to the mparking service access number, echoing the PIN. For security reasons, other functionality is blocked as long as the driver has not sent the correct PIN.

Charging: The driver requests to pay into the parking account by sending an SMS to the service access number providing the amount of parking hours and the PIN. The system checks back via SMS to the driver. If the driver confirms the transaction, the system increases the parking account on debit of the driver's phone bill. Alternatively, drivers may choose credit card payment on a web interface.

Parking: The driver requests a virtual parking ticket via SMS providing the intended parking duration. The system checks the balance and confirms the ticket via SMS to the driver. By default, the ticket is valid for the car number entered during registration. However, drivers can book tickets for arbitrary cars by

including the desired car number to the ticket request. Moreover, drivers may book tickets that do not become valid immediately but at some specified point of time in future.

Notification: For convenience the driver can let the system inform him on the approaching end of his ticket's validity. Moreover, he can actively request information on remaining parking duration and current balance via SMS.

Help: On syntactically incorrect requests, the system tries to figure out the drivers' intentions as far as possible, resulting in a context specific help message sent back to the driver.

2.2.2 Warden

Wardens use the m-parking system to check parking cars for valid virtual tickets and for creating fines.

Check: The warden requests the ticket information for a parking car entering the car number to a handheld device, that holds an online connection to the system. In case there is a valid ticket for a given car number, the system will also provide additional information like remaining duration.

Fine: On illegally parking cars the warden enters the data to the handheld device and scans the bar code from a parking fine form. This establishes a one-to-one mapping between the virtual fine stored in the system and the printed out parking fine fixed on the windscreen. Both the barcode scanner and the printer are integrated parts of the handheld device.

2.2.3 Administrator

The system offers a web interface for administrative tasks. Among others, these comprise

- Administration of wardens (as wardens require a login in order to connect to the system)
- Blacklist administration
- Administration of fines (including cancellation)
- Administration of drivers (however, drivers in general administrate themselves using the web interface)

As shown above, m-parking offers appropriate interfaces to all three roles in the parking process; to the driver, a user not specifically trained for using this system and hence requires simplicity and convenience, to the warden, as a professional in particular caring about efficiency and performance, and last not least to the administrator, providing a powerful means for controlling the system.

2.3 Technical Concepts

The aim of this section is to discuss the implementation-related issues of the m-parking application. Within the limited scope of this paper there is no possibility to give an in-depth picture of the solution. Instead we present a bird's eye view and the realization of some special requirements.

2.3.1 Overview of the system's structure

Figure 1 shows the structure of the system.

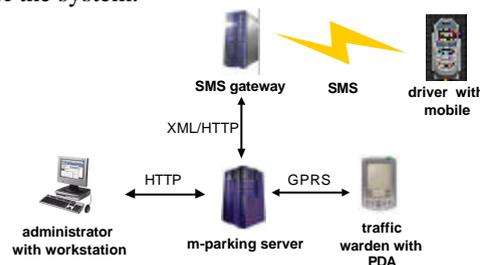


Figure 1. The structure of m-parking solution. The m-parking server communicates with the external entities via HTTP.

The administrators access the system via intranet with a standard web browser (Figure 1). The traffic wardens use PDAs with 3rd party application to query for valid car numbers or to register a fine. The PDA application is connected to the server via HTTP over permanent GPRS connection. The drivers communicate with the system sending and receiving SMSs. The SMS handling is managed by the SMS gateway of the mobile provider: the incoming SMSs are forwarded to the m-parking server as HTTP requests, whereas the server can initiate SMS sending by posting an XML requests over HTTP to the SMS gateway.

2.3.2 Implementation features

In this chapter we focus on some special requirements on the solution and draw-up a picture about the applied solution.

Ensuring reliability and shortening time-to-market: The m-parking solution is based on the proprietary framework of Siemens, called *ServiceXpress Framework* (Hovanyi, 2002). This Java based framework provides built-in functionality like database access management, user management, and authentication control that speed up the development. Additionally, the capabilities of *ServiceXpress* serve as a reliable environment for the m-parking solution, ensuring the 7 x 24-hour operation time

Transactions over SMS: Being a non-reliable system (ETSI, 1994) the SMS communication between the driver and the server would have been a weak point of the system. Preventing the difficulties the concept of SMS transactions was introduced. The drivers are provided with confirmation messages, whereas repeated requests from drivers are recognised and omitted.

Multiple client types: The system has several terminal types. The different protocols are managed by using protocol specific adapters. The adapters access the business logic via *Facade* (Gamma, 1995). This architecture eases the future enhancement of the system with new terminal types, like WAP capable phones.

3. EXPERIENCES

The solution is currently at the pilot-phase, a limited number of users are experimenting with it. The m-parking system is used by 1000 test users without any fee. The pilot-phase is not yet finished, the evaluation of customer feedback is in progress. The preliminary surveys show the following results:

- 77% of drivers is satisfied with the current set of functionality, whereas only 5% finds it inadequate
- Most of the drivers (78%) do not need the query function on the current ticket status
- Most of the drivers (84%) do not buy parking tickets for a point of time in the future
- More than 83% of drivers says that the system is user-friendly and only 5% finds it inadequate. However, the opinion about enabling the service with the PIN code is worse, 70% is satisfied with it, 10% is definitely not.

4. CONCLUSION

The paper presents the m-parking solution for Vienna. Its key characteristics are:

- SMS-based: the drivers communicate with the system via SMS
- Prepaid: the drivers have own accounts for parking, that must be charged before
- Ticket-based: the drivers buy parking tickets for a defined period (oppositely to solution where the drivers inform the system explicitly)

m-parking is just a “simple” mobile application. However, as it is accessible and attractive for a wide range of people, it can serve as a starting point to introduce them into the e-Society.

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E-GOVERNMENT AND APPLICATIONS LEVELS: TECHNOLOGY AT CITIZEN SERVICE

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ABSTRACT

Nowadays, more and more governments all over the world are trying to change their traditional profile to an electronic one. E-government aims at providing better and quicker services from the public services, not only to citizens but to enterprises as well. However, e-government's successful development and operation demands proper design, which will comprise the basis for its application. This adaptation can be implemented gradually in levels, which will enable the unobstructed data flow from/to public sector and will give the opportunity to citizens and enterprises to obtain the highest access to the services that are provided by the state. This paper presents the application levels of e-government from the lowest one to the highest and more complicated one.

KEYWORDS

e-government, levels, citizens, public sector, government, public authorities.

1. INTRODUCTION

Citizen requirements and needs increase continuously, so information searching and the completion of the various tasks have as a result the loss of valuable time in the tracking of responsible actor and waiting in queues. Moreover, the percentage of citizens who acquaint with the Internet has been recently increased. These two facts lead many governmental organizations to proceed with the provision of e-government applications via web sites. According to the survey [1], one of the most pioneer countries in e-government services is Canada. The portal <http://www.canada.gc.ca> offers services organized by the target-group in which are attended e.g. Canadians, non Canadians, businesses, etc.

USA also has early demonstrated a steady advance in e-government, which is close, related to the fact that they are one of the main providers of software and hardware solutions [5], [8]. The high penetration factor of American citizens in Internet (from 23% February 1998 to 56% November 2000) has significantly contributed to reach this fact. The first portal created for this purpose is <http://www.firstgov.gov> in an effort to gather all governmental web sites in one place (one-stop shop).

The <http://www.ukonline.gov.uk> portal constitutes a trial of British government to provide services via Internet [3], [4], [7], [9]. Today, the portal offers: submission of applications for VAT, taxes return, agricultural subsidies from Commission, etc.

Moreover, European Community with the program "IST-Information Society Technologies" supports the use of Internet for on-line governing. "e-Europe" master plan contains important activities for the support and promotion of e-government:

- e-Content program (<http://www.cordis.lu/econtent>) for the development of electronic content,
- IDA program (<http://europa.eu.int/ISPO/ida>) for data interchange between administrations,
- IST-Information Society Technologies program (<http://www.cordis.lu/ist>) for the development of research projects, etc.

e-Gov.gr aims to operate as a reference portal for entering the web of e-Government services in Greece as well as for learning about e-Government best practices abroad and accessing e-Government-related resources in general [10]. At the information level, KEP (center for citizen support) provides information about citizens' rights, everyday life, licentiates, certificates, youth, work and insurance, emigrants, etc. through its web-site <http://www.polites.gr>. Finally, TAXISnet (<https://www.taxisnet.gr/web>) offers the services of Treasury – General Secretariat of Information Systems (<http://www.gsis.gov.gr/home.html>) electronically. The citizen has the opportunity to submit his tax return and VAT claim, to pay his debts, etc.

2. E-GOVERNMENT LEVELS

The idea of e-government has matured considerably over the last years [2], [6]. More and more governments worldwide are trying to change their traditional profile to an electronic one. E-government can be distinguished into three basic models:

- *Government-to-Government*: relates to these activities, which will improve and upgrade governments' services.
- *Government-to-Citizen*: relates to the relationships between governments and citizens. It mostly deals with law and democracy issues.
- *Government-to-Business*: relates to the relationships between governments and businesses. It mostly deals with co-operations, common activities in national and international level.

This transition can lead to a series of strategic, administrative and operational benefits that relate to: best coverage of citizens' needs and requirements, reduction of the cost and response time, greater satisfaction of the citizens, support on new and improvement of current co-operations, processes automation, upgrading of government profile and image, access to more and reliable information, etc.

For the implementation and successful operation of e-government, the proper design, which will be the basis in order to receive the above benefits, is necessary. The application of e-government in the public domain can be gradually in levels. This allows the unobstructed flow of information from/to the public sector and gives the possibility not only to the citizens but also to the enterprises (private sector) to acquire better access in the services that state provides. These levels, beginning from lowest and advancing in most complicated, are separated as presented in figure 1.

2.1 Level 0 – Authority's internal organization

An authority, in order to advance in the process of e-government, should create the suitable infrastructure. This level includes tasks, such as supply of hardware and software for office applications and network interconnection existing and new equipment. The supply of essential equipment and its network interconnection constitute a basic condition in order for the remainder levels to be implemented and for the institution to finally support e-government.

2.2 Level 1 – Electronic protocol

This level refers to the passage from the conventional protocol (hand-written) to the electronic one. For the full computerization of authority's documents (incoming and outgoing) the transition from the conventional

entry (manuscript) to the electronic (files) is required. In this level, the authority’s book of incoming/outgoing documents is suppressed and document distribution henceforth is kept electronically for timesaving and facilitation in document searching and recovering. Moreover, each service of the authority has its own protocol number, given manually by the user.

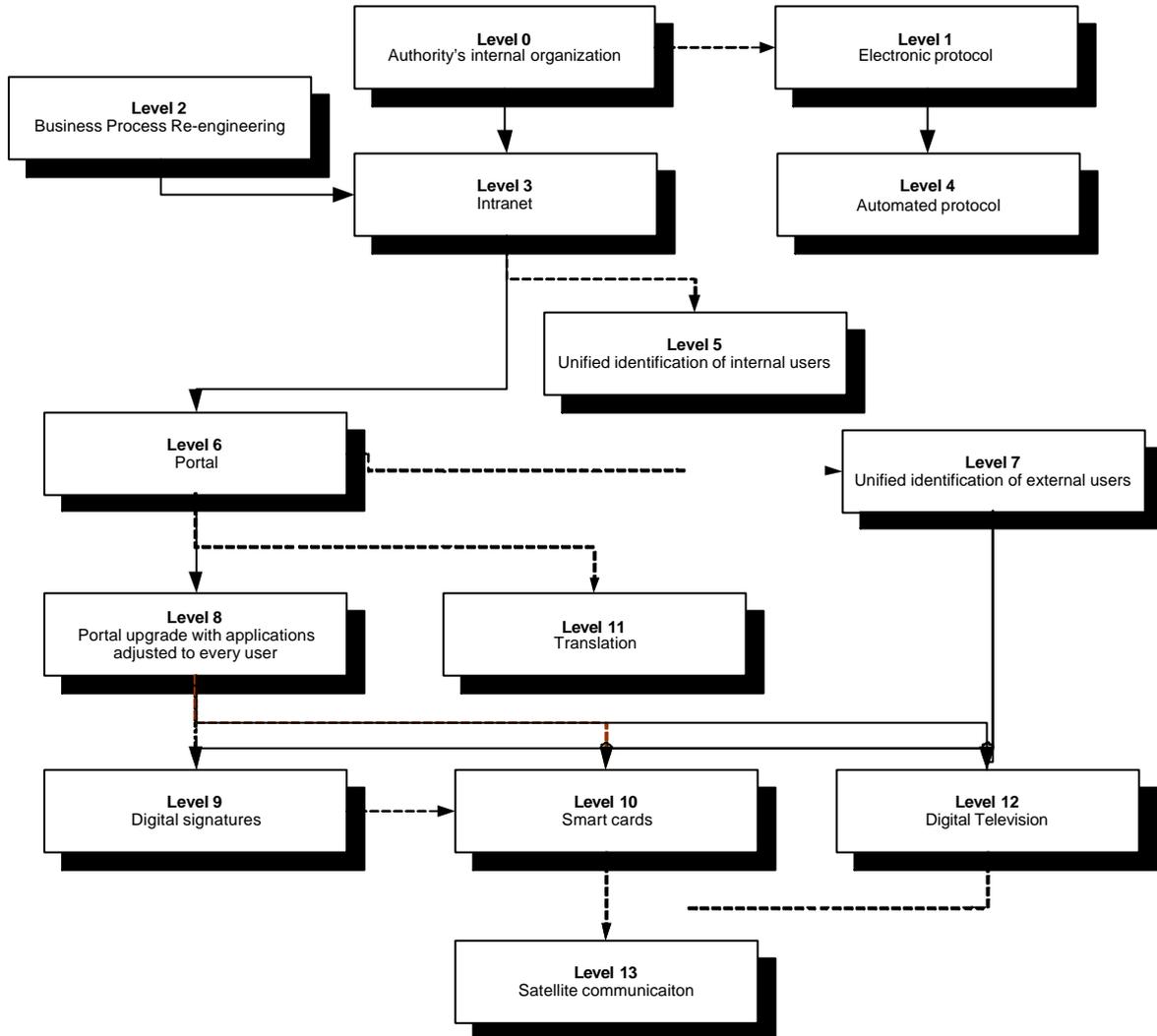


Figure 1. Application levels of e-government.

2.3 Level 2 – Business Process Re-engineering

This level is related to feasibility study of documents’ flow re-planning, internal processes interrelation, and authority’s flow chart processes preparation for the next level, and to specifications, planning and implementation of the applications that need modifications and improvements (legacy systems). Specifically in this level, the differentiation of each public authority, depending on the type and the breadth of their applications, is presented. For each authority, new levels of applications should be created after a feasibility study. For the passage to the following levels, all processes from the organisational side should be registered in order to achieve their unification and communication in the whole public authority. At the same time, it should be defined how the applications that are already used by authority’s services are suitable to remain operational with small interventions and modifications.

2.4 Level 3 – Intranet

Intranet is supported at Level 0 and in the existing infrastructures. The employees of the institution, via an Internet-based environment are able to use applications of their department or other departments without having installed these applications in their personal workstation. In each application where a login is required, the user (employee of institution) maintains the login/password that used before the implementation of Level 3 (authorization capability, authentication). In particular it may concern:

- Electronic distribution of documents (suppression of hard-copy documents).
- File management and common space for storage of documents.
- Follow-up of employees' availability (calendar) and to do list.
- Organisation of internal meetings (taking into consideration not only the employees' availability but also resources e.g. when and which meeting room is available, etc.).
- Transaction of document charging.
- On-line library.
- Telephone list of employees.
- News, statements, proclamations.
- Other applications essential for the completion of daily work, adapted in the needs of each department and each address (e.g. in urban planning, management of building authorisations and control of illegal constructions).

2.5 Level 4 – Automated protocol

To all applications that it is required, Level 1 automatically provides a protocol number, without the personal use of electronic protocol from the user. This application constitutes the input and output gate of documents and files that the institution totally manages. Its layout will provide the system ability of recording, monitoring, checking and informing the total of internal and external activities that are realized by the persons in charge of receipt and service of citizens, consequently the improvement of working conditions and the upgrade of services provided.

The documents' registration must be performed in the units of central class, while, through network, the follow-up with the charging of each document in specific unit, sector and individual of the central or other class will be performed. The documents' import in the system must be performed with the automatic choice of protocol number and date, while the subjects of documents will be selected from a specific list, which will be common for the total of units of each authority's class. Segregation of the incoming and outgoing documents must be provided. Moreover, a separation of internal and external registrations from the authority's point of view is required for the distribution of documents. Still, the software, will propose the protocol number in increasing order and it will be ensured that it is unique for the whole authority.

The communication among the software functional units should be safely realised with the use of encryption. The possibility of security gradation at the processing performed by the protocol is required and where it is needed, the document in question must be coded respectively.

2.6 Level 5 – Unified identification of internal users

This level deals with the study, the design and the implementation of a common login/password for all applications that require one, which will correspond to one single internal user. Nowadays, at the several applications installed and used at governmental services, each employee/user has a different login/password to be identified as unique by the applications and to be able to access and use them. With this Level, a unique pair of login/password will be assigned to each user, enabling him to access all applications used internally in his service.

2.7 Level 6 – Portal

Level 6 deals with the implementation of a portal addressed to citizens presenting information on the public sector without the need of user authentication. Through this Level, the government's image to the public

seems integrated and not as a collection of different partial pieces. The citizen can be served by visiting a one-stop shop. Moreover, several portals can be included.

2.8 Level 7 – Unified identification of external users

This level deals with the study, the design and the implementation of a common login/password for all applications that require one, which will correspond to one single external user. It refers to applications that are electronically available and were accessed only by the citizen's personal attendance at the specific public department. It does not refer to the applications that will be developed under the framework of Level 8.

2.9 Level 8 – Portal upgrade with applications adjusted to every user

The main scope of this level is the portal update and enrichment with applications that demand external users' authentication, which varies from weak to very strong. The aim is the portal to permit several users' categories to access information and services according to the privileges granted to them. The portal's users can belong to any of the following broad categories: citizens, ministries' and other public authorities' employees, organizations' employees, and administrators. The portal must provide a central point of data accumulation and interconnection with several different applications and systems used by various participants, located in different sites. Therefore, the issue of security and the issue of personal data manipulation are of high priority. For the portal's reliable and efficient operation, the definition of security policy is required. According to this policy, the citizen will use the same pair of login/password entering the specific location and will be recognized by the system until he logs out.

2.10 Level 9 – Digital signatures

In contrast to documents in paper, digital documents are more vulnerable to alterations or forgeries. To avoid therefore the danger of unwanted modifications, digital signature processes have been developed, supported by cryptographic methods. However, digital signature legalisation is required, in order for applications, documents and transactions demanding citizen's signature to be equivalent to their electronic versions digitally signed and sent from the citizen's workstation. Digital signature fulfils simultaneously mainly two functionalities. One is affirmation, as the receiver may be certain that the delivered message belongs to the sender, without any intermediate modifications. The other one is confidentiality, as the receiver is assured that he is the only one who will read the message and not any unauthorised people as well. The root of the process to create a digital signature are the cryptographic algorithms, which use different keys for "locking" and "unlocking" an electronic message.

2.11 Level 10 – Smart cards

It constitutes an advanced and secured authentication pattern in order for the citizen to use the portal and includes personal data encryption. Smart cards compose the most well-known authentication method of the people participating in transactions. These cards are capable of re-specifying the data stored at their memory and can be used in advanced applications. At these cards, unique data on their owner are stored, used for their authentication, such as personal ID, as well as data relevant to the advanced applications, facilitating the smart cards' holders transactions with the Government, automating procedures, which in the conventional way are time-consuming and demand bureaucracy and long queues at citizens' help desks, etc. Depending on each authority's peculiarities, a large number of applications using smart cards came up and can be classified to several layers according to their operational dimension.

2.12 Level 11 – Translation

Level 11 copes with the translation of the applications that are available to the citizens into several languages, due to the number of the emigrants in Greece and the joint market in the European Union. All the above-mentioned functionalities must be understood and be accessible to non-native citizens, as Greece is appealing

to many economic emigrants, which while trying to find a job, they are obliged to transact with governmental services and these transactions have been characterized so far as extremely time-consuming and difficult.

2.13 Level 12 – Digital Television

The target of Level 12 is the citizen to access the portal via digital television. The ultimate stage of e-government where the citizen (native and non-native) will be able to access these services through his television in a way similar to zapping through television channels according to his preferences, as television is a communications mean more accessible and familiar to the average citizen.

2.14 Level 13 – Satellite Communication

Governmental executives' information and opinion exchange through satellite signals (GPS). This advanced stage composes the way of informing the governmental executives on the evolution of national affairs, during their travelling abroad due to their obligations, through satellite signal. Moreover, it provides the capability of sending information to the portal, in order to promptly inform the citizens, as well as of discussing with other executives and the citizens on vital governmental issues.

3. CONCLUSION

Governments, facilitated by information technologies and the Internet, promote and support e-government, aiming to more rapid and more efficient citizens' servicing from public authorities. This attempt is not an easy one, since it demands correct and prompt design, infrastructures' availability at wide-scale and modification of citizens' mentality. Nevertheless, following gradually a series of levels, the transition from the traditional government to e-government may succeed. Information Communication Technologies may contribute essentially to this direction, as long as the state and the citizens adopt them under the framework of a broader reorganization of the public sector. The outcome will be the allowance of the unobstructed information flow from and to the public sector and the offering of the possibility to the citizens, as well as the enterprises, to acquire better access to the governmental services.

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NAVIGATING THROUGH A MEETING MINUTE WITH A HANDHELD

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ABSTRACT

In the last years, handheld users registered an exponential growth. In spite of their strong limitations, those little devices have undeniable advantages. A small screen and limited memory are the strongest restrictions. In this paper we present a problem concerning the use of meeting minutes in a handheld. In order to go beyond limitations, a general architecture and a system is presented. This system is being implemented and tested using verbatim of debates of plenary session of the Parliament.

KEYWORDS

Handheld computing, meeting minutes, text navigation

1. INTRODUCTION

The generalization of handheld is associated not only to opportunities but also to limitations. In fact, those devices allow a great mobility of computing. Its dimension allows keeping it in a pocket and handling it with a palm. But this mobility imposes some restrictions: a small screen and limited memory.

The general problem, analyzed here, is the problem of viewing a meeting minute in a handheld. This general problem may be decomposed in several purposes. Consequently, the solution may consist in the following: reducing the number of words shown in the screen of the handheld, allowing the possibility of navigating through that subset of text.

In the following section, related literature is presented. Then, general guidelines for solution are listed. Based in those guidelines, proposal is presented as well as a general architecture. In the next section, a case is analyzed and finally, some of the ideas are discussed.

2. RELATED LITERATURE

In what concerns the support to meetings, handhelds may play an important role (e.g. Davis et al., 1999, Greenberg et al., 1999, Wiberg, 2001). But, those researches emphasizes the use of handheld to support interactions (Wiberg, 2001).

The problem analyzed here is related to several areas of the literature, like summarization, handheld computing, handheld HCI and hypertext use in handhelds.

The summarization field is an important area of research, whose primary focus are not the subject of this paper. But important contributions, produced in this field are being introduced in the field of handheld computing. (Buyukkokten, et al. 2001).

Handheld HCI studies emphasizes the text input (MacKenzie et al. 2001, e.g. James & Reischel, 2001) and text readability (Marshall and Ruoto, 2002) and Web Searching (Buyukkokten, et al. 2000b).. Handheld navigation is another important area of research (Buyukkokten, et al. 2000). In this field, the most important purpose is producing browsers specifically adjusted to those devices. (Buyukkokten, et al. 2001).

3. THE PROBLEM AND SOLUTION

The general problem, analyzed here, is the problem of viewing a meeting minute in a handheld. This general problem may be decomposed in several purposes. Consequently, the solution may consist in the following: (1) Reducing the number of words shown in the screen of the handheld and (2) Allowing the possibility of navigating through that subset of text.

The summarization is related to the possibility of navigating and linking each subset of the text. The subsets of texts may be the following:

- A list of participants that performed interventions;
- A list of participants including their affiliation (e.g. political party or department);
- A list showing the argumentation process, from proposal to approval;
- A presentation of the discussion (typically the first intervention of the chairman);
- An intervention, or if an intervention is too big a paragraph.

After identifying each one of the texts, it is important to identify links between them. Generally, those links are obvious.

4. A PROPOSAL

In order to solve the problem presented in the last section, a proposal is presented. This proposal consists of the following processes: create a data structure, classify interventions, add extra data, perform simple queries and finally, organize information in a hypertext structure.

Several researchers proposed a structure to organize those kinds of interventions in a meeting. The use of classification systems based in IPA (Costa & Costa, 2002) or a structure like Ibis (Conklin & Begeman, 1988, Conklin, 1992). The use of genre analysis may also be useful to classify the interventions (e.g. Costa & Aparicio 2002). The structure may be enriched with additional information, typically contextual information (e.g. Aparicio & Costa 2001). This information may be retrieved using query languages, like SQL. But this is not the more adequate way of reading a text. So, in order to be read thoroughly, data must be organized in a user-oriented manner. The one that is proposed here is the use of hypertext.

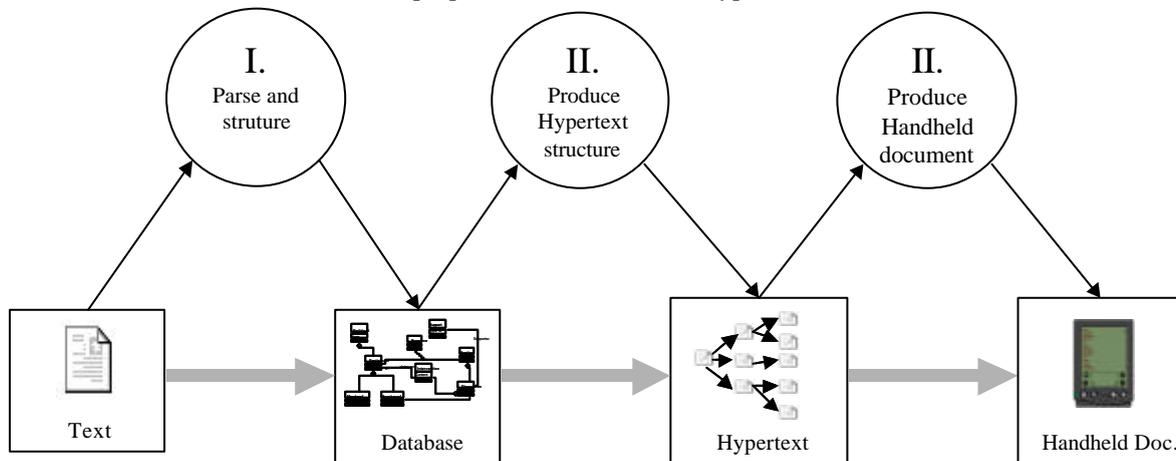


Figure 1. General Architecture

In the Figure 1, the general architecture is shown. As may be seen, the text is converted in a data structure, and data structure is converted in a hypertext structure.

In the step I, the text is parsed and introduced in a relational database, corresponding to a data model produced for the specified problem.

In the step II, a hypertext structure is produced. This hypertext structure is basically the result of a set of queries to the data structure. The production of pages is very flexible.

Finally (step III), the HTML is converted into a handheld document. This last part of the prototype is based in the Plucker software (www.pklr.org) and Python is being used as programming language.

5. A CASE: MEETING MINUTES OF PARLIAMENT SESSIONS

The need of summarizing a meeting minute is the consequence of the length of some of those texts. Also, the need for the integration of additional context data is important. An example arises from a meeting minute (verbatim) of a parliament session; it is way this example was used to test the prototype. But beforehand it is important to characterize the context of the problem.

Laws ruling the Parliament were analysed in detail and a deeper analysis of the activities performed by the parliament was made, especially plenary sessions. The emphasis was in the legislative process, although not restricted to it. Legislative initiative lies on Members of Parliament and Parliamentary Groups - the legislative instruments are referred to as Bills, in this case and also with the Government, when the instruments are called proposed laws. After admission by the President of the Parliament, the instrument receives an Opinion from the specialist Committee to which it was allocated, before a general debate, which always takes place in plenary session. The debate ends with a vote on the whole instrument in general. A debate and vote on the instrument in detail follows, covering each clause, either in Plenary or in Committee. Certain matters must be debated and voted in detail in plenary.

The definitive text is then subjected to a final overall vote, always taking place in Plenary. An instrument thus approved is called a Decree of the Parliament. The Decree, signed by the President of the Parliament, is sent to the President of the Republic for approval. After promulgation, the Decree is designated as a Law, and is sent to the Government for signature by the Prime Minister and is then, finally, delivered to the National Press for publication in the Republic Journal. The Parliament has the duty to watch over fulfilment of the Constitution and laws, and to deliberate over the actions of the Government and Administration.

Here, we are interested in the availability of plenary meeting minutes in a handheld. So, the steps previously presented in the proposal session were followed:

- In the step I, data model produced for the problem of meeting minutes of parliament sessions was produced. This model was developed using some of the information reported in the last paragraphs. Then text was parsed and introduced in a relational database, corresponding to model. Additional classification of each intervention was produced.
- In the step II, a hypertext structure was produced. This hypertext structure was basically the result of a set of queries to the data structure. The production of pages is very flexible but in this situation is based in the assumption that each intervention is very long and may be decomposed in several handheld screens. In the first level a meeting minute is a list of interventions, then, each intervention is composed of a list of paragraphs for each intervention. Each paragraph is then composed of phrases.
- In step III, the HTML was converted into a handheld document, using Plucker software.

Although not completely analyzed and evaluated, several impressions were recognized. In first place, the text is still very large, and uses a great quantity of memory, especially in important discussions like budgeted debate. Then, sometimes, there are interventions that are difficult to understand. In what concerns this last observation, the use of other forms of decomposing the text was suggested as possible solution. In fact, instead of using interventions and phrases as forms of decomposing the text, it can be divided in arguments.

6. DISCUSSION AND FUTURE WORK

In order to solve the problem of showing meeting minutes in a handheld a proposal was presented. This proposal integrates several concepts and technologies with additional development.

The prototype described and partially developed still need to be evaluated. Specially, the identification of the exact number of words per page and the more adequate way of decomposing a long text in subsets must also be carefully analyzed.

7. CONCLUSION

In this paper a problem concerning the use of meeting minutes in a handheld is analyzed. In order to go beyond limitations, a proposal is presented here. This proposal consists of a framework implemented through

the creation of a data structure that may be filled with data obtained from a parsed text. With this data structure it is possible producing handheld documents with hypertext structure. Therefore, the readability of bigger texts in a handheld can be partially solved by using the framework presented in this paper.

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ENHANCING THE EFFECTIVENESS OF SELF-REGULATED LEARNING VIA COLLABORATIVE LEARNING FOR ADULT DISTANCE LEARNERS

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ABSTRACT

Effective self-learning is a core prerequisite for lifelong learning in the competitive global market and a rapid development of knowledge society. For adult learners who have a comparatively higher possibility in learning independently and distantly, how to enrich their competency in effective self-learning has been a significant issue. Self-regulated learning (SRL) is a strategy of self-learning but is less discussed in adult distance learning. In this paper, the author examines how to apply SRL to facilitate adult distance learning. The literature review is employed as the methodology and the focus of analysis is on how to enrich the effectiveness of SRL via the enhancement of collaborative learning in the context of adult distance learning. Accordingly, five recommendations are raised for further research and application in SRL.

KEYWORDS

self-regulated learning, collaborative learning, adult distance learning

1. A NEW LEARNING STRATEGY FOR ADULT LEARNERS

This paper is intended to explore how to improve the accomplishment of adult distance learning through self-regulated learning (SRL). According to the summative definition of Boekaerts (1999), SRL is defined as the extent of an individual's active involvement in learning process in aspects of metacognition, cognition, affection and behaviors. SRL is focused on how an individual initiates, changes, continues his/her learning and the process of transference. Accordingly, by SRL, an individual has to play a main role to control and manage the learning process rather than only be a negative follower. For adults who have comparatively more personal available conditions to learn actively and independently, SRL would be a useful strategy, especially in the context of distance learning. But, there has been less research upon SRL in the fields of adult and distance learning compared with in traditional educational psychology.

In the limited literature, Trawick (1998) employed a questionnaire survey to collect data from students with an experience of academic failure in American community colleges. The results show that there are many students utilize SRL strategy and SRL have a significant positive correlation with the expectancy of academic achievement. Namely, SRL has positive effects on academic achievement. Morris, Gredler and Schwartz (1998) sampled adults in workplace and explored the relationship between SRL and task performance. They found out that SRL and task level could explain 33% variance of the performance. It implies that SRL is one of the crucial contributors to task performance. Therefore, they recommended that SRL is important and can be taught to workers in the workplace.

2. SRL FOR ADULT DISTANCE LEARNERS AND THE DEMAND OF COLLABORATIVE LEARNING

In the academic field of adult distance learning, the issue similar to SRL is not entirely ignored. For example, when Holmberg (1990) discussed the practice of distance education, he also put one of the focuses on

developing self-instructional courses to enhance distance learners' positive learning conditions. In the book Lockwood (1995) edited, three parts of papers regarding the topics of the student experience, learner use of media, and course design and assessment occupied nearly 30% of the whole book. However, there have been more general and broad discussions but less research upon a concrete topic like SRL. More studies in SRL of adult distance learning, based on the fruitful findings in traditional educational psychology, are highly demanded. As Holmberg (1990) stressed, distance education is self-based oriented. An individual adult learner should be put in the core of research and practice in distance learning. SRL is therefore able to lay a foundation to achieve this purpose.

The potential contribution of SRL to adult distance learners depends on many requirements and learning strategies. In terms of learning strategy, collaborative learning is a major one that has been usually raised to enhance the effectiveness of self-learning. For instance, one of the seven SRL strategies recommended by Lapan, Kardash and Turner (2002) is to let learners practice learning strategy with peers. The chief purpose of collaborative learning is to pave a way for learners to share responsibility, to achieve the learning objective collaboratively and to learn from each other rather than to depend on others and to loaf one's responsibility. So, there are many conditions for successful collaborative learning like an equal status in participation and flexible rules for collaboration. For independent adult distance learners, collaborative learning would provide accessibility to do self-feedback and self-monitoring and then improve the learning effectiveness through peer learning. Miller (2000) sampled 297 senior high school students to explore how they became self-regulated learners in English and Math. He found by path analysis that external peer comparison is the major factor forming the perception of students' self-regulation. The finding implies that collaborative learning would be helpful to reinforce SRL. Collaborative learning is therefore able to conquer the potential limitation of SRL and supplement its advantages. This is a strong demand for adult distance learners to conduct SRL and collaborative learning together.

3. LINKING COLLABORATIVE LEARNING FOR ADULT SELF-REGULATED DISTANCE LEARNING

SRL can be taught and has to be learnt by adult distance learners. It is a crucial task for adult distance learners to facilitate personal conditions for cultivating the literacy of SRL and link collaborative learning to enhance the effectiveness of SRL.

3.1 Conducting task analysis of adult distance learning to figure out the component of basic competency and readiness for collaborative learning

The idea of task analysis in the field of organizational behavior and workplace education can be borrowed to be a method to explore the required components of competency in adult distance learning. The findings can be the blueprint for adult self-enrichment, and for programme designed and offered as learning supports by teachers. This blueprint would be also the prerequisite and preparation for following collaborative learning. The research into the micro dimension of SRL is helpful to be a starting point.

3.2 Exploring more personal conditions for effective adult distance learning linking to collaborative learning

Since the elements of SRL cover domains of metacognition, cognition, affection and behaviors, an individual learner has to enhance many necessary conditions as early as possible. The research conducted by Eom and Reiser (2000) upon the examination of SRL's effects on learner-controlled and programme-controlled computer based instruction is one of the recommended topics.

3.3 Supporting adult distance learner to enrich the literacy of SRL and collaborative learning

How to improve adults' literacy of SRL and collaborative learning via continuing learning is a critical task of teacher for instruction and providing learning supports. After task analysis of distance learning, SRL and collaborative learning are fully understood, teachers then can design a concrete teaching programme as the required subject for adult distance learners. The research that Hadwin and Winne (2001) applied four phases ie understanding task, setting goals and planning, enacting study tactics, and evaluating and adapting metacognition, to promote SRL is worthy for reference.

3.4 Organizing study circles to practice collaborative learning

Adult distance learners can be encouraged to organize long-termed study circles to conduct collaborative learning. The operation of study circle can be in a form of student society. Teachers have to design curriculum based on the target of improving the application of students' collaborative learning. Additionally, an adult class can be divided into several study circles for long-termed collaborative learning. Teachers need to provide them with diverse and continuous opportunities to run their circles.

3.5 Assessing the effectiveness of SRL and collaborative learning continuously

The major and specific purpose of different assessments is to improve the effectiveness of SRL and collaborative learning. Teachers play a significant role to assist adult distance learners through teaching activities. Teachers also have to give instant feedback from the result of exams to adult distance learners via different learning media and tracks. Teachers are able to apply the theory of modeling learning argued by Albert Bandura to select excellent individual learners and study circles to be the models.

4. CONCLUSION

The author proposed a less discussed concept, SRL and discussed how to enhance its effectiveness via collaborative learning for adult distance learners. SRL and collaborative learning are not born competencies and require learners to prepare in advance and to enrich continuously in the process of learning activity. What this paper has discussed would be helpful for academics and practitioners to enhance the literacy of SRL. Five recommendations were listed for further research and application in SRL.

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THE ROLE OF INTELLIGENT DECISION SUPPORT SYSTEMS IN THE FORMATION OF AN INFORMATION SOCIETY

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ABSTRACT

The paper presents one of numerous directions of IT education, covering Intelligent Decision Support Systems (IDSS). On the basis of several years of experience in teaching IDSS at university management faculties as well as surveys conducted among students and graduates, the authors try to prove the hypothesis that IDSS education is one of the crucial elements of manager training aimed at the ability to make decisions in the Global Information Society.

KEYWORDS

Intelligent Decision Support Systems, Information Society, IT education.

1. INTRODUCTION

In the era of globalisation, EU expansion and establishment of international economic associations it is a challenge for the modern world to manage the knowledge that facilitates high flexibility of decision making processes.

National economies ought to be flexible, which is connected with the continuous adjustment of their activities to market requirements. High flexibility can be achieved through the usage of information technology (IT), advanced manufacturing technology (ATM) as well as high technology (HT).

2. IDSS IN IT EDUCATION

Nowadays, significant emphasis is put on education, which prepares potential future managers for flexible reaction to change, with the application of IT and knowledge management.

Education in the field of IT is the condition to keep the balance between the continuous development of informatics and information technologies, artificial intelligence and the intellectual development of societies. It is considered that in a global sense the knowledge on IT may be the measure of the level of industrialization and economic progress of particular countries. The process of reaching the highest level of perfection by a 21st century company through IT ought to happen through technology leaps, continuous education and improvement in this respect (Kieltyka, et al, 2000).

The paper presents one of numerous directions of IT education, covering Intelligent Decision Support Systems (IDSS). On the basis of several years of experience in teaching IDSS at university management faculties as well as surveys conducted among students and graduates, the authors try to prove the hypothesis that IDSS education is one of the crucial elements of manager training aimed at the ability to make decisions in the Global Information Society.

The idea to write the present paper was born in the final stages of the authors' work on another book from the series 'Information Technologies in Management' directed to students and educational centres specialising in IT (Kieltyka, et al, 2000)..

The authors emphasise the necessity to include problems relating to the implementation of Intelligent Management Support Systems in the IT educational programmes.

The choice of that line in the educational program is not accidental, as at the moment the Intelligent Decision Support Systems (IDSS) constitute a separate class in the modern information processing technologies. They are active systems characterized by the ability to learn and to adjust to decision processes. IDSS are capable of dealing with a whole range of information inaccuracy problems, such as: excess, incoherence, uncertainty, the lack of analytic relations between the related groups of information, low predictability and often -apparent discrepancy (Kuceba, et al, 2002).

The application of IDSS is supported by its capabilities, allowing it to process: incomplete data, numerous data in a fast and effective way, fuzzy information, to generate approximate results, associated access to information contained in databases and knowledge bases. The education in the field of IDSS requires the clarification of and acquainting the students with the IDSS components, such as: expert systems, neural networks, genetic algorithms, evolutionary algorithms, hybrid systems, fuzzy systems and their applications (Hopfield, 1984)(Thim, et al, 1995).

There is also a global meaning to the stress put on IDSS education at Polish universities. With the aim of improving its position in relation to other nations in mind Poland must emphasize the quality of education in order to educate specialists who will cope with the demands of modern markets, realizing defined missions and goals of organizations going beyond this country. Polish students possess the ability to use modern, IDSS supporting software like artificial intelligence simulators, e.g. Sphinx 3.0, Statistica Neural Network or BrainMaker (Kieltyka, 2000) (Kuceba, et al, 2002).

3. RESEARCH HYPOTHESES VERIFICATION

A survey has been conducted in order to verify the need of introducing Intelligent Decision Support Systems (IDSS) to the IT education programmes. The research was to provide information on IDSS development possibilities and perspectives in the processes of corporate management of companies run by presently educated managers. The research has been conducted among two groups of students and graduates of university management faculties in Poland:

Group I

Students and graduates of university management faculties in Poland who have completed an advanced IT course, covering IDSS issues – 100 respondents.

Group II

Students and graduates of university management faculties in Poland who have completed a basic IT course – 100 respondents.

The research was to verify two detailed hypotheses:

1. Education in the field of IT, covering IDSS issues is the condition to keep the balance between the continuous development of informatics and information technologies, artificial intelligence and the intellectual development of information societies.
2. The process of reaching the highest level of perfection by a 21st century company through IT ought to happen through technology leaps, continuous education and improvement in this respect.

Due to limited space the paper presents only particular results of the research conducted.

The first part of the survey concerned the definition of the most important directions of manager education, related to the formation of a Global Information Society. According to the respondents, five most crucial directions in the future decision-makers education are the following: IT (72% - of all the answers), knowledge management (60% - of all the answers), intellectual resources management (52% - of all the

answers), economy (47% - of all the answers), strategic management (45% - of all the answers). There have also been the most important abilities of a manager defined: creativity (68% - of all the answers), communication – „e-communication” and interpersonal communication (63% - of all the answers), flexibility in decision making processes (57% - of all the answers), obtaining and transforming knowledge (53% - of all the answers), dynamics (51% - of all the answers). The answers obtained in the first part prove the hypothesis that knowledge management and further development of IT are the basic conditions of a properly functioning information society.

The second part of the survey concerned the respondents’ knowledge on information tools enabling gathering, processing and transmission of data, information or knowledge. Students’ expectations in the field of IT education in Poland have also been defined. The figures 1.a and 1.b present general results of this research.

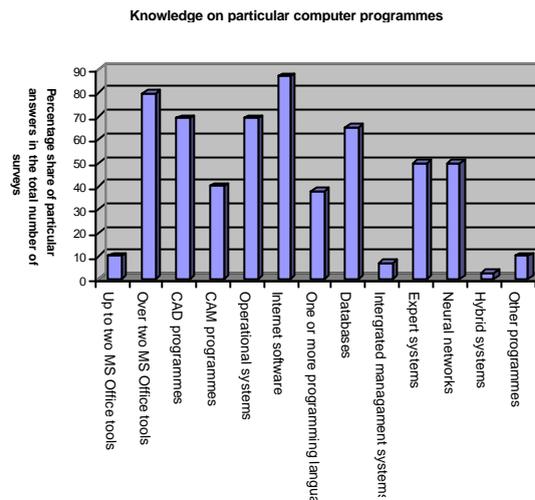


Figure 1.a Knowledge on particular IT techniques among the respondents

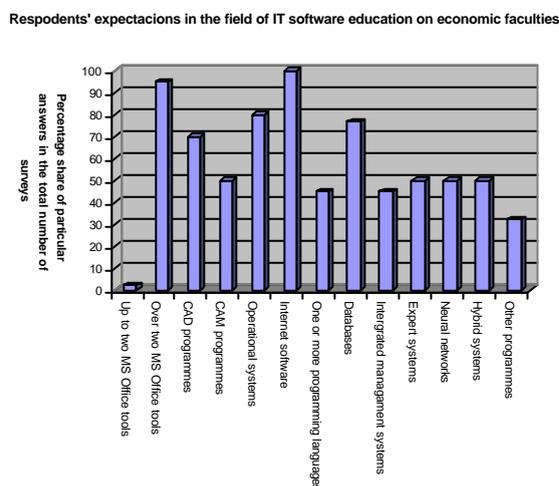


Figure 1.b Students’ expectations in the field of IT education

On the basis of the survey results presented on Fig 1.a it may be stated that over 90% of the respondents possess some basic knowledge on IT. They utilise internet tools, which means that they see the necessity of functioning in an esociety that may be called a virtual one. These people are of the opinion that the programmes of new fields of studies related to IT should cover methods and tools of data transmission as

well as integrated management systems. 50% of all the respondents have declared the knowledge on particular IDSS tools such as: neural networks, expert systems. The result is well grounded as only one group of the respondents had been trained in that field. Such result proves as well that these information tools are new and not very popular in particular environments, for example in relation to MS Office, internet tools, CAD or databases. However, presently only these tools enable knowledge management in a virtual society. While justifying this answer the students of the first group stated that IDSS enable them not only to become familiar with knowledge management basics in theory but also in practice by creating certain schemes of action and improving the ability to solve problems. The same, first group of respondents sees the necessity of further education in the field of IDSS (Fig. 1.b). The members of the group have enumerated several factors that prove the necessity of educating future managers who are to take decisions in an e-society in the field of IDSS. The most frequently enumerated advantages of IDSS are the following: the possibility of a flexible decision-making process or its support (78% - respondents from group I), shaping the reality in relation to uncertain environment conditions (63% - respondents from group I), fast decision generation by compilation of numerous variables, incomplete databases and knowledge (60% - respondents from group I), incomplete data processing (60% - respondents from group I). As it may be easily noticed, the advantages coming from the knowledge and application of IDSS overlap with the answers of both respondent groups on the basis of which the crucial directions of manager education have been defined.

It proves the hypothesis that education in the field of IT, covering IDSS issues is the condition to keep the balance between the continuous development of informatics and information technologies, artificial intelligence and the intellectual development of information societies.

4. CONCLUSION

On the basis of the research and observations carried out in the field of IT training effectiveness, it has been stated that students who have completed courses in accordance with IDSS programmes reveal, in comparison to those studying according to standard IT programmes, a greater flexibility in decision making processes. Such people react faster to unexpected changes occurring in their environment, they are more flexible to IT software and hardware changes.

Education in the field of IT is the condition to keep the balance between the continuous development of informatics and information technologies, artificial intelligence and the intellectual development of societies. Managers and decision-makers need tools such as IDSS, supporting today's training processes and enabling real influence on the development and application of intellectual assets of an information society.

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BUSINESS SIMULATOR MEETS SOFTWARE PLAYERS

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ABSTRACT

Business simulation modeling is a traditional collaborative learning tool to give students an integrated perspective to business management. Recent progress of AI technology makes it possible to build business models with human- and software-agents participation. This paper describes a novel business simulator development for educational use in marketing domains. Our approach consists of (i) gaming experiments among human players, (ii) home-made simulation models by the students themselves using a business model description language (BMDL), a business model development system (BMDS), and corresponding decision rules of the agents, and (iii) machine learning agents with classifier systems (LCSs) to improve the decision knowledge and the game balance. This paper demonstrates the effectiveness of our approach to business simulation by employing machine learning agents.

KEYWORDS

Business Simulation, Collaborative Learning, Machine Learning Agents, Learning Classifier Systems

1. INTRODUCTION

Business simulator is a traditional collaborative learning tool to study business and management principles under controlled situations. There are many conventional gaming simulators in the literature (for example, refer to [Elgood,1993] and [Barreteau, 2001]). Also, a gaming simulator such as "Internet forum" have been developed into computer-based game to act as decision making tools in business on the internet [Hare,2001]. However, students with real world experience will not be satisfied by playing-only simulators. They want to know how to make good management decisions by themselves to develop business models, decision support tools, and business information systems.

To meet the requirements, we set the following goals to design the business simulator:(1) From one to a dozen of students can execute the simulators at the same time and different places. Therefore, adding to human players, multiple software agents should participate in the games as sub-audiences of the players. (2) We must develop enough number of business games in order to train students to easily understand their own business models. The development requires automated tuning to improve the game performance, that is, the interestingness and the educational effects.

Generally, so far, it is very difficult even for experienced experts to develop a suitable simulator. To overcome the difficulties, the introduction of multiple software agents is critical. Human-agent participation has the following roles: (i) to substitute human players by software agents, (ii) to understand the decision making procedure by implementing agent functionality, (iii) to speed up the game development by tuning the game parameters, (iv) to control the game balances by agent participation during the game executions, and (v) to explore desirable business processes by machine learning agents. This paper investigates a novel methodology to establish a gaming simulator development cycle. First, students learn business principles via existing games, next, they develop their own games by, for, and of themselves, and finally, the games should be accumulated for the future use. The paper demonstrates a small example of such development. As a

learning device, we employ a typical genetics-based learning classifier system, XCS [Buts and Wilson, 2000]. LCS architecture is suitable because of both its learning ability and understandability of the knowledge.

2. SYSTEM ARCHITECTURE

The architecture of Business Model Description Language, Agent Rules, and Business Model Development System and sample learning sessions are shown in Figure 1. A model developer describes his or her business model in BMDL and Agent Rules. This is a natural extension of the architecture developed in our previous research [Terano, et al. 1999].

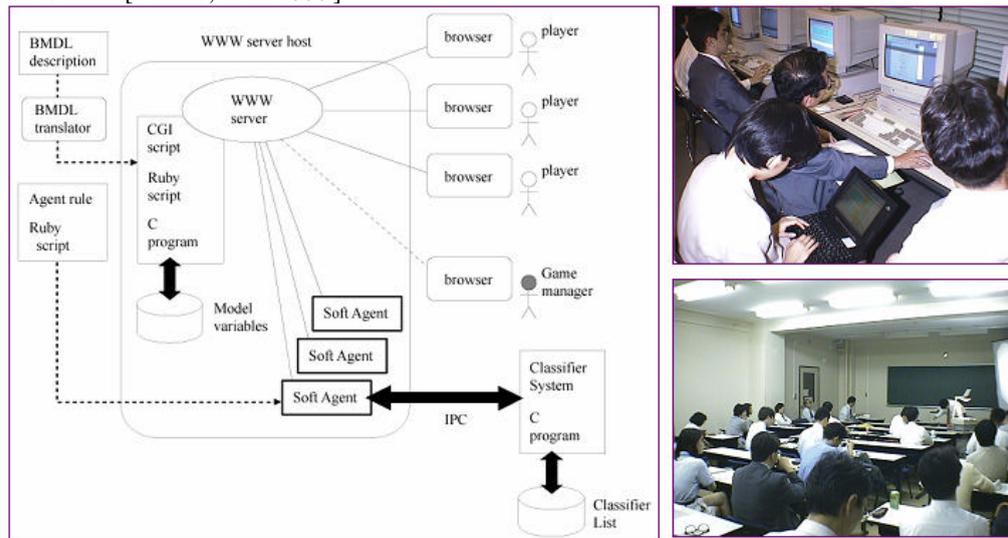


Figure 1. System Architecture of the Business Simulator and Collaborative Learning Sessions

BMDL is a newly designed language, by which even naive users are able to describe their business models to specify the definitions and relationships among business variables over time, the ways of decision making, and user interfaces. Via the BMDL translator written in Perl Language, the source codes of the business model in BMDL is converted into the C language sources, CGI sources, spreadsheet type databases for game variables, and the I/O screen data in the HTML files. Linking these codes together, BMDS simultaneously generates executable codes for the WWW server program for a game manager and the client programs for the human participants.

Plural players including both human and software agents participate in a generated game in a step by step round mode. A game manager controls the game play at every round, that is, the manager lets the players make their decisions. After confirming the inputs of all human players, the game manager executes the function of software agents, and then proceed the round. Such roles of the game manager are quite common in gaming simulation literatures.

3. EXAMPLE OF LEARNING AGENT DEVELOPMENT

3.1 Experimental Set Up

As a testbed of our approach, we develop a manufacturing company game. The specification is summarized as follows:

- Business Domain: Manufacturing;
- Task: The procurement of the raw material, manufacturing and sales of the product;

- Objective: To increase sales amount to get the amount of the cash deposit;
- Decision making items at each round: Raw material procurement, Production instructions, and Sales price;
- Game setting:
 - Initial raw material stock: 400
 - Transportation and production delay: One term
 - Transportation and Stock charges: one money unit/item
 - The price the lower, the larger the demand
 - Demand forecast at two rounds later is shown to a player.
- Number of the Software Agents: Six agents with 1) reactive strategy (3 agents), 2) hand-coded rules of a human player's (2agents) and 3) XCS-based machine learning agents (1 agent).
- Using the game, we design the following experiments with three phases:
 - Phase 1 Gaming experiments with only human players to study the basic performance of the game and players;
 - Phase 2 Gaming with software players with simple hand coded decision rules and human players to validate the feasibility of the software agent players;
 - Phase 3 Gaming with software agents with hand coded rules and a learning agent with XCS.

We have implemented the three software agents as alternatives of human players for Phase 2.

- Reactive Agents:
 - 1: If the demand of the next round is larger than 0, produce the maximum amounts under the material stocks and new arrivals.
 - 2: Order materials based on the demand prediction of 2 rounds later
 - 3: Give maximum or minimal feasible sales price;
- Imitation of Human Players: Use log information of human decisions at each playing step;
 - Learning Agent Players: Use the following state, action, and reward information to the classifier coding.

Table 1. State/Action/Reward Encoding for XCS Learning Agent

state	Round Number	4bit	1 - 10
	Demand Prediction	8bit	0 - 255000 (unit 1000)
	Material Stock	6bit	0 - 6300 (unit 100)
	last action	5bit	"action" info below
	last 2 action	5bit	"action" info below
action	Sales Price	1bit	Min/Max
	Product Order	1bit	Yes/No
	Material Order	3bit	0 - 2100 (unit 300)
reward	Cash Amount	int	Game Rslts offset

We have explored the parameter space of XCS so as to acquire high performance decision rules of the learning agent. The setting is different from the ones they recommend in their paper. The parameters are shown in Table 2.

Table 2. XCS Parameter Setting for the Experiments

Parameters in XCS		Ours
Max Population Number	N	800
Learning Ratio	β	0.1 - 0.2
Fitness Parameters of CF	α	0.1
	ν	5.0
Accuracy	ϵ_0	1% of rwrdr
Discount Ratio of Pred.	γ	0.71
Threshold of GA	θ_{GA}	25 - 50
Mutation Ratio	μ	0.01 - 0.05
Threshold of Deletion	θ_{del}	20
Ratio of Ave. CF and CF	δ	0.1
Threshold of Inc.	θ_{sub}	20
Ratio of #s	$P_{\#}$	0.33
Random Action Reatio	P_{explr}	0.5

3.2 Results and Discussion

The summary of the experiment is shown in Table 3. Columns of Best Human, Hand Coded, and Learning Agent respectively represent the decisions at each round of the game. In the game, although software agents do not control the amount of product numbers, the results have indicated that the learning agent overperforms the best human players.

This means that (1) using machine learning techniques, we can tune the game parameters up; (2) the development process is highly improved by the only computer simulation without human players; and (3) we are able to acquire decision knowledge to over perform humans' ones.

Table 3. Comparison of Rewards of the Three Players

Rnd #	Dmnd	Best Human		Hand Coded		Learning Agt	
		Prdct.#	Lgst.	Prdct.(Y/N)	Lgst.	Prdct.(Y/N)	Lgst.
1	0	400	4400	Yes	2100	Yes	2100
2	1000	1700	3000	Yes	2100	Yes	2100
3	1800	0	4725	No	2100	Yes	2100
4	0	3000	3000	Yes	2100	Yes	2100
5	2000	0	6750	No	2100	Yes	2100
6	0	6000	0	Yes	0	Yes	2100
7	14000	0	500	No	300	Yes	2100
8	0	5000	0	Yes	0	Yes	300
9	4000	3750	0	Yes	0	Yes	300
10	3000	0	0	No	0	Yes	300
reward		174		141		186	

4. CONCLUDING REMARKS

In this paper, we have described the basic idea of our business simulator development methodology from the conventional "human players only environment" to the one with mixture of both human and machine-learning agents. This enables us to enhance the collaborative learning with business simulators.

From the other experiments about much more complex cases, we conclude that the toolkit is effective for game designers to develop and tune up their own simulators. We have already had experience of business modeling education over these five years and have more than one hundred games. These games can be re-implemented using our learning agent architecture. Future work includes (1) to explore the "best solutions" of a certain class of games using the proposed architecture and (2) to employ other learning techniques for the software agents.

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ON THE DESIGN OF THE FAIR INTEGRATED DATA EXCHANGE SYSTEM (FIDES)

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ABSTRACT

In e-commerce environments, there are cases where pre-established relationships between business parties do not exist, and therefore they are unlikely to trust each other a priori. It is not unusual for legitimate business parties to misbehave in order to gain some (usually financial) advantages. Protecting business parties from each other is therefore as important as protecting them from outside attackers. Non-repudiation and fairness security services are needed in e-commerce systems to provide solutions to these issues and enable secure and reliable execution of business transactions among distrustful business parties. Our work is concentrated on the design and development of a system capable of supporting efficient non-repudiation and fair electronic data exchange for a broad range of e-commerce processes, and implementation of these services using the emerging messaging technologies.

KEYWORDS

E-commerce, security, non-repudiation, fair exchange.

1. INTRODUCTION

In the last decade we have witnessed the enormous growth of the services available over the Internet, with e-commerce services being certainly the most notable ones. The most commonly seen e-commerce applications are on-line exchanges of electronic business data, such as digitally signed contracts, e-payments, software, digital publications, etc. Due to the valuable nature of such data and the fact that business parties involved in on-line exchanges do not necessarily trust each other fully, adequate security measures are needed to ensure that the exchange process of such data is non-repudiable and fair. Being *non-repudiable* means that the exchange process should provide enough evidence to protect all participating parties from false denials that an important electronic data has been sent or received. Being *fair* means that the exchange process should be able to avoid situations where one party has received the expected data, while the other has not. Development of non-repudiation and fairness security solutions for e-commerce will facilitate establishing trust between business partners, and consequently will increase the overall volume of e-commerce.

A number of security protocols and mechanisms have found their way into e-commerce activities and products. For example, the Secure Socket Layer protocol (SSL) can be used to establish a confidential communication channel between the two parties on the Internet. A number of epayment systems (SET, Digicash) are available to support on-line secure payments. Digital signature techniques together with the Public Key Infrastructure (PKI) can provide certain degrees of e-transaction accountability (such as transaction authenticity and non-repudiation of origin), and transaction integrity. Secure/Multipurpose Internet Mail Extension (S/MIME), Electronic Business XML (ebXML), etc. provide a signed receipt security service. However, these protocols provide transport rather than application layer security, which is needed for e-commerce transactions. Proof of receipt provided by these techniques is universally dependant upon the sender filling a request for the return of an acknowledgement. It therefore relies on the honesty of the recipient, which provides no protection to the sender if the recipient chooses not to sign and return the

acknowledgement after having seen the message. In other words, all these techniques provide only limited level of security protection for e-commerce transactions.

This paper presents the outcome of the initial phase of our on-going FIDES (Fair Integrated Data Exchange Services) project, aimed at developing a complete end-to-end solution for automatic provision of the integrated non-repudiation and fair exchange services. The focus of our research is to investigate ways to guarantee non-repudiation and fairness in e-commerce by employing secure exchange protocols and cryptographic primitives. We will also address the issues of business user *anonymity* (particularly traceable anonymity) and *mobility*, and integrate the newly developed and/or existing approaches to produce modular, interoperable, scalable and reliable architecture for automated provision of non-repudiation and fair exchange services.

The paper is organised as follows. Section 2 presents the background research and related work on non-repudiation and fair exchange protocols. Section 3 presents our contribution - a general design of a component-based architecture for the FIDES. Conclusions and our further research are given in section 4.

2. BACKGROUND

In the context of electronic data exchange, *fairness* ensures that, at the end of the exchange, either each party receives the expected item(s), or neither party receives anything. A party refusing to send his item, after having received and viewed the other party's item, can violate the fairness of an exchange process. An unreliable network channel may also affect fairness, as an item may be lost when the underlying communication is cut-off during the course of the exchange.

Additionally, commercial transactions have legal significance. *Non-repudiation* service establishes evidence concerning a particular transaction, in order to resolve any subsequent disputes about the occurrence of the transaction. ISO standards (ISO/IEC 13888) identify various classes of non-repudiation services, two of which are of our particular interest: non-repudiation of receipt and non-repudiation of origin.

Non-repudiation of origin service provides the recipient of a message with the evidence of the origin of a message, and can be achieved by using a digital signature technique. The originator of the message generates a digital signature on the message using his private key, while the public key corresponding to this private key is uniquely and legally bound to him through a certificate issued by a trusted certification authority. The signature of the message itself constitutes the evidence of the origin of the message. In this way, the message originator cannot later deny that he has sent the signed message, since he is the only one who could have produced the digital signature on the message.

Non-repudiation of receipt service provides the originator of a message with the evidence of the receipt of the message by the intended recipient. This service is more difficult to achieve than non-repudiation of origin, as it requires the cooperation of the recipient of the message to return an acknowledgement message containing his signature (i.e. "non-repudiation of receipt" receipt). In e-commerce environments, simply requesting the recipient to return his signature on the received message offers no protection against repudiation of receipt if the communicating parties are not mutually trustful and the recipient chooses not to acknowledge the receipt of a message after seeing its content.

Therefore, participating parties must follow certain protocols in order for non-repudiation and fairness to be guaranteed in all circumstances. Secure exchange protocols are the basic building component of the non-repudiation and fair exchange security systems, and have been the focal topic of the research community over the last two decades. Non-repudiation and fair exchange protocols have evolved from two-party only protocols and simultaneous bit-by-bit exchange of items (Blum 1983, Even et al 1985) to Trusted Third Party-based protocols, in which an on-line trusted third party (TTP) is employed to mediate exchanges, transfer the items and evidence, and help achieve non-repudiation and fairness (Bürk and Pfitzmann 1990, Ray I. and Ray I. 2001, Zhou and Gollmann 1996, Zhou and Gollmann 1997).

The most recently developed approach is to employ an off-line TTP to act as an independent arbiter. Under normal circumstances, when participating parties can come to a successful exchange conclusion themselves, the TTP is not invoked. If any dispute arises during the protocol execution, the participating parties will turn to the TTP for help. After examining the evidence of the exchange provided by the participating parties, TTP makes the decision and takes necessary steps to resolve the dispute and restore non-repudiation and/or fairness. Protocols designed based on this approach are called optimistic protocols

and can be found in the work of Asokan et al (2000), Bao et al (1998), Boyd and Foo (1998), Chen (1998), Chuan-Kun and Varadharajan (2001), Zhang et al (2002), Zhou et al (1999), etc. Optimistic protocols greatly reduce the involvement of, and communication and security requirements placed on, the TTP. Therefore, the optimistic TTP-based approach will be adopted for our FIDES project solution.

3. THE FIDES SYSTEM

The FIDES system has been designed as a message-oriented middleware component (Figure 1), located centrally on an application server within enterprise architecture, enabling B2B interactions with business partners electronically through predefined business message exchanges. Business messages carry business and valuable data retrieved from enterprises' back-end application systems. Internal processes of the enterprise are implemented by back-end applications and are not exposed to business partners. Should any dispute arise regarding the business message exchanges, business partners may contact the chosen Trusted Third party (TTP) on-line or off-line to resolve the dispute.

An enterprise user initiate transactions on behalf of the enterprise by connecting to his FIDES system and instructing it of the kind of a transaction he wishes to conduct (e.g. contract signing), business data he wishes to exchange (e.g. contract) and a business partner he wishes to engage with. Additionally, an enterprise user may browse incoming transaction requests from other enterprises and decide whether to accept or reject them. After these initial settings that require users' intervention (i.e. initiating transactions or accepting/rejecting incoming transaction requests), FIDES systems from both enterprises engage in the agreed transaction (i.e. contract signing) automatically.

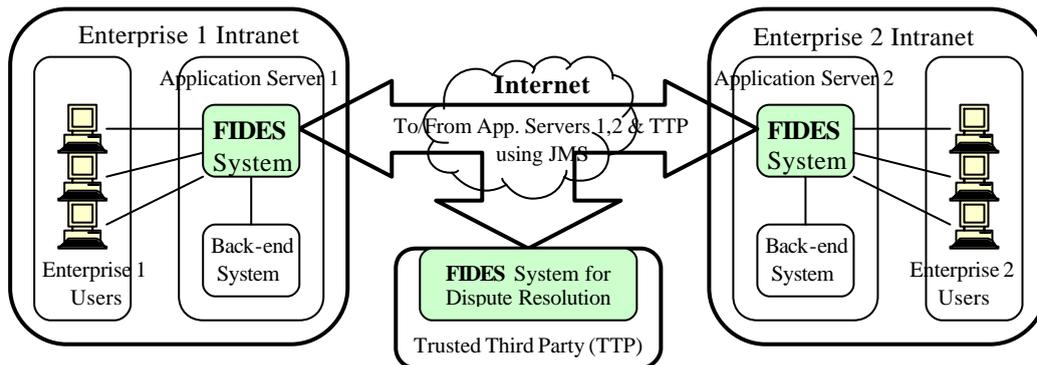


Figure 1. The FIDES system overview

The FIDES system consists of two sub-systems - *User Authentication and Access Control Mechanisms* and *Non-repudiation and Fair Exchange Services*. Integration of the non-repudiation and fair exchange services with the user authentication and authorisation services within the FIDES architecture will provide full end-to-end security for e-commerce transactions. The overview of the FIDES system architecture is shown in Figure 2.

3.1 User Authentication and Access Control Sub-system

User Authentication and Access Control Sub-system provides an access to the system resources and services only to authenticated and authorised enterprise users. They are based on the identity of the user and on the role and privileges the user has in the system. When a user accesses the system, he must first authenticate himself to the system, i.e. prove his identity. After the successful validation of the identity, the system assigns privileges to the user, based on the user's access rights. The user is only allowed to perform the operations for which he has privileges. In this way, sensitive business data, information about business partners and transactions, and other system services and resources are prevented from unauthorised access and modification.

In order to provide a higher level of security measures, we may employ two different types of public-key certificates (i.e. two-tier certificate structure) – personal certificates (for business users) and enterprise certificates (for enterprises). Personal certificates may be used for the communication between enterprise users and the FIDES system within an enterprise, and enterprise certificates may be used in the subsequent non-repudiation and/or fair exchange protocol execution between enterprises (i.e. enterprise-to-enterprise or business-to-business communications). The benefits of personal certificates is twofold: firstly, users within an enterprise can be kept accountable for their actions as all communication between them and the FIDES system will be signed using their personal certificates; secondly, personal certificates can be used to provide strong authentication, as the identity of the user can be extracted from the personal certificate and verified by the FIDES system.

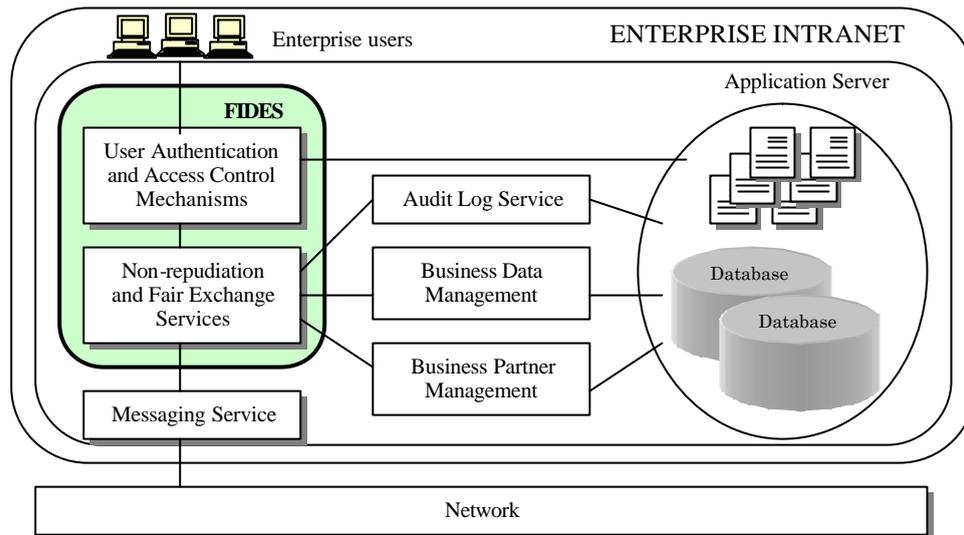


Figure 2. The FIDES system architecture

3.2 Non-repudiation and Fair Exchange Services Sub-system

Non-repudiation and Fair Exchange Services (NR and FE services) are a sub-system for the provision of secure and non-repudiable transfer and fair exchange of business data. Security protocols for non-repudiation and fair exchange constitute the basis of this sub-system, and are based on Java Messaging Service (JMS). These services can be invoked as a part of a business process. For instance, the complex e-purchase business process may be consisted of several phases - negotiation of business content (i.e. offers), contract signing of the agreed offer, and payment (on-line or off-line) for the goods (tangible or intangible) to be delivered. In this scenario, NR and FE services can be invoked to protect some parts of the e-purchase process, for instance when signing an agreed offer, or making an electronic payment. However, our intention is to design the system in a generic way so that various business scenarios that require non-repudiation and fairness protections are supported. Our aim is also to provide a uniform interface for exchanging different types of business data, such as signed data, payments or e-goods.

3.2.1 Applicability of Non-repudiation and Fair data Exchange Services

Depending on the types of business items exchanged in business processes, the design and implementation of non-repudiation and fair exchange protocols also vary. Due to the different nature of business items and different security requirements for their exchange, it is difficult to develop a complete *generic* approach, by which the exchange system can support exchange of arbitrary business items with non-repudiation and fairness security requirements. According to the properties of the exchanged items, we distinguish three main types of the items (SEMPER):

- Signed data – data (known to both parties) accompanied by the sender's or recipient's digital signature over the data, such as signed contracts, e-receipts, etc.;

- E-goods (intangibles) - valuable and possibly confidential data or information to be exchanged (not known to the recipient beforehand), such as important documents, software, images, videos, electronic publications, journals, etc.;
- Payments – special kind of signed data, but signed and certified by the third parties (usually banks), such as e-checks, e-cash, etc.

The resulting exchange combinations of these three types of items are listed in the following table, and they cover the main business processes that involve secure exchanges of business items.

Table 1. Resulting exchanges

	Signed Data	E-goods	Payment
Signed Data	Contract signing		
E-goods	Certified email (E-goods with receipt)	Fair exchange of e-goods	
Payment	Payment with receipt	E-purchase	Money exchange

Certified email and payment with receipt can be implemented with non-repudiation protocols. In these scenarios, an email or a payment, together with their proof of origin, is exchanged for its (non-repudiable) proof of receipt. Contract signing is a fair exchange of two digital signatures on a contract. In e-goods exchange or money exchange, parties fairly exchange e-goods or payments. E-purchase is a fair exchange of a payment for an on-line delivery of purchased e-goods.

3.2.2 Security Services

During a course of a business process, business data transferred or exchanged needs different security protections. NR and FE service sub-system will provide the following security services for business data.

Basic (message transfer level) security services:

- Data confidentiality (prevention of the disclosure of sensitive or secret data to parties external to the business process);
- Data integrity (prevention of the unauthorised alteration of data);
- Non-repudiation of origin (i.e. data authentication - a proof that a source of data is as claimed).

Advanced (message exchange level) security services:

- Non-repudiation of receipt (protection against recipient's false denial of having received data);
- Fair exchange (exchanging data with another party fairly, so that either both parties receive the desired items, or neither party does);
- Anonymous fair exchange (engaging in the fair exchange anonymously, so as to conceal a party's identity and location (privacy), which can still be traced by the designated third party, in the case of dispute).

Another important security property of the system is accountability, which ensures that actions of an entity can be uniquely traced to that entity.

Message-level services operate on single messages. Basic security services, such as data confidentiality, integrity and origin, are message-level services as they can be achieved by sending a single message. On the other hand, message-exchange level services, such as fairness and non-repudiation of receipt, are message-exchange level services, as they are properties of an exchange process and require both sending and receiving side to engage in a protocol of some sort in order to achieve them.

4. CONCLUSIONS AND FUTURE WORK

Secure e-commerce must provide reliable execution of business transactions over untrustworthy communication systems, and adequate protection against any misbehaving parties inside an e-commerce system. As one of the most commonly seen e-commerce application is on-line exchange of valuable data, adequate security measures are needed to ensure that the exchange of such data is secure, non-repudiable and fair.

In this paper we have presented the problems of repudiation and unfairness in e-commerce, and the general design of a system for the integrated provision of the security services required for e-commerce

processes. Integrating these services in a e-commerce system will provide a higher level of trust between business parties, as all participating parties will be held accountable for their actions.

Our future work will be concentrated on the further design and development of the FIDES system capable of supporting secure, but efficient non-repudiation and fair data exchange services, and integration of these service with the authentication and access control services to provide complete end-to-end security for e-commerce processes.

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DIGITAL SIGNATURE AND AUTOMATIC DATA PROCESSING

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ABSTRACT

Today many services can be requested via network by sending an electronic message to the service provider. If the data is coded in syntax "understandable" to computers, it is possible to automate its interpretation, elaboration and storage, thus speeding up data processing and reducing human error.

Digital signature can be associated with Internet messages in order to guarantee sender authentication, message integrity and non-repudiation of origin. The verification process of incoming digitally-signed messages is usually performed by the e-mail client, on behalf of the end-user. However, if digital signature is applied to data subjected to automatic elaboration, in order to maintain the abovementioned benefits it may be convenient to automate the verification process as well. The idea is to implement the verification process in the e-mail server rather than the client. In this paper we describe our experience designing and implementing software to automate the verification of digitally-signed messages and web forms in order to simplify the registration of Internet domains under the .IT Top Level Domain.

KEYWORDS

Digital signature, automatic data processing, domain name registration.

1. INTRODUCTION

Verification of incoming digitally signed messages is a critical operation which is usually performed by the receiver via e-mail client. If the verification process is unsuccessful the client alerts the user. However, the user plays a fundamental role in the entire process:

- he/she correlates message content with the sender (usually a relationship exists between sender and content);
- he/she authorizes the client to upload and/or remove certificates of trusted Certification Authorities (CAs) and configures the client for retrieving the CAs' Certificate Revocation Lists (CRLs), in order to ensure the correctness of the verification process.

In system design, it is very important to evaluate the purpose as well as the context in which the digital signature is applied. It is obvious that the automation of the verification process is applicable only within certain contexts. If no semantic relation exists between data and sender which only the receiver is able to understand then the verification process can be transferred to automatic systems, which are able to process a large number of messages in a single time unit. The Message Verify (MV) system has been designed to simplify the registration of Internet domains under the .IT Top Level Domain (TLD), performed by the Italian Registration Authority (RA - <http://www.nic.it/>).

* Work carried out when the author was still employed at IIT-CNR

Usually ISPs (or maintainers) register domain names on behalf of third parties (organizations, associations, persons, etc.) also taking charge of technical maintenance duties such as managing DNS for the requested domain. Each domain name registration requires a two-step procedure:

1. fill out and send a letter of assumption of responsibility (LAR) for the use of the domain, signed by the registrant (via fax or surface mail);
2. send one electronic mail¹ containing technical and administrative data needed for the registration (domain name, organization, admin-c, etc).

The e-mail can be automatically generated by filling out a web form, or manually composed as text file with well-established fields conforming to a pre-defined syntax (i.e. name:value). The elaboration of these data is automatic. The SW for data processing is triggered upon message reception. It performs user access control and verifies syntactical and technical correctness of data (i.e. it checks DNS configuration). If any control fails an automatic error notification is created and sent to the sender. User authentication is performed by means of a password assigned to the ISP. This password permits one to access the web form (for the domain registration) or alternatively it can be (ciphered and) included in the plain text message. With the same password an ISP can view the status of his on going registrations (via web interfaces).

The MV system introduces the use of digital signature instead of user/password authentication. The use of digitally signed messages offers 'strong' user authentication and guarantees data integrity as well as non-repudiation of origin, fundamental for proving data trustworthiness in case of legal problems (i.e. between the RA and its customers). An alternative approach (vs. signed e-mails) is the use of digitally signed web forms. Both technologies are valid: the use of an e-mail server, which is a "store and forward" service rather than an interactive service (such as web) permits masking any processing delay and accidental server unavailability from the user. However, web service offers the user a better awareness of the session progress (data transmission and elaboration).

This study embraces both the design and development of an automatic system for verifying digitally signed messages and web forms as well as the activation of security mechanisms, in order to maintain an adequate degree of operational security and reliability.

2. THE SYSTEM

The MV system has been designed to be transparently placed between the message's arrival and the automatic elaboration of its content. "Transparent" means that the pre-existing legacy SW for automatic elaboration must remain unchanged. This basic requirement was the first constraint on the system design. The system automatically verifies the digital signature associated with an incoming message before transmitting data to the process for automatic elaboration. If the verification is successful, the request is accepted and elaborated; otherwise it is rejected and one notification is automatically sent to the sender.

The operative environment consists of an OpenVMS cluster composed of two DS20 nodes (883 Mhz) sharing a 400 Gb disk array (RAID 5 configuration). The load of the two nodes is balanced in a dynamic way, and any operative intervention, including software installation or node upgrading causes no interruption of service. The MV system is composed of numerous SW Modules written in DCL, and utilizes the cryptography libraries of OpenSSL (<http://www.openssl.org/>). It interacts with the PMDF electronic mail system (<http://www.process.com/>) and the HTTP OSU Web server (Ohio State University Web Server) running on both the cluster nodes.

The system is composed of SW Modules, databases and web interfaces for administration and control. Each Module, which can be executed in parallel on each node of the cluster, performs one specialized function. Figure 1 shows the logical scheme of the Message Verify system, where processes (Modules in execution) are represented by rectangles and databases by ellipses. Modules perform the following functions:

- The Message Input Process performs pre-processing of messages to extract data necessary for subsequent elaboration, synchronization between the MsgVerify system and fax-RA system (receiving LAR) to generate the unique identifier, and message queuing;

¹ The e-mail must be sent from the provider/maintainer within ten working days from the date when the RA has received the LAR, otherwise the domain name becomes available for a new assignment.

A new component was recently added to the system (Form Input Process) for accepting signed web forms containing the domain registration data. Using a Netscape browser (4.04 or higher) it is possible to apply a digital signature to a “web form”. These versions include a JavaScript “method” (crypto.sign.Text) enabling the user to apply a digital signature to input data. Conforming to the PKCS7 and to the “cryptographic message syntax”, Netscape utilizes the “external signature” modality. The result is that the “signed-data” structure will not contain the original data, which must be dealt with separately. In this case the session is interactive and user receives acknowledgement of the signature verification process along with a unique identifier, which can be used for accessing the state of the request. The synchronization of the unique identifier between Messages, Fax, and web forms required rewriting the allocation algorithm. The new algorithm is now able to manage any level of conflict of access to the identifier generator, keeping in mind the fact that faced with a conflict in resource allocation it is simpler and correct to generate an error message to the interactive user (by web access) rather than interfere with the message and/or fax processes.

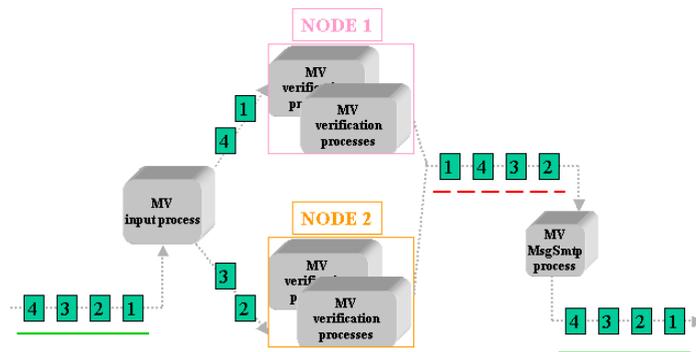


Figure 2. Message flow

2.1 Related work and security issues

The problem of reducing cost of bulk cryptographic operations (and in particular public key operations, which are computationally expensive) has been treated in numerous papers. Two approaches are widely studied: “remotely keyed encryption” and “server-aided cryptography”.

The purpose of remotely keyed encryption is to efficiently accomplish encryption by sharing the computational load between a fast but untrusted device and a slow trusted device. Blaze introduced remotely keyed encryption schemes (RKESs) to support cryptographic applications requiring high bandwidth, such as encryption of on-line multimedia contents, in a secure low bandwidth smart card environment (users’ private keys never leave the smart card). The interesting property of these schemes is that the load of communication and computation required of the smart card is independent from the input size [Blaze96]. Following studies to define the security of RKESs [Lucks97, Blaze98, Lucks99] have been accomplished. In particular Weis applied remotely keyed encryption in a java card environment [Weis00].

Server-aided cryptography refers to the ability to aid small and resource-limited devices in expensive computation. Jakobsson introduced this term while studying how to decrease the local computational cost by transforming a heavy task into a large set of small subtasks carried out by a set of external servers, and performing security analysis of the proposed scheme [Jakobsson01]. By using this scheme he generated inexpensive server-aided batch signatures, showing improved efficiency for groups greater than 20. Recently Ding applied server-aided cryptography in smart but resource-limited devices such as PDAs, cell phones and palm pilots [Ding02]. In particular he generated server-aided signature (SAS) while implementing fast certificate revocation, fundamental for correctness of the verification process. This approach is based on using a partially trusted server, which acts as “security mediator” (SEM) executing the main load of the computation. Two “half signatures”, independent but inter-related, are generated by the SEM and the user to create a SAS signature. A relevant characteristic of this scheme is its on-line nature permitting fast revocation of signing capabilities, which limits damage from potential compromises. However, centralization of the architecture and incompatibility of SAS signature with other signatures types, make it impractical at the moment.

Berson et al. proposed providing cryptographic operations as a network service [Berson01]. Authors designed and built a centralized "cryptoserver" equipped with HW cryptographic accelerators for providing public key operations to clients via their internal network. This system allows clients to benefit from hardware speedups while reducing CPU load as well as the cost of a single cryptographic operation, because the cost of the accelerator is spread out over a large number of clients. Note that this approach differs from the previous ones because it implies that the client must trust the "cryptoserver" with knowledge of his private key. This delegation mechanism practically simplifies the design of the user-server interaction, although it poses a security risk of private key storage and protection. Berson observed that outsourcing cryptography inherently raises questions about the trustworthiness of the computation. However cryptographic operations can be split into two categories: those requiring knowledge of the client's private key, i.e., decryption and digital signature, and the other one needing only the client's public key (publicly distributed by means of his certificate) which are encryption and verification of digital signature. It is obvious that the first category poses "security" issues (of secret key storage and protection) and then requires more attention than the second one. Thus, instead of building a complete cryptoserver, it is simpler to entail a subset of cryptographic operations (encryption and digital signature verification) and limit automation to these ones. In this case, assuming that the communication between the client and server is secure, the cryptographic operations have the same degree of trustworthiness as performing the computation locally.

Our idea is similar to Berson's approach but is less ambitious. The MV system automates only one cryptographic function, which does not require the use of secret keys. For this reason, in comparison to previously discussed schemes, although limited, it appears simpler, cheaper (it is based on free cryptographic SW) and standard, thus inter-operable with any type of signature. The goal is to improve the quality of service offered to a large set of widespread users. In our scenario, the automation of the verification process is possible and appropriate because signed data do not contain any semantic information that only the receiver is able to understand. Therefore, the main security issue of the MV system is its integrity.

If the system is violated then the entire service can be compromised: for instance, if the legacy SW receives input data bypassing authentication, it makes a registration invalid. In the 2001 annual security report CERT affirms: "... the ability to attack a system depends on the 'global' security of the Internet". This implies that at the moment there is no way to implement a totally secure policy but it is important to create a strategy and use combined technologies to fend off intruder attacks. According to this approach, in order to protect the system, different contra-measures have been applied in order to build protection levels with different features (SW design, operative environment, network, etc.):

- the system is designed to be failure-tolerant and robust. It is carefully configured (access control, logging user sessions, auditing of security-relevant events, all features/services not explicitly required are disabled, etc.). Last, SW patches for OS and/or applications are rapidly applied.
- the MV system and the legacy SW are within the same security perimeter.
- protection of network perimeter includes:
 - blocking the transfer of executable files on the Internet gateway and/or e-mail server;
 - configuring servers disabling features/services not explicitly required;
 - configuring routers/firewalls to enable only traffic to authorized servers and ports ;
 - running and maintaining updated anti-virus software;
 - In addition Intrusion Detection Systems, which conduct analyses of live network traffic and Honey pots can contribute to monitoring network and system activities and detecting attacks.

In addition, managing network services in the OpenVMS² environment signifies reducing the recurring security problems typical of other platforms, and compatibility between different versions of software. The potentials of using OpenVMS system are absolutely equivalent to those of the Unix and Windows systems, with the notable advantage of its being one of the least-attacked systems to be found on the Internet today.

At the moment, the drawback of the proposed solution relies on costs of certificate creation and distribution as well as help desk support. The solution is applied to ISPs, which although they are a restricted number, manage nearly all domain name registrations³. This kind of automation will then be suitable for everyone when PKI technology further penetrates e-society.

² The security protection provided by OpenVMS Operating System has been evaluated by the National Computer Security Center, receiving a C2 rating.

³ Direct contract with final users (domain name requester) are possible but discouraged.

2.2 Performance

Before buying expensive cryptographic HW/SW, it is important to evaluate the real load of the system or application to verify whether high performance is necessary or not. First, we must consider that:

- in general e-mail based applications are not required to be as rapid as interactive applications such as web;
- to test the system, the RA set up its own CA and issued certificates only for a restricted set of ISPs, thus implying a low load of the MV system.

To evaluate system performance we undertook a real test in the operative environment. The test was split into two parts: verification, and message delivery to the software for automatic elaboration. In operating system terminology, a job unit can involve the execution of one or more Modules. In the test the job includes all message elaboration between its arrival in the system to its exit. A script was set up to create and send a load of 2000 signed messages to the system. Test results show that better performance can be achieved by activating a single job in each node of the cluster, with the total execution time of 1h and 4 minutes. The activation of more jobs on the same node (multiple process instances) does not produce additional advantages, but provokes a slight increase in total execution time, probably due to competition of processes for access to resources. The average number of domain registrations per month in 2002 was 15.687 (<http://www.nic.it/>). The test was performed with the cluster fully operative and the results showed that the system should be able to process the current monthly load in less than 9 hours. This implies that we do not need to invest in expensive cryptographic HW/SW.

3. CONCLUSION

The Message Verify system was developed to permit automatic elaboration of digital signature in a flow of messages. The experimentation revealed numerous advantages:

- Increased Quality of Service. Digital signature offers strong authentication (vs. the weak "user and password" mechanism), data integrity and non-repudiation of origin;
- Increased efficiency of service compared to signature verification via e-mail client;
- Transparency of service for RA operators. The service is user-friendly – training is not required;
- Reliability of the verification process and document management;
- Low-cost, using free cryptographic software.

As an additional benefit, the use of certificates and secure mail has permitted users to become familiar with these technologies, which have wider application fields. Although the proposed solution implies the initial cost of certificate creation and dissemination, in a (hopefully near) future, when all citizens have their own certificate to access numerous secure on-line services, this kind of tool should be advantageously utilized to obtain strong authentication of sensitive services (i.e. accessing critical resources) directed to a large audience, such as that offered by Public Administrations and Health Departments.

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STRATEGIES FOR HIGH PERFORMANCE E-COMMERCE AND APPLICATION SERVER PARALLELISM

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ABSTRACT

Accelerating e-commerce is an interesting research problem with obvious commercial applications. Improvements in back-end database systems, as well as new network infrastructures, have certainly contributed to better e-commerce performance. However, the growing demand for customized content generation is a continuing challenge. Numerous companies are offering caching solutions based on content components, such as images or video clips, or even the partial results of time-consuming computations. This paper describes some of the future prospects of using parallelism, as well as caching, to provide such dynamic content and discusses the complementary strategies of *computing less* and *computing faster* to improve the performance of content generation and other Web-based computational tasks. The availability of elegant and field-tested parallel programming environments such as JavaSpaces and MPI, as well as a renewed interest in parallel platforms such as Beowulf clusters and the emerging grid computing initiatives all point toward the increased future use of high performance computing techniques in the e-commerce context.

KEYWORDS

Parallel Programming, High Performance Computing, Accelerating E-Commerce, Web Caching

1. INTRODUCTION

Despite the dot-com bubble, the importance of the Internet and e-business methods remains and continues to provide new avenues for commerce, with trends such as Web services and grid computing foreshadowing exciting new possibilities. A key feature of current and future e-commerce applications is the ability to generate customized content for consumer or business services. This paper discusses developments in parallelism and caching, focusing on their ability to power such dynamic content generation. There are two basic approaches to improving the performance of content generation and other Web-based computational tasks. The first is to *compute less* and this strategy is designed to avoid unnecessary computations by caching and reusing any expensive content fragments. This approach had been widely implemented in various forms of Web caching and such have mechanisms have proven quite useful in reducing the need for repeated computations, as well as for distributing content and thereby reducing overall Web delays. The other approach is to *compute faster* and the idea here is not to avoid, but to speed up computations. Given the pace of technological advances, an easy and sound migration strategy has been simply to upgrade computer hardware. However, a more scalable alternative is to use parallelism, which has the potential for enabling novel Web-based services that were previously impractical. While parallel programming has been used extensively for scientific computing, it has not been widely adopted in many business applications. Its most obvious use in general business computing is prepackaged within enterprise-class database systems. To a lesser extent, a simple form of parallelism is reflected in the use of multiple servers in the Web tier. The paper discusses the use of parallelism in the

application server layer. By using general parallel programming environments, the power of parallelism can be brought to bear on the computationally intensive application server tasks as part of the software development process. Of course, a combination of both caching and parallelism is ideal and is well supported by some parallel programming approaches.

Application server parallelism can be employed in two ways. *Intersession parallelism* is the simplest form and basically improves throughput by assigning end-user sessions to different processors. In this approach each session still runs on a single processor and requires the same amount of time. This style of parallelism uses the same sequential algorithms and does not require any sophisticated parallel programming. *Intrasession parallelism* applies multiple processors to a single session to improve response time. This form of parallelism requires the development of truly parallel algorithms. That is, new methods of accomplishing computationally intensive tasks in parallel must be designed. This requires parallel programming skills above and beyond the typical business programmer's experience. However, the benefits may be substantial, enabling new classes of information services such as molecular modeling in the bioinformatics area, or customized weather models, or personalized quantitative financial models. There are some interesting industry-wide trends that should place even more emphasis on complex and expensive tasks in the application tier. Some of these include (1) Proven parallel programming technologies, such as JavaSpaces and the Message Passing Interface (MPI) that provide the toolkits necessary for implementing parallelism in the application server tier. (2) Large collections of networked workstations, explicit architectures such as Beowulf clusters, and emerging Web-based grid computing that provide interesting platforms for parallelism, and (3) Web services standards that allow more off-the-shelf components to be used and ease the interoperability challenges. All of these trends create opportunities for high performance e-commerce centered in the application server tier.

2. TIERED ARCHITECTURES

Multi-tiered information system architectures are part of the commonly accepted software development environment. The three basic server tiers (Web servers, database servers, and application servers) represent the most critical components of many current information systems and present very different performance-related challenges. Web servers are typically off-the-shelf solutions that implement accepted Internet standards and manage the connections of multiple clients. Large-scale implementations require multiple servers, load balancing strategies, and even caching capabilities. However, most Web server systems are robust and commonly available technologies. Database servers are the most mature of the three tiers and major database vendors offer sophisticated software packages, with a host of performance tuning technologies, including a variety of index structures, memory management, query optimization strategies, and parallelism. The relational database market is fairly mature, with a few leading vendors holding large market shares. These database engines provide high performance data manipulation capabilities, as well as embedded programming languages for custom implementations of data-intensive tasks. However, most of the customized software and integration technologies reside in the application server tier. Mohan, a leading database researcher at IBM, noted that "DBMS researchers and practitioners should pay more attention and influence work in the application server area!" [Mohan 2002]. The growing size and complexity of multi-tiered systems, as well as trends such as Web services, will only increase this emphasis on the application server technologies. Therein lies an opportunity to use those parallel programming techniques that have been nurtured in the scientific computing field and apply them in the business domain for high performance e-commerce applications.

3. PERFORMANCE BOTTLENECKS AND WEB DELAYS

In considering the performance bottlenecks and delays in Web-enabled systems, much attention is focused on the delays inherent in the many protocols and processing steps in the Internet such as the foundation TCP/IP

protocols, DNS lookups, and HTML requests that comprise typical Web interactions [Zari et al. 2001]. While these delays are important, they are mostly external to the software development environment and tiered architectures discussed above. The Web servers, application servers, and database servers that are used to construct most systems simply rely on the existing Internet infrastructure. One strategy that has been used to affect performance is Web caching, which has been extensively applied to improve the performance of Web-based systems. It temporarily stores content fragments and fulfills any new request from cache rather than re-computing the content, and such caching strategies can reduce network traffic and latency by moving content fragments "closer" to end-users. In addition, fewer server-side resources are utilized since requests are satisfied from cache rather than server processing [Zari et al. 2001]. The caches can be located at different points such as forward proxy caches, edge-of-Internet caches, and edge-of-enterprise caches for improving response time, bandwidth usage, and Web delays. Static caching stores fixed content fragments such as images, HTML pages, or chunks of text. These techniques improve network usage, but do not affect server-side resources since the fragments are not computed. The dynamic content that provides a customized user experience does require on-demand computation and dynamic caching techniques. This heavy computational burden is the reason that many Web-enabled systems minimize dynamic content generation. However, this is precisely the approach that delivers exceptional customer experiences and can enable whole new types of Web-based services. In order to speed up or scale up such computations, both caching and better computing approaches are required. Parallelism in the application tier stands out as one such approach.

4. THE ROLE OF PARALLELISM

One of the challenges of parallelism is to develop new algorithms that are suitable for parallel execution. Two approaches have been pursued in the past. One approach is to take a sequential algorithm and discover opportunities for parallelism using specially developed compilers. Looping constructs, particular mathematical functions such as matrix operations, arrays, and other code sections offer opportunities for automated parallelism. These types of tools have been useful in domains like scientific computing, but are ultimately limited by the underlying sequential algorithms. A second, and more scalable approach is to develop new parallel algorithms that often rely on very different parallel approaches to computational tasks, requiring a creative leap and original software development. An intriguing collection of research projects and programming practices have arisen from this perspective [Carriero and Gelernter 1990] and [Foster 1994]. Such efforts focus on the design and implementation of truly parallel algorithms and the general patterns of programming that emerge.

In the context of e-commerce and the three server tiers, parallelism can play several key roles. The most mature use of parallelism is in the database tier. Relational database systems are set-oriented and usually manipulate data in aggregate. In addition, the structured query language (SQL) is declarative rather than procedural, meaning the results of a query are described without specifying the detailed procedural methods for accomplishing the retrieval. This constrained, high-level language provides natural opportunities for parallelism. Database researchers and vendors have implemented a variety of parallel algorithms for the major relational database operators. In the Web tier, a simple parallel strategy of multiple Web servers and load balancing can be used to handle many simultaneous connections. This approach is often used to maintain many sessions rather than speeding up any single session. Since connection management and Web protocols are clearly driven by standards, there are fewer opportunities to apply customized parallel algorithms. The lightweight nature of typical Web interactions at the server level and the dominant network delays make it difficult to implement more sophisticated parallel techniques. Therefore, load balancing is usually sufficient and more interesting opportunities for parallelism may be found in the application tier.

5. PARALLEL PROGRAMMING ENVIRONMENTS

Among the fundamental features of parallel programming are mechanisms for communication and synchronization. Processes must be able to divide up a problem, share intermediate results, and collect final answers through some form of interprocess communication. Dependencies in a parallel algorithm may require certain processes to wait for the results of other processes using some type of synchronization mechanism. An elegant example of a parallel programming environment that provides these key features, as well as other benefits, is the Linda model [Carriero and Gelernter 1990]. The Linda model, along with some interesting new features, forms the basis for JavaSpaces which re-implements the Linda programming model, but adds multiple spaces, persistent storage features, and some support for transaction management [Freeman et al. 1999]. Six or so simple operations are used to read and write from a logically shared, associative memory or “tuple space.” This associative memory supports an *uncoupled* programming style and anonymous communication, simplifying algorithm development and debugging. In addition, JavaSpaces includes the notion of object leases that provide control over the duration of the items in a space. Therefore, caching benefits can easily be provided using this parallel programming environment. Objects that remain in a space are in a sense cached for future operations and the lease management facilities can be used to create cache replacement policies. Thus performance improvements can be achieved both through parallel execution and object caching.

The Message Passing Interface (MPI) is one of the most popular parallel programming environments. It is freely available for many computing platforms. Like JavaSpaces, MPI provides mechanisms for process communication and synchronization. However, in MPI the communications are not anonymous and do not rely on a spaced-based programming model. This means some lower level features may need to be implemented, but MPI provides a second interesting parallel programming environment for application server development.

6. CONCLUSIONS

More and more information systems are providing Web-enabled services. Most often these systems are multi-tiered, with logically or physically distinct Web servers, application servers, and database servers. There is some use of parallelism in these current architectures. For instance most relational database systems incorporate specific algorithms and optimization strategies for parallel query execution. In our efforts to move toward high performance e-commerce, the application server seems like fertile ground for further applications of parallelism. While there has been strong interest in caching, the power of parallelism has received relatively little attention. The pieces are falling into place. There are elegant and field-tested parallel programming environments such as JavaSpaces and MPI. There is renewed interest in parallel platforms, such as Beowulf clusters and the emerging grid computing initiatives. There are also Web services standards that will enable more comprehensive and powerful electronic linkages. All of these factors point toward the increased use of high performance computing techniques in the e-commerce context.

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SECURE COOPERATIVE SOFTWARE DEVELOPMENT FOR HANDWRITTEN CHARACTER RECOGNITION¹

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ABSTRACT

The advent of the world wide web (www) and hypertext transfer protocol (http) has greatly changed the use of Internet. It has been, and probably will remain for several years, one of the fastest and easiest ways to share documents and exchange information.

People involved in computer science research and, specifically, in cooperative software development need privacy and authentication when perform network operations. The existing Internet, on the contrary, is basically an “open network”. It does not provide any kind of security. Everything can be eavesdropped, altered and modified.

In this paper a new approach for cooperative, network, secure software development is presented. It is based on the secure socket layer (ssl). The khoros framework has been used to develop the recognition software. Distributed software development requires not only the knowledge of specific case tools like, in this case, khoros, but also the management of complex operating systems and network protocols. An extension of the khoros-programming paradigm, to include distributed development, is here presented. This solution allows an authenticated software exchange in Internet. It can be used for securing file sharing of different software structures. A test implementation that extends OpenSSL is here described.

KEYWORDS

Cooperative software development, Secure development environment, Pattern recognition.

1. INTRODUCTION

Character recognition is mainly based on intelligent system applications. Complex and sophisticated software with self-learning capability is generally used. The recognition process consists in feature extraction, in hypotheses formulation, and in validation to take a decision [Impedovo and Salzo - 2000].

Intelligent system software development requires the cooperation of many researchers, each one having peak knowledge of his particular field of study. The members of a research group not always live in the same place, generally use different tools to exchange information and to share documents, but are interested to achieve the same goal.

This paper aims to present a solution for secure, distributed and cooperative software development in Internet. This solution allows authenticated researchers to upload and download software components. The shared space contains only and exactly the software produced by authorized developers.

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The proposal realizes not only a storage system based on Internet protocols, but also a way to cooperatively build secure software in Internet.

The proposed solution allows application software developers to automatically update a shared system, in a trusted way. Researchers, authenticated by certificates, can easily perform secure network operations. All necessary decisions and computations are automatically performed by the system.

The communication system hides operating system, environment and security details. It allows people to concentrate only in application software development. Abstraction level and operational complexity are the same required to perform equivalent operations in the local graphical environment.

The implementation is based on nodes that can act as both service clients and service servers. The system can be used either to upload or download files or to execute specific secure remote commands. A Secure high-level Internet service, based on secure channels, is provided.

In section two requirements of cooperative software development are reported. The proposed solution is described in section three. The experience of the khoros glyph transfer is presented in section four. Conclusions are in section five.

2. REQUIREMENTS OF COOPERATIVE SOFTWARE DEVELOPMENT

The problem relates to how a research group can develop, on a local machine, and securely upload, in a shared trusted space, software components. The constraints deal with the fact that working teams generally hasn't knowledge of security protocol usage, and developers don't know low level programming details and software organization.

Here it is supposed that the researchers have already organized the skeleton of the system and that the planning phase has been already carried out. It is also supposed that the developers have already defined the function structures and the interfaces of the recognition system. Since now on each member has to develop, maintain and update the software in his site and update the shared system.

In the field of character recognition the problem of software integration and software reuse is crucial. Here many algorithms are necessary to solve the problems related to various processing phases. In order to manage the enormous number of algorithms and to quickly prototype software systems, the use of specific computer aided software engineering (case) tools and of software frameworks is required. Several software frameworks have been proposed: khoros [Rasure and Konstantinides - 1994], HIPS [Landy et al. - 1984], KBVision, SPW and HUE [Cracknell and Downton - 1999]. In this paper the khoros framework has been considered.

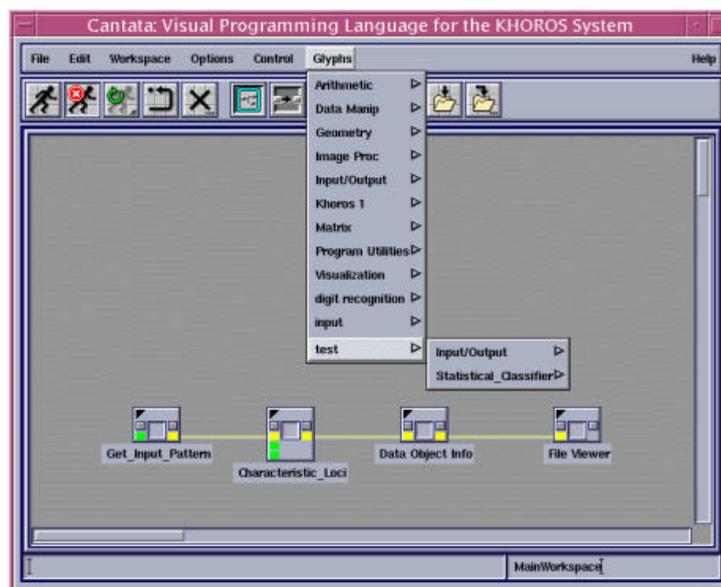


Figure 1. Toolboxes, glyphs and workspace in khoros

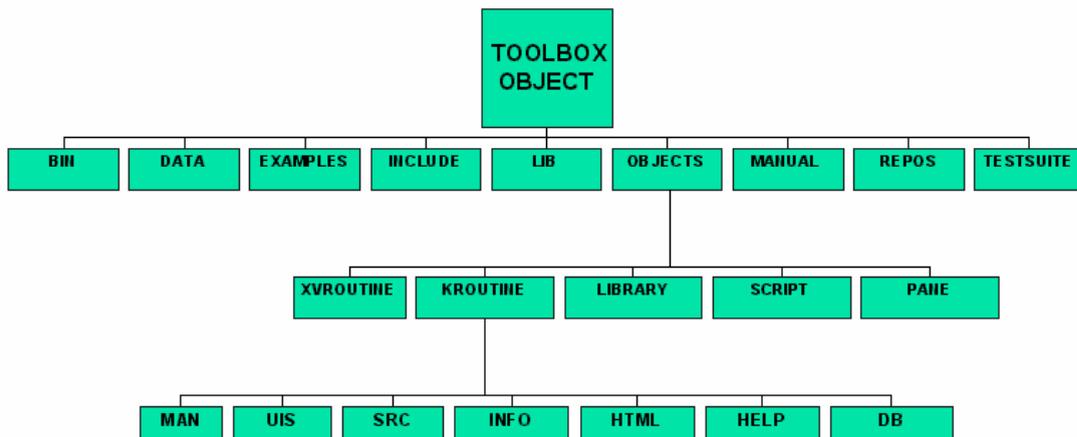


Figure 2. Toolbox object directory structure

New khoros glyphs and toolboxes can be developed to implement specific functions of any application. These are added to the already existing ones and integrated in the environment. The communication between the glyphs occurs by mean of the kobjects, structures that abstract the data flows between functions. Appropriate methods allow the management of kobjects.

In cooperative software development newly implemented glyphs must be uploaded in a shared space. Shared wrong implementations need to be downloaded in the local machine, modified and reloaded. After each transfer, the entire structure of the glyph needs to be rebuilt. All software components must be recompiled and reinstalled.

Each toolbox, and each glyph contained in it, corresponds to a complex directory structure. Every directory contains specific files. The end users update some files; the framework updates the others. Moreover, the khoros development environment runs on personal computer or on workstation systems, and can be compiled within different operating systems (Linux, Windows, Unix). The guest computer can have the same architecture of the machine containing the starting glyph or a different one. It can use the same operating system or another one.

While working on his computer, the developer uses the khoros graphic interface. If an advanced communication support is not available, many command line operations must be performed to transfer a glyph in another machine. Various programming details of the operating system and of the development environment must be known. Generally this knowledge lies outside the researcher's field.

Since the command sequence is always the same in every architecture and operating system, commands can be enclosed in a piece of code. By using the scripts the developer becomes able to act on the remote machine nearly in the same way in which he acts on the local computer. However the access control based only on login and password is not enough to guarantee the authenticity of a programmer that updates the shared recognition system. The transmission in clear of files can be object of computer piracy actions. In effect an efficient access control and a secure data transport are necessary. A secure file transfer is not sufficient. The only use of secure terminals is not enough. With secure terminals the number of allowed operations in the shared space cannot be controlled. Indeed, a reduced set of operations on the remote machine is necessary.

In this contest, it results necessary the development of a solution that allows both a secure file transfer and a controlled execution of remote commands. Such an implementation must hide all security and environment details and must grant a strong authentication of all people involved in software development. A trusted distributed environment need to be realized.

3. THE PROPOSED SOLUTION

Taking advantage of all security facilities supplied by the ssl protocol, a new method for a secure file transfer is proposed. Intelligent system software components have been considered.

A prototype that fulfils constraint imposed by the network cooperative software development is here described. The application has been developed specializing the OpenSSL [AAVV Welcome - 2000] implementation of the ssl protocol.

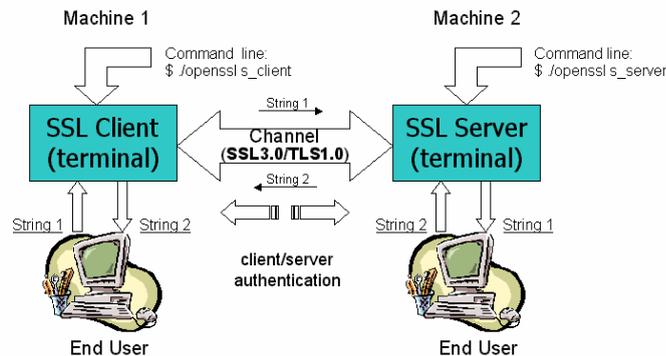


Figure 3. OpenSSL services

OpenSSL supplies all facilities for message codification, certificate production, digest calculus and key generation, but has no computational capability. It provides only secure channels and allows only two terminals, a client and a server, to exchange strings in a secure way. End users, operating outside the system, interpret data and do all necessary computations.

The solution here presented extends the OpenSSL. It includes in the package all necessary computational capabilities to realize the desired service. All the intelligence to carry out operations is no longer furnished by end users at terminals, but is included in the application. Messages to be sent through the secure channel are produced by the application services. Messages arriving from the secure channel are captured and elaborated by the system.

Domain specific high-level function interfaces the ssl secure channels. Messages directed to output procedures are intercepted and inputted into the application services. Messages produced by application services replace those arriving from the input procedures, and are sent into the secure channels.

Implemented services realize all the necessary operations to support cooperative software development. The ssl protocol warrants that only strongly authenticated software developers can operate. The glyphs produced only by authorized people arrive in the shared space. The stored glyphs implement exactly the recognition functions developed by researchers.

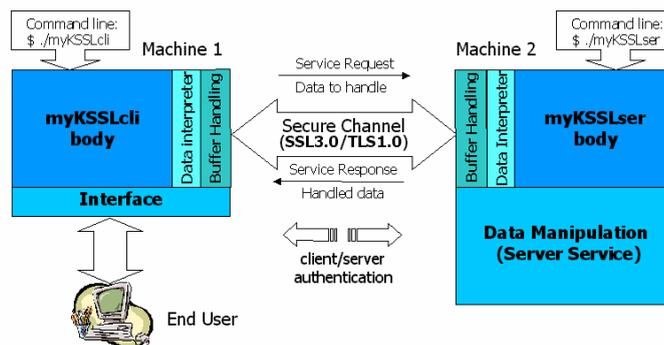


Figure 4. The proposed solution organization

The communication system consists of a server and a client part. The server waits for service requests arriving from a secure channel. The client, when particular conditions occur, triggers events and, if necessary, forwards service requests to the server.

Both client and server can perform computations. The client performs local computations. The server performs remote computations. A machine can be powered by only one of the two components or by both.

4. THE KHOROS GLYPH TRANSFER

A real experience has been carried out transferring and installing glyphs of a program for character recognition. Since khoros can be installed in different platforms and operating systems, a distributed, multi-platform, client-server application has been prepared.

The application executes series of operations, performed in a prearranged order. Firstly, if necessary, it creates a toolbox; then it creates the new glyph skeleton; then it transfers the modified source code files; finally, it installs the modified glyph in the target environment. All these services realize operations that can be grouped into two classes. Services implementing a secure telnet can be collected in the first class. Services implementing a secure ftp can be collected in the second class. The end user can use a simple interface to realize the operations. The right inputs and the command sequences are always suggested.

Moreover, in the same session a command, once performed, cannot be repeated. This avoids that opened connections allow an iterative, and potentially dangerous and uncontrolled, software substitution, without sufficient control. A timer on opened sessions avoids that connections remain opened and unused for long time.

Reactions can be triggered by a pattern matching mechanism applied to the properties of the documents. If correctly used, document properties can expose a useful set of information on documents and can be used to activate the appropriate behaviour of the application.

In this solution the searched pattern is not matched against properties of each single element, but against the properties of a particular element in the directory structure of the objects. A toolbox object can be in only a status among the following: scratch, work, development, and production. When the status changes, say from development to production, the entire toolbox can be moved from one machine to another. A software object is a collection of many and different files. When a local install is performed, the executable files are updated; consequently an automatic update of the entire software object in the remote machine can be performed.

In this way, the properties of a root element are inherited by all the elements in a directory tree. When a matching role is satisfied, all files included in the tree can be copied or moved to a given network location.

The implementation has bi-directional operating capabilities. Tests have been carried out to verify the correct execution of the system either in upload and download phase. The following machines have been utilized: one laptop mobile computer having a Linux RedHat operating system; two Sun workstation, model Ultra, having a Sun Solaris operating system; one desktop PC with a Linux Suse operating system. All machines had a khoros development environment. The prototype application was installed and well configured in each computer.

Some glyphs that realize the principal phases of the handwritten digit recognition were developed. They implemented the pre-elaboration, the segmentation and the recognition phase. Three different authors, working on three machines with different architecture and operating system developed test glyphs. As soon as the glyphs were completed, they were transferred inside the fourth machine containing the whole intelligent system. In this last machine the glyphs were installed and the perfect integration with the rest of the system was verified.

From that moment, all the members of the development group could access each new glyph, either to use it or to bring changes or corrections. If updates resulted necessary, everyone could download the glyph on his own machine and add necessary modifications. After changes, the modified glyph was reinstalled in the shared space.

In the first testing phase all the glyphs were uploaded, from the client computers, to a Sun workstation configured as the server. Then from the PC, configured as a client, same glyphs were downloaded from the Sun workstation, still configured as the server. The downloaded glyphs were rearranged and returned into the shared space on the server. In each transfer phase the correct program execution on every different architecture and operating system was verified.

End users founded the application easy to use. No particular training resulted necessary to use the experimental cooperative system.

5. CONCLUSIONS

This paper investigates a method to securely develop distributed software for character recognition. An enhancement to a particular system (khoros) is presented, but the solution can be applied to other different environments. It presents a solution that hides network and security details to high-level software developers, while ensures a trusted and distributed development environment based on certificates.

Other solutions analysed, generally used for Internet file sharing, based on web downloading, peer-to-peer file sharing and WebDAV [Whitehead and Wiggins - 1998] don't satisfy the constraints imposed by cooperative software development. Indeed, software for character recognition is produced using complex frameworks such as khoros [Rasure and Konstantinides - 1994]. The distributed development process requires the authentication of all participants and privacy in communications.

This solution is well integrated with development tools, hides all details and doesn't compromise the ssl protocol security.

The main differences of this implementation with respect to other structured document spaces systems, such as Lifestreams [Freemann and Fertig - 1995] and Placeless Documents [Dourish et al. - 2000], are not only the ability to react to document changes via a set of rules, but also security support and tree government. The Lifestreams system uses timelines as a major organizational resource to manage document collections. Placeless Documents treats the content of a document space as a "view" of document hierarchy, produced by a query, applied to some attributes associated to the same documents in the space.

This multi-platform, distributed, client-server, Internet application is a proposal for a secure cooperative network software development. This tool, during the development and test phase of a recognition system makes cooperation and information exchanges simple and secure.

Actions are triggered by events associated to document properties; computations are all performed within the distributed system. Only a reduced set of operations is allowed on the remote machine. Only strongly authenticated people can perform remote commands. The ssl protocol warrants security in communication. The khoros environment supports software development.

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DERIVING ONTOLOGY-BASED METADATA FOR E-LEARNING FROM THE ACM COMPUTING CURRICULA

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ABSTRACT

Using metadata is very important for achieving best results in finding and reusing e-learning material. Metadata are however effective only if there is a common agreement on the terminology used. Defining an ontology is a way out, but creating a good ontology and reaching a consensus on it is a non trivial task. In this paper, we claim that an ontology for Computer Science can be extracted as a side-result from the work made by an ACM committee on Computer Science curricula. We extracted the ontology, and we suggest that it could/should be used for defining metadata on e-learning material that is concerned with the Computer Science domain. We provide both an XML and a DAML+OIL representation of the ontology. Also, we suggest a possible way to navigate the metadata that allows enriching each lesson with a set of related material automatically extracted from the repository of e-learning material. Finally, we discuss possible additional uses of the ontology, and the exportability of our approach to other disciplines.

KEYWORDS

Metadata, Ontology

1. INTRODUCTION

It is well known that the production of e-learning material is an expensive task: therefore the perspective of being able to “write once, use anywhere”, i.e. the ability to reuse learning material is a very appealing one. Unfortunately, as software engineers know, writing for reuse is difficult and costly, and an infrastructure is needed to be able to effectively find reusable material. Metadata’s mission is to facilitate reuse in different environment. Some metadata are “container oriented”, i.e. they are meant to inform the learning management system about format, sequencing etc. of the material. Other metadata are meant to facilitate the use of the material by teachers, by curriculum designers and by producers. Several standards have come out to define a common convention for metadata definition and representation (IEEE LTSC P1484.12, , AICC AGR, ADL SCORM, Dublin CORE METADATA INITIATIVE etc.).

While container oriented metadata are well accepted and used, there are ongoing discussions on the other kinds of metadata that create conflicts and hamper the adoption of meta-data technologies. An interesting point of view is expressed by [Nilsson 2002]: they argue that the image of meta-data as being objective information about data is wrong, or at least incomplete. This image is tied to the fact that most meta-data aware systems only contain indisputable information such as title, author, identifier, etc. However, data description about the type of granularity of objects, pedagogical purpose, assessments and learning objectives, etc., represent subjective interpretations of resources. They therefore support the existence of multiple, even conflicting descriptions, and maintain that the RDF technology allow to implement and use such subjective metadata.

However, even to express subjective views we need to agree on a common vocabulary that specifies what we mean. That's where the notion of ontology comes in. According to Gruber "A specification of a representational vocabulary for a shared domain of discourse -- definitions of classes, relations, functions, and other objects -- is called an ontology" [Gruber 1993]. An ontology is therefore a controlled, hierarchical vocabulary for describing a knowledge system. It abstracts the essence of concepts, and allows distinguishing various kinds of objects and defining the relationships among them.

Besides the subjective vs. objective metadata issue, we believe that the part of the problem with metadata and with reusability stems from the lack of a common ontology. In the present paper we propose an ontology for describing the content of e-learning material in a particular domain: Computer Science. We also discuss the extensibility of our model to other disciplines.

2. DEFINING AN ONTOLOGY

The advantages that an ontology offer are obvious: "Gradually, computer scientists are beginning to recognize that the provision, once and for all, of a common, robust reference ontology -- a shared taxonomy of entities -- might provide significant advantages over the ad hoc, case-by-case methods previously used." [Smith 2001]. The problem is: how is it possible to produce an ontology?

A good ontology should cover the target domain in an exhaustive way. Moreover, an essential property is that it should be accepted by a broad community: ontological commitment is defined as the agreement of multiple parties to adopt a particular ontology when communicating about a specific domain. Both these features are very difficult to achieve. Therefore some research has been devoted to solving the problem of how to construct a good ontology. [Holsapple 2002] list five possible approaches to ontology design: Inspiration, Induction, Deduction, Synthesis and Collaboration. Inspiration is based on individual viewpoint about the domain; Induction and Deduction start respectively from specific cases and from general principles relative to the domain. Synthesis puts together existing ontologies to generate more general or more agreed-upon ones. Collaboration is somehow similar to synthesis, but while synthesis puts together several efforts by combining the finite products, collaboration obtain the result by putting together the processes that would generate individual ontologies. According to [Holsapple 2002], the last approach has a built-in evaluation facility to access quality and acceptability of the resulting ontology. In their conclusion, they claim that a collaborative approach can be used to design ontologies for many applications, among which distance learning.

We state that in some fortunate cases yet another possible approach is possible, i.e. to reuse (possibly implicit) ontologies that were agreed upon within a framework in a different setting. We demonstrate such case. In 2001 the Association for Computing Machinery (ACM) published the result of an excellent work for recommending undergraduate program in computer science. We notice that in doing that, they went through the definition of an ontology that has both the nice properties above mentioned: it covers exhaustively a domain, and is the product of a large, collective work that encountered a very broad acceptance in the Computer Science community. We therefore propose to reuse such ontology for expressing the computer-science-domain-specific metadata of e-learning artifacts.

3. THE ACM COMPUTING CURRICULA 2001 FOR COMPUTER SCIENCE

Since forty years, ACM gives recommendations for the undergraduate program in computer science: the process produces a new recommendation approximately every ten years [ACM1965,ACM1968,ACM1978, Tucker 1991] Recently, a new recommendation was released in its final form [ACM2001]: the Computing Curricula 2001 for Computer Science (CC2001). More than 150 people were directly involved in the focus groups established to contribute to the process. Their work took three years: the task was defined in 1998, and the final version is dated December 2001. The stated goal was "to review the Joint ACM and IEEE/CS Computing Curricula 1991 and develop a revised and enhanced version for the year 2001 that will match the latest developments of computing technologies in the past decade and endure through the next decade". To ensure the broad participation necessary for success of the project, fourteen knowledge focus groups

representing a wide range of constituencies and areas of expertise were established. Six pedagogy focus groups were in charge of developing a holistic perspective and to address a variety of questions that transcend the boundaries of the individual subdisciplines. The report has been widely reviewed by academics and practitioners through a series of three public drafts, and feedback was obtained through sessions at conferences and meetings, including the Special Interest Group on Computer Science Education symposium (SIGCSE), the Frontiers in Education conference (FIE), the World Congress on Computers and Education (WCCE). The final document was endorsed by the ACM Council in November 2001 and by the IEEE-CS Board of Governors in December 2001.

Although the definition of CC2001 is strongly influenced by educational practice in the United States, the intent was to ensure that the curriculum recommendations are sensitive to national and cultural differences so that CC2001 may be useful to computing educators throughout the world (for instance, at the University of Trento, Italy, we found it to be very useful for checking content and structure of our own CS curriculum). So we can conclude that the work done by ACM meets the requirements to cover a domain in an exhaustive way, and to be accepted by a very broad community. However, its goal was not to define an ontology usable in the e-learning domain, but rather to be a reference for building a traditional college curriculum.

We notice that in the process of defining the curricula, an intermediate step is the definition of an ontology. We propose that this intermediate step be used as the ontological foundation for building metadata that allow indexing and reusing e-learning material in the Computer Science domain. Moreover, it can be used to provide a metalevel navigation tool that enhances the usability of e-learning material. To illustrate the reusability of CC2001 as an ontological foundation, we shortly describe the structure of the results that it provides.

One final result is the definition of a suite of courses, subdivided into three categories: introductory, intermediate and advanced. Prerequisites and syllabus are specified for each course (actually, only the 47 introductory and intermediate course are covered in detail: the 80 advanced courses are not fully described in the document). Another final product is the set of "Curriculum models". The report identifies six approaches to introductory computer science that have proven successful in practice, four thematic lines for presenting the intermediate-level courses, and some other example of curricula as a whole.

As we mentioned however, the most important part for our goals is the intermediate step that allows defining courses and curricula: the definition of the Computer Science body of knowledge, i.e. the catalog of "knowledge elements" appropriate to undergraduate computer science programs. The CS body of knowledge is organized hierarchically into three levels. The highest level of the hierarchy is the area, which represents a particular disciplinary subfield (e.g. "Human-Computer Interaction"). The areas are broken down into smaller divisions called units, which represent individual thematic modules within an area. Each unit is further subdivided into a set of topics, which are the lowest level of the hierarchy. For instance, the topic "Online communities: MUDs/MOOs" belongs to the unit "HCI aspects of collaboration and communication" that is part of the area "Human-Computer Interaction". Each unit has a number of learning objectives that are associated to it: for instance, one of the learning objectives of the unit "HCI aspects of collaboration and communication" is to "discuss several issues of social concern raised by collaborative software" (typically there are approx. 5 learning objectives per unit).

In total, the body of knowledge is divided in 14 areas, 132 units and 950 topics. The units are further classified as belonging to the "core" or being "elective", the core being composed by the 64 units for which there is a broad consensus that the material is essential to an undergraduate degree in computer science. We believe that the expression of body of knowledge is a perfect ontology for describing e-learning material in the field of Computer Science: it is granular enough to be precise, it has aggregation relations that allow finding related/similar material, and defines a vocabulary that removes ambiguity.

4. REPRESENTATIONS OF THE ONTOLOGY

The CC2001 document comes with two appendixes: Appendix A-CS Body of Knowledge and Appendix B-Course Description.

Appendix A & B DTD

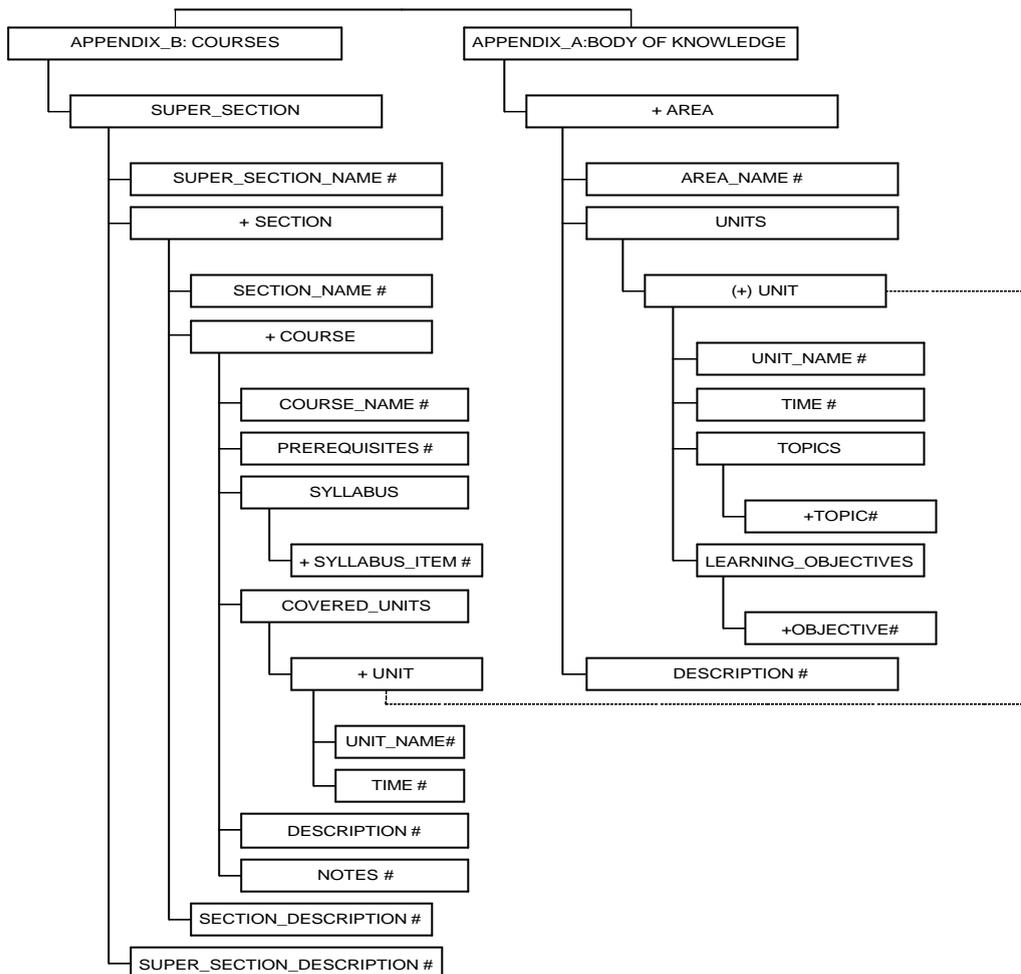


Figure 1. The DTD structure for the XML description of the Computing Curricula 2001 Computer Science. + indicates “one or more instances”, # indicates that the node is a leaf (although it might contain CDATA). The UNIT tag is present in both Appendices, and refers to common data.

Appendix A contains the detailed structure of the Body of knowledge: for each area is given a short description and the list of units. For each unit is specified if the unit belongs to “core”, a measure of its extent (according to a metric measured in conventional units called “hours”, although the document does not endorse a particular teaching style), a list of topics, and a list of learning objectives.

Appendix B contains a list of courses, grouped in sections (introductory, intermediate and advanced). Sections may be divided in alternative tracks (object-first, hardware-first etc.).

Courses contain a description, a list of prerequisites, syllabus, a list of covered units and sometimes additional notes. (“Units” are basic building blocks and are referred in both Appendices).

We extracted information from the CC2001 pdf file by defining a grammar that could feed a parser to automatically extract data and format them in the form of an XML file. We could not define a grammar that would respond to all the needs: although the Appendices are highly structured, their structure was probably not formally defined. Moreover, accidents like page numbers ended up in the text file that was passed to the parser. We had therefore to do some fine-tuning by manually adjusting the XML data. Finally, a DTD was defined for each Appendix so that we could check the syntactic correctness of the resulting files.

Figure 1 shows a graphic representation of the structure defined by the DTD.

The representation provided by the DTD+XML files is “pure” in the sense that it reflects the structure given by the ACM committee. However it is not completely satisfactory because it is limited to the

representation of a taxonomy. An ontology could add more semantic relations than the simple containment. The simple XML representation however is not suited to incorporate additional relations, such as “is needed for”, “is important for” that would be useful to select related material according to its relevance. These and similar relations would increase the usefulness of the ontology, and therefore it is important to choose a representation that allows their inclusion. We therefore transformed the primitive XML data in a DAML+OIL representation [Horrocks 2002]. Of course, by extending the original data with added information we risk losing the wide consensus that should be implicit in the original representation.

XML and DTD files for Appendix A and Appendix B, as well as the DAML+OIL representation of the ontology are available on the web site <http://latemar.science.unitn.it/Ontology>.

5. POSSIBLE USES OF THE ONTOLOGY

As we mentioned, defining a common vocabulary and having good metadata enhances the chance of finding material (while studying, or while producing new lessons) and makes reusability possible. It also allows better knowledge management, information exchange and enables intelligent agents.

Also, it allows different navigation paths that pass (implicitly or explicitly) through metadata space. We are currently exploring such navigation. We envision a navigation system that allows students to perform a kind of navigation that is traditionally not allowed by standard hypertextual systems. In particular, we wish to allow navigation on a metalevel: at any time a student should be able leave the e-lecture s/he is currently engaged in, and move to a more abstract level (i.e. the metadata level), finding hyperlinks to related topics, and then plunging down in material that deals with the chosen topic. The idea is expressed in Figure 2.

In the figure, the lower plane represents the traditional hypertextual space (we will call that “content space”). Elements within the plan represent learning material, and arrows in the plane symbolize hyperlinks. The upper plane is the ontology plane. Entities in this plane are defined by ontology vocabulary. Thin arrows in the ontology plane stand for the relations among entities. A student’s path (shown as the set of thick arrows) could start from the learning material, jump on the metadata level (i.e. on the ontology plane), follow relations on that plane and go back to learning material, performing an hyper-jump that was not anticipated by the producer(s) of the learning material: in fact it could end up looking at some learning object that belongs to a different course, but that is related to the material that was at the origin of the hyper-jump.

Such navigation could be started in many ways. An explicit form could be based on hyperlinks (to be placed for instance among the navigational options, typically as headers or footers of the page) that point to the “ontological space”. When followed, these links would bring either to automatically synthesized pages that show the available links both in the ontological space and back to content space. Alternatively, the hyperlinks could activate a concept navigation tools, like the ones provided for navigating topic. Leaves in the topic maps should then expand in references to material in content space.

We expect the explicit metadata navigation to be too abstract for students, but very useful for teachers who try to reuse learning material and to explicitly reference existing material (e.g. as a mean to cover prerequisites, or as additional material).

For students we are working at a different reification of the hyper-jumps idea. Each e-learning document will be enriched by navigation headers and footers that point to “related material” and that opens an automatically generated page that list possible destinations points, grouped by (related) topic. The related topics can be chosen as the siblings of the topic to which the currently explored material belongs. In this way jumps through ontological space would happen without an active participation or awareness of the student. The tool that automatically compiles a list of related material and adds it at the end of each lecture in the repository is in the final development stage and should be ready by the time of the conference. We implemented such tool that will be described elsewhere.

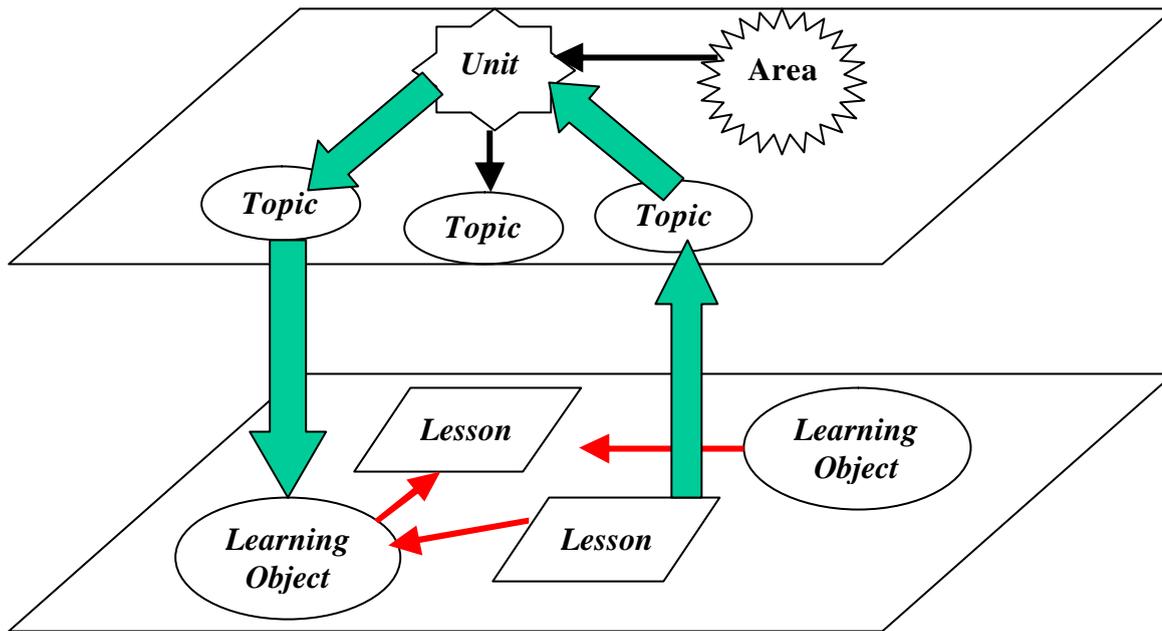


Figure 2. Traveling through content space and ontological space

6. EXPORTABILITY OF OUR APPROACH TO OTHER DISCIPLINES

A question is whether the approach we described can be applied to other disciplines. We are not aware of similar effort in other fields, although we believe that similar work could certainly be done for scientific disciplines: e.g. in Mathematics and Physics it should not be too difficult to produce similar results. Of course, the key of the Computer Science case is the wide recognition of the CC2001 model, that was officially endorsed by the major US association of the field (ACM and IEEE). If similar initiatives were started for instance by authoritative associations like AMS (American Mathematical Society) and APS (American Physical Society), a similar patterns could be applied to these disciplines. We have the feeling (but we would be happy to be proven wrong) that covering human science in a systematic, exhaustive and agreed upon way would be much more difficult.

Similar approaches could be thought by starting from different premises. The source we propose for the ontology is especially suited for providing e-learning meta-data because, after all, the original effort was anyhow concerned with teaching (although the focus was different). One could try to derive an ontology from different efforts, like the bibliographic codes (e.g. the Library of Congress classification), or the classification of scientific papers (like the one performed in the “Physics Abstracts”). However, we believe that both classifications have the wrong granularity: LOC classification and similar ones are too coarse, while the taxonomy of scientific papers is probably too fine. This second one is also perhaps out of focus for the goals we are interested in. So the question of how to apply our approach to other disciplines remains without a convincing answer.

7. CONCLUSION

We have claimed that ontologies are essential to have a language to express metadata in an elearning environment. Building ontologies however is a very difficult task, in part because in order to reach the goal it is necessary to build consensus on the ontology itself. While some authors classify several ways to produce ontologies, we suggest that the most efficient way is to reuse existing ones. We have shown that an excellent ontology for the domain of Computer Science can be extracted as a byproduct from the ACM effort to suggest standard college curricula. We have explicitly extracted an XML and a DAML+OIL representation

of the ontology. Moreover, we suggest that metadata built according to such ontological representation can be (explicitly or implicitly) navigated by teachers and students, leading to a more extensive and integrated use of the existing material.

We have discussed the possibility to extend our approach to other disciplines, concluding that there might be hope that a similar operation can be performed for other scientific disciplines.

The approach we present has been used in practice: at Trento University we are presently in the process of putting on line e-learning material for many courses, and in particular we intend to publish on-line material for the whole set of Computer Science courses. For these courses, we label all the data with metadata derived by the ontology we presented here. Metadata navigation is made possible by suitable tools.

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KNOWLEDGE EXPOSURE RISKS DUE TO INTERNET-BASED VIRTUAL REALITY TRAINING

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ABSTRACT

Companies in high tech industries (ranging from Aerospace to Health) are increasingly investing in training packages to support customers in understanding and using their products. These training-packages are now taking the form of 3D virtual reality environments where trainees can navigate, browse and learn in an authentic and close to reality context. These products supported by combinations of photographic techniques and virtual reality programming platforms are now becoming very effective as training tools. However, the combination of a virtual reality world with a precise description of construction and operational details as now been identified as a possible knowledge exposure risk and a threat to internal knowledge management. This paper presents a case-study of a company operating in this field of training and learning. The results of a preliminary analysis of perceived risks and threats by its customers are discussed and proposals on how to address these risks of exposure put forward.

KEYWORDS

Knowledge Exposure, Risk Management, Risk Model, Risk Identification, Virtual Reality Training.

1. BACKGROUND

The modern *Information Society* has seen organizations spending more on information and communication technologies (ICT) and services than the traditional *Industrial Age* spending on capital goods. This factor combined with the rapidly increasing knowledge base of society, decreasing investment per-capita in education, the growth in importance of ICT in general and the Internet in particular and the significant change in educational and training paradigms has created new demands on training providers and designers.

Trainees and companies are increasingly seeking for training programmes that in addition to the subject matter specific knowledge also impart transferable skills such problem solving in the context of subject matter, creativity and innovative thinking, life-long learning, as well as communication and presentation skills. Although the acquisition of these skills could be seen as the general goal of every learning strategy, a better understanding of how we learn and its implication for the design of instructional materials will enable the training packages to serve learners better (Duffy & Jonassen, 1992).

The advancements in Internet technology and telecommunication technologies such as ISDN and broadband have enabled such authentic environments in terms of Virtual Reality Learning Environments (VRLE). These environments allow the creations of meaningful, realistic settings that enable free investigation of information in context. Often VRLEs also allow collaboration with peers and tutors. Although ideal as learning environments, VRLEs pose unexpected but clear knowledge exposure risks for high technology companies in highly specialized sectors such as aerospace, pharmaceutical, or medical

industries. In fact, by allowing external individuals to explore authentic models of their products containing exhaustive explanations of every detail of their designs, these companies are running high knowledge exposure and knowledge leak risks. This paper discusses the case study of a company that specializes in the creation of 3D VRLEs based on a combination of VRML and 3D photographic databases.

2. THE COMPANY

Alignment International specializes in large-scale metrology, quality engineering and alignment. The company was first established in 1998 and now provides a wide range of services in all engineering disciplines including: *Measurement Services; Training; Equipment Sales; and Systems Integration.*

Alignment provides services worldwide and has a network of over 300 experts in localities spread across the globe with practical hands on application knowledge in virtually every engineering application.

In 2002, Alignment International was acquired by Smiths Group PLC who bought the intellectual property rights of their products. The Smiths Group was founded in 1851 and has then grown to be one of the UK's leading specialist engineer, operating internationally in four distinct sectors: Aerospace; Medical; Sealing Solutions; Industrial. Smiths headquarters is founded in London with its manufacturing businesses located principally in the UK, USA and continental Europe.

3. 3D MODELLING BASED ON VRML AND PHOTOGRAPHIC DATABASES

One of the important areas of expertise of Alignment is the creation of 3D models based on VRML and 3D photographic databases of process plants, machinery, aircraft and ships which can be navigated in a PC environment using a variety of 3D viewing packages. For this purpose, Alignment has created and designed its own authoring system that allows the creation of virtual environments and 3D models, which are supported by photographic databases. These environments create authentic and detailed virtual models of plants, machinery, aircraft and ships that are easily navigable and contain comprehensive and detailed information that can be queried by users or trainees at the click of the mouse.

At the core of the authoring tool is the photographic database created by using special surveying and photographic equipment in loco, which allows modelling of the environment and all objects that it may include. The environments produced are implemented using and Internet based technology denominated virtual reality mark up language (VRML), which is "an open standard for 3D multimedia and shared virtual worlds on the Internet" (Web3D Consortium, 2000). According to Nunes and Conway (2000), the VRML 2.0 specification gives the mark-up language considerable advantages: use of multimedia 3D objects; integration with other web based technologies; cheap to implement and to use; platform independence; easy to embed in any web environment through the use of plug-ins; online on-demand; enabling the use of embedded CMC technology; and allowing animated objects.

Therefore, Alignment International is able to produce realistic, accurate and visually matter-of-fact environments easily navigable by simple walk-through. Individual entities within the environment can also be linked to external sources using HTML or other linking methods. In addition to these specialised features, these 3D models and environments are easily and efficiently upgraded and revised to reflect innovations, changes, new data, explore other technologies, and archive reference information.

According to Dr. Bassnett, one of Alignments Directors and the technical expert that created this authoring system, the use of 3D model databases is very successful and is a spin off from Geographical Information Systems (GIS), the multi billion-dollar business worldwide. The success of which, is now evident in the aerospace industry where the major benefits for the use of 3D models are currently being exploited. GIS are systems capable of assembling, storing, manipulating, and displaying geographically referenced information, normally using 2D images maps and vector scans. These systems have become very common and can be found in virtually every council, fire brigade, and utility company worldwide. The innovation proposed by Alignment International consists in using 3D data to produce 3D environments. This is allows for more realistic and easily navigable solutions, which are ideal for training applications in

complex and very specialised settings. Therefore, using the Alignment system in training became one of its important applications.

The advantages of VRML learning environments in training are considerable and were discussed by Nunes and Conway (2000) in terms of: providing visually rich environment; providing authentic and interactive contexts; providing real life like ways to represent the authentic situations; providing information rich environment; allowing real-time 3D manipulation of environment (active learning); allowing hyperlinks to anything else on the web; potential for multi-user environments as planned for VRML 3.0; possibility of embedding 3D simulations; and finally the possibility of implementation of multiple perspectives.

In sum, Alignment’s VRML and photographic based system can be used to create 3D worlds that represent a problem and its context realistically. Specialized knowledge and technical skills are promoted within the authentic environment and reinforced by increased interactions with both the environment and the objects that compose it. These authentic, user-friendly and intuitive interactions encourage creativity and innovative thinking. Furthermore, because it is a web-based application, hyperlinks enable access to vast amounts of information both company specific and general.

4. KNOWLEDGE EXPOSURE RISKS INHERENT TO TRAINING SOLUTIONS BASED ON VRML AND PHOTOGRAPHIC DATABASES

Despite the many advantages behind the use of these VRLEs their very nature poses clear knowledge exposure risks. The fact that the environments produced are realistic, easy to navigate and contain comprehensive specialized and technical knowledge, pose clear exposure of that knowledge to third parties. Additionally, and since these VRLEs are linked to internal databases and offered as web applications poses important security risks. The research discussed in this paper focus on knowledge exposure risks.

For Alignment International, the problem is particularly complex, since they produce these learning environments on behalf of very specialized companies, for the use of third party companies or individuals as shown in Fig. 1.

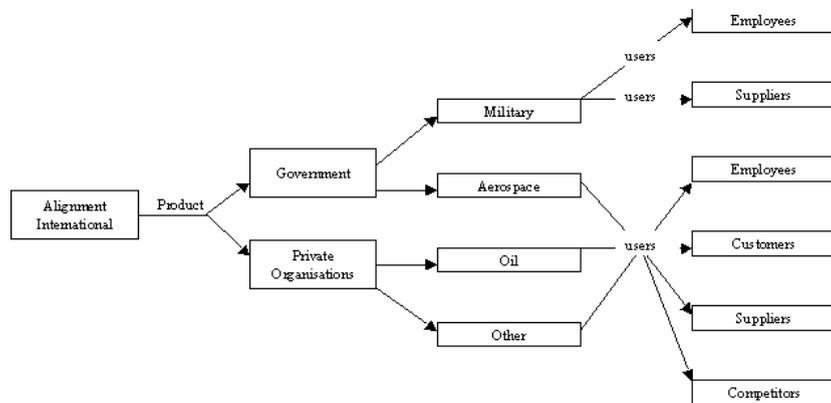


Figure 1. Alignment Business Structure for VRLEs Implementation.

In terms of risk analysis, the actors in this process are Alignment International as the designers and developers of the VRLEs, their *direct customers* who order the VRLEs for training purposes and, finally, the actual trainees that use the VRLEs that maybe internal to the customers or in turn their customers of suppliers.

The root for the risk problem lies in the knowledge exposure that the direct customers incur when offering training through a VRLE. That is, the knowledge loss that may occur by offering detailed and exhaustive information about their products, designs and solutions through an easy to navigate, intuitive and realistic environment. This loss of knowledge may therefore be expressed in terms of valuable internal information that may be leaked accidentally or voluntary either by external or internal forces to the direct customers. Therefore the risk lies in the "leaky" nature of knowledge (Liebeskind, 1996, Wernerfelt, 1984) and in the easy access and comprehensiveness of the environments created.

Internally, it is possible to regulate this knowledge leak to certain degree, through the use of the contractual rules and disciplinary actions on one hand, and the use of technical user authentication such as the use of passwords, firewalls, encryption, on the other. Nevertheless, and because it is "unrealistic to believe that employees will remain with an organization for their entire working life" (Frank, 2002), the company will still be faced with the problems of knowledge leakage (Lamming, 1993) when fully trained and knowledgeable employees leave.

Externally, the problem becomes considerably more complex, as the contractual relationships become difficult to control. The major risk here is as Twigg (1997) expressed it, that individuals that have gained experience and acquired knowledge through use of the VRLEs while employed by third party companies then transfer to competitors and use this knowledge to improve competitor design and innovation capabilities.

Additionally, there is the issue of intent in the knowledge leakage. It may be deliberate and in this case it is a criminal act, or it may be accidental in this case either the result of unwanted facilities in the VRLE or very often a precipitate, unthinking or even naïf act. One of the interviewees gave a very clear example: "if a certain piece of information is downloaded to an external customer PC, it then becomes is free to go anywhere".

The simplistic answer to this problem is provided very bluntly by Frank (2002): "The easiest way to reduce knowledge loss is to avoid losing it in the first place". However, this is not a possibility in this case, as the acceptance, usefulness and even success of the products design and solutions offered by the direct customers depends in large extent from good and efficient training of the employees in the third party companies. Therefore, and contrary to Macdonald's (1993) and Twigg's (1997) opinion risks will have to be run, even if VRLEs based training involves sensitive information within technological networks.

5. MANAGEMENT OF KNOWLEDGE EXPOSURE RISKS

Risk is the occurrence of an event that has consequences for, or impacts on, projects or organisational life (Kliem and Ludin, 2000). As stated by Yeates and Cadle (1996), all projects involve risk of some sort. According to these authors, this risk may stem from the nature of the work - for example if there is a lot of innovation involved -, from the type of resources available, from the contractual relationship which is in place or from the political factors which influence the project.

Therefore in order to better understand risk and its consequences, Charette (1989) proposes a useful conceptual overview of risk:

"First, risk concerns future happenings. Today and yesterday are beyond active concern, as we are already reaping what was previously sowed by our past actions. The question is, can we, therefore, by changing our actions today, create an opportunity for a different and hopefully better situation for ourselves tomorrow. This means, second, that risk involves change, such as changes of mind, opinion, actions, or places [... Third] risk involves choice, and the uncertainty that choice itself entails. Thus paradoxically, risk, like death and taxes, is one of the few certainties in life."

(Charette, 1989)

This conceptual overview of risk is particularly relevant when considered in the context of IS design and development processes. In fact, and as discussed by Pressman (1997), the future is our concern and the project manager must be prepared to identify risks that may cause the IS project to go awry. By the admission of Charette (1989), this may in itself be an impossible task. Drucker (1975) once said in support of this idea:

"While it is futile to try and eliminate risk, and questionable to try and minimise it, it is essential that the risks taken are the right risks."

(Drucker, 1975)

So if it is not practicable to eliminate risks altogether, it is possible to manage projects in a way that recognises the existence of the risks and prepares, in advance, methods of dealing with them if they occur (Yeates and Cadle, 1996). This implies a process of risk management that should include: identification of risks; assessment and analysis of those risks; evaluation and prioritisation of those risks; mitigation of the risk if desirable; monitoring and reviewing; acting to mitigate or remediate the effects of the occurrence of the risk.

The risk identification process in terms of Alignment International projects is clearly based on the relationship with their direct customers as shown in Fig. 2.

Thus, as it can be seen from Fig.2, the risk identification and assessment processes are of crucial importance for the success of the business relationship between Alignment International and its direct customers, and may ultimately be crucial for the acceptance and success of the training solutions

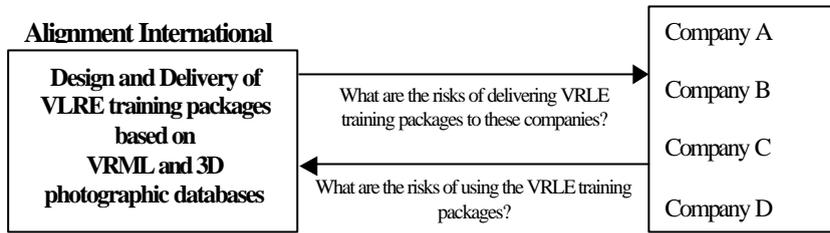


Figure 2. The Concerns of both Organizations.

proposed. This process must be an integral part of the project and needs to be conducted before the design and development stages in order to alleviate the anxieties and fears of both parties involved.

Nevertheless this process cannot be reduced to the simple negotiation of risk between the two types of company. In fact, and since the greater risks of exposure and leakage are related to the third party companies - the secondary customers - need to explicitly involved in the process of risk assessment as shown in Fig. 3. It can be seen in that diagram, that a number of risk assessment processes need to be carried out between all the different parties who will be using the VRLEs. Each party will be interested in determining the risk to their own organization, both internal and external, and to implement control or mitigation actions necessary to alleviate these risks.

Alignment International needs to negotiate the risks involved with its direct customers. However, the risk assessment process needs to involve the secondary customers in order to provide the direct customer with appropriate and informed advise on the risk to be taken. Alignment may be involved in the negotiations between direct and secondary customers, but only in an indirect and advisory role.

Once risks are identified and assessed and the project is started, risk thinking on knowledge exposure and leakage should not be put aside. Since this is such a crucial aspect, it must be seen as an integral part of the management of the project by the contractor, its senior management, the project team members and the even the secondary customer.

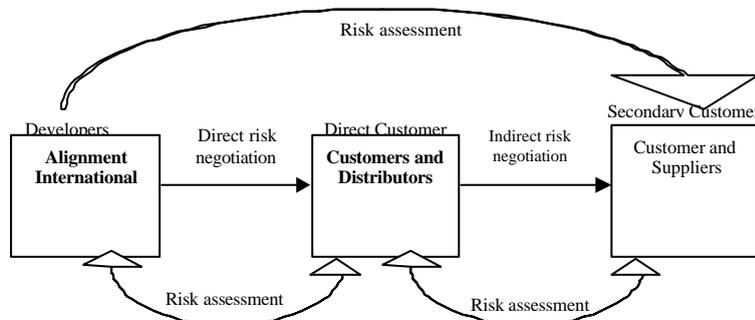


Figure 3. The Risk Distribution Model

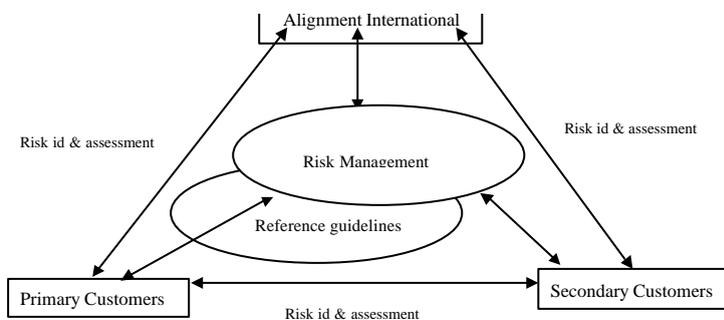


Figure 4. Risk Management Model

Knowledge exposure concerns should be part of the continuous risk management approach from the beginning of a project until the outcomes are realized. Knowledge exposure risks should be continually assessed and preventative and/or contingency measures should be considered. This attitude towards this type of risk should influence technical and design decisions as well as provide insights on technical options, thus empowering managers to make informed decisions. The corresponding risk model is shown in Fig. 4. This risk model is based on the flow of feedback information to

and from the Alignment International, as well as between both the primary and secondary customers. The arrows here indicate the need for the risk identification and risk assessment to be a continuous process throughout the project until all the major risks are identified and control or mitigation strategies implemented.

At the end of the project, the risks of knowledge exposure associated with the usage of the VRLEs by the secondary customers need to be explicitly highlighted and described. Therefore, becomes necessary to provide a risk management or reference guideline for both the direct and secondary users.

6. CONCLUSIONS

Social change, technical advancement and emerging learning theories are converging to change the way training is provided in companies and between companies. Some of this provision will take the form of virtual reality environments supported by web technology and available through intranets to company employees and through extranets to third party companies such as customers and suppliers.

The theoretical advantages proposed for this type of training provision may be hindered by a number of technical, implementation and conceptual problems that may result in important knowledge exposure and leakage risks. Therefore, projects to develop these very high-technology training solutions must be supported by an inclusive risk management process that allows adjustable and responsive project management, taking into account the highly sensitive and potentially risky nature of the solutions proposed.

Risks are potential obstacles to the success of any project; therefore, if knowledge exposure and leakage are not considered seriously, the use of virtual environments in training may yet become another of the periodic fashions that we all have witnessed in the ICT sector.

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INVESTIGATING AND CAPTURING ELECTRONIC EVIDENCE

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ABSTRACT

This paper is intended to introduce the reader to various techniques and tools that can be used in defensive and investigative modes and in some cases in both ways to the user's advantage. The criminal world has recognized many opportunities for turning this technology into an effective tool for criminal use and, therefore, this information and these techniques will play an increasingly more important role in the legal process. While some techniques may be replaced by others, the focus on forensic computing will, never the less, increase.

KEYWORDS

Electronic evidence, surveillance, forensics, chain of evidence, evidentiary copy, evidence acquisition.

1. INTRODUCTION

Evidence gathering techniques of a forensic nature have a long and established history in criminal investigation. The personal computer has become one of the most important tools in the twentieth century. As might be expected, this powerful tool, in addition to its obvious positive uses, can be used for illegal purposes. The age of the Internet has highlighted the importance of the development and use of forensic techniques as applied to the gathering of electronic evidence. This importance is ever increasing.

2. FORENSIC COMPUTING

Information stored on the computer(s) of a suspect, usually with the permission of the Court, can be viewed and analysed. In a covert or hostile environment, however, there will be no authorization and cooperation that might otherwise be directed by the Court.

When it is possible to have physical access to the target system potentially damaging evidence may be obtained from the areas known as unallocated space (erased files), Windows work space or swap file, slack space, bad blocks (or sectors), extra tracks and other transient storage areas. When the target machine contains files that have been encrypted using programs like Microsoft Word or Excel, or WordPerfect and others the investigator can use readily available tools to derive the passwords for those files. He then documents those activities and decrypts the files that are encrypted. Directories, File Allocation Tables, and associated information (like names and types of files, dates and times those files are created or modified, etc.) are examined and analysed to help build time-line profiles.

The information gathered from these techniques is stored on a separate medium for analysis purposes and can be searched for key words or phrases relative to the case and relevant findings documented for later use. Most investigators recommend the creation of CD-ROMs containing a bit by bit mirror copy of the hard disk being scrutinized, however, that process may require several CD's to be created with the larger hard drives. CD's normally cannot be easily modified and can retain the exact information copied - this is important for evidentiary purposes and subsequent analysis. In the case of very large hard drives, tape backup may be more practical. The original target disk is NEVER used directly in any way that would enable ANY modification of it to take place.

3. EVIDENCE ACQUISITION

Before any action is taken it is the responsibility of the investigator to observe the normal scene preservation and evidence gathering techniques. The location should be photographed from various angles (all 360 degrees) and an inventory of relevant items should be created as the normal part of the case documentation. However, this paper is not intended to address that investigative process other than to remind the reader of its importance. The following are a few simple steps to the forensic process:

3.1 Evidence Gathering Sequence

The most important issue in forensic evidence gathering with respect to computers is the preservation of the original data. To that end, the first task at hand is to create a mirror copy of the hard disk somewhere. That may be on another hard disk, many floppy disks, one or more CD's, or tape, etc. Prior to doing this the target machine should be physically inspected (while turned off) to insure that there are no physical devices in place that might damage information contained on the hard drive(s). To insure that the mirror copy is accurate a CRC or preferably a hash (MD5) value for the entire contents of the hard disk must be created from the original and matched to the corresponding CRC(s) or hash values created, in the same way, directly from the mirror copy - thus certifying its authenticity, accuracy and completeness. Most forensic backup tools have this as a feature (for example EnCase¹, SafeBack², etc.).

3.2 Analysis of Target Storage Device(s)

A thorough analysis of open, unknown and hidden data residing on the target device (actually its certified copy - the original should not be used for analysis) should be made and the results of specific searches and search parameters should be formally recorded (for evidentiary purposes) and copies of relevant material printed for inclusion in the case file.

If specialist expertise is required, they should be supervised and their activities and results formally recorded (for evidentiary purposes). The written results of the analysis process will constitute a major part of the formal case documentation as it pertains to whatever may be found on the computing storage devices under investigation.

3.3 Case Preparation³

It is the investigator's responsibility to present the information gathered in a logical, professional and accurate format - as required by the specific jurisdiction. It is not the investigator's responsibility to suggest intent but rather to present the facts and certify their authenticity so that the truth may be found⁴.

3.4 Chain of Custody

The chain of custody is a term used to describe the process and the formal documentation (proof) that proves to a court of law that the original evidence has not and could not have been tampered with from the time that it was captured until its presentation in that court (and any future court proceeding). This means that the original evidence must be held in a secure storage facility - typically a police evidence room that is normally manned 24 hours a day and access to that room is restricted. The importance of this process cannot be overemphasized since cases have been lost when the prosecutor was unable to prove that the evidence could not have been altered. Remember, document and log everything.

¹ *EnCase*: a forensic product of Guidance Software, Inc., <http://www.guidancesoftware.com/>

² *SafeBack*: a forensic product of New Technologies, Inc., <http://www.forensics-intl.com/safeback.html>

³ *A useful reference for case preparation*: Rosenblatt, Kenneth S., *High-Technology Crime Investigating Cases Involving Computers*, San Jose, California, KSK Publications, 1995, ISBN: 0-9648171-0-1.

⁴ *A useful reference for testifying about technical evidence as an expert witness*: Smith, Fred Chris, Bace, Rebecca Gurley, *A Guide to Forensic Testimony*, Addison-Wesley, Boston, Massachusetts, 2003, ISBN: 0-201-75279-4.

4. INVESTIGATING THE CONTENTS OF A HARD DRIVE

There are three basic types of information normally or potentially stored on personal computers:

4.1 Open Information/Data (easily available to anyone with access)

Open information consists of operating systems executables and relevant data, configuration and temporary files; user applications software (like word processors, spreadsheets and so forth) and their associated configuration, data and work files; and user generated data (documents and files generated by and associated with the various applications residing on the user disk). This includes specialty files like graphic files, programming source code, etc. This may be a source of valuable evidence and would normally be scrutinized first.

4.2 Unknown or Potentially Unknown Information/Data

PC operating systems, in order to provide input/output (I/O) services for resident applications, perform their tasks in a well documented, structured, and specific sequence. As a result, there are certain areas on a hard disk that may contain information that most users are or may not be aware of. Examples of these are deleted files, Windows temporary workspace, slack space⁵, and RAM slack⁶. Any or all of these areas may contain evidence relevant to an investigation.

4.3 Hidden Information/Data (deliberately hidden or disguised)

Some information may be deliberately hidden in a number of places and in a number of ways in order to raise the level of difficulty required to find, access and/or interpret it. In and of itself, this activity does not indicate guilt or innocence, however, it should raise a red flag for the investigator and care should be taken in the handling, processing and documentation of such activity. A deliberate way to hide data/information is by the use of encryption. Files that are encrypted by certain software will have their own signature and may be detected by that signature. An example of this is the use of PGP⁷ and other commercially available cryptographic software.

Other examples of hiding places are partition waste space⁸, bad sectors⁹, changing the partition table such that a volume is hidden from the operating system and other spaces on disk not normally used. Information found in these areas should probably be investigated further since the user obviously felt that their data/information was important enough to take the trouble to hide it. An example of disguising data is changing the name of a file and its descriptive extension (.DOC, .JPG, .GIF, etc.). Most file types have a distinctive signature, however, and these can easily be checked (some forensic products provide a feature that highlights those files whose extension does not agree with its identified signature - an example is EnCase).

Information may also be routinely hidden within various graphics, audio and/or video files (.JPG, .WAV, .AVI, etc.). Steganography is the art or science of hiding data or information within other data or information. There are many software packages (Invisible Secrets for example) that accomplish this task freely available on the Internet. The information hidden may or may not be encrypted prior to being hidden. It is a standard forensic procedure to look for this specialized software on the target machine as an indicator of this type of activity. If the target machine appears to have this type of activity present then further expertise might be

⁵ *Slack space*: is the space between the logical end and the physical end of file and is called the file slack.

⁶ *RAM slack*: is the space from the end of the file to the end of the containing sector and is called RAM slack. Before a sector is written to disk, it is stored in a buffer somewhere in RAM. If the buffer is only partially filled with information before being committed to disk, remnants from the end of the buffer will be written to disk. In this way, information that was never "saved" can be found in RAM slack on disk.

⁷ *PGP (Pretty Good Privacy)*: - originally developed by Phil Zimmermann and made available in the public domain.

⁸ *Partition waste space*: After the boot sector of a partition, it is customary to skip the rest of the track and start the volume on the next track.

⁹ *Bad sectors*: A sector is a group of bytes within a track and is the smallest group of bytes that can be addressed on a drive. There are normally tens or hundreds of sectors within each track. Bad sectors reside in clusters that are flagged in the FAT (File Allocation Table) as bad and thereafter the flagged cluster(s) are no longer available to normal access, however, DIRECT reads and writes may still be possible.

required. Finding such applications would be an indication that they might have been used to protect the privacy of certain information/data.

5. DETERMINING THAT CRYPTOGRAPHY HAS BEEN USED

This is harder than it might at first seem. There are forensic tools like IsEncrypted¹⁰ and others that do just that. However, IsEncrypted is designed to find files that have been encrypted by specific applications software and can only identify that software that it knows about. IsEncrypted is a very useful forensic tool but it would not find any files that were encrypted by any other software application. Many standard applications such as Word or Excel (and there are many others as well) make encryption with strong algorithms optionally possible. While the algorithm implemented may be computationally secure and theoretically unbreakable, the way it has been implemented within other software may be flawed and successful attack may be achieved as a result. AccessData Corporation also makes available individual modules specifically designed to resolve the password used from files encrypted by one of these designated applications. In other words, if you use the encryption option that Word offers to protect your documents, then by obtaining the Word module from AccessData and applying it to the encrypted file the password you used may be resolved and the file thereafter will be able to be decrypted by the investigator.

Another method of finding out whether encryption has been used is to look for known encryption software that is installed on the target system. Some forensic tools will do this based on a known signature pattern - a technique much like searching for a known virus. Encryption that is unknown to the methods described thus far may be more difficult but not impossible to detect. Moreover, some encrypted files may be hidden within other files where steganography¹¹ has been used. As you can see, determining whether cryptography has been used is not a simple matter.

6. SOCIAL ENGINEERING¹²

Once the determination has been made that encryption has been used and that the suspect will not cooperate by providing their keys, there are a number of other techniques that may be used (with varying degrees of effectiveness) to obtain particular keys. The first may be referred to as social engineering. This technique makes use of whatever information is available about the suspect. Most people do not construct their keys in a way that make them difficult to guess. Their main concern is being able to remember the key themselves. Therefore, the probability is that the key will be something that they have an interest in. For example, in a particular case, the suspect was a police officer. He had a pretty good knowledge of computing and used strong encryption and it was well implemented. The chances of "breaking to code" were nil. We compiled a dossier containing personal information about this individual (his children's names, his wife and girlfriend's names, his badge number, etc.). The next step was to search the evidentiary hard drive copy for incarnations of some of these names and phrases. As it turned out, the very first search (on his badge number) turned up six candidate keys -- the third one tried was it. While this was a real life successful example the investigator could have spent many hours trying the various bits and come up with a dead end.

7. AUTOMATED SOCIAL ENGINEERING

Where only a part of the suspect's hard drive is encrypted we often get positive results by creating a dictionary of all of the plain text words on the suspect's hard drive. That dictionary is used to iteratively test for a good password. People often use meaningful (to them) words for their passwords and encryption keys to help them remember what they are. Often these are stored in plain text somewhere on their hard drive. This attack strategy exploits that weakness and produces positive results often enough to retain the technique in our little bag of tricks.

¹⁰ *IsEncrypted* - An AccessData Corporation product designed to find files that have been encrypted with specific products.

¹¹ *Steganography* - the technique of hiding data within other data.

¹² *Social Engineering*: This topic has been explored in great detail in Kevin Mitnick's book: *The Art of Deception*, Wiley Publishing, Inc., Indianapolis, Indiana, 2002, ISBN: 0-471-23712-4.

8. PHYSICAL CIRCUMVENTION

There are two places where physical intervention can be used. The first is where the suspect is under investigation (such as the much publicized Nicodemo Scarfo¹³ case) and is not likely to cooperate with the investigators by providing their keys. This intervention takes place prior to the actual seizure of hardware. The rationale is that the key may be captured in real time and always without the knowledge of the suspect.

The second place is after the seizure has occurred. An example is where a suspected child pornographer was believed to have illegal images on his computer but would not provide the key to decrypt his system. A warrant was obtained to perform the surveillance and a key logger was installed on his machine. Within three hours of returning his machine, the authorities had the needed keys and were then able to unlock the previously captured evidentiary copy of the encrypted hard disk revealing enough pornographic material to result in nineteen additional counts on the incitement – and a conviction.

The tools used to accomplish the acquisition of subject keys for both scenarios described above are varied. There are physical devices and there are software devices. Physical devices break down into a few types: the first is a radio transmitter, next is the interception of electromagnetic emanations, and finally there are devices with internal memory that record keystrokes. Transmitters and keystroke recorders must be physically installed on the target computer.

Keystroke recorders are small plug like devices that are inserted between the keyboard and the CPU. Two examples of this type of device are KeyKatch¹⁴ and KeyGhost¹⁵. Another version is a complete keyboard which is swapped with the suspect's. These devices essentially work the same way. You simply install them and retrieve them after the surveillance is completed or periodically as required. They are then installed on a forensic computer, given a password and the contents of the device's memory are then downloaded to a text file for later processing. These have a distinct advantage over software key loggers in some circumstances. These devices will record ALL keystrokes on a given machine. Software key loggers can only begin recording AFTER the logging software becomes operational. In the event that the target machine uses CMOS based encryption, the keys are not available to such software until after the entire boot-up process is completed and therefore after the keys have actually been entered. Systems that have entirely encrypted primary hard drives (right down to the boot sector), cannot normally support software only keystroke loggers.

These are a sample of the kinds of hardware approaches that might be taken in an investigation. In the past they have provided good results and if used with the appropriate authorities (warrants) evidence gathered in this way can make or break a case.

9. SOFTWARE CIRCUMVENTION

There are a number of software surveillance tools available that can capture keystroke data albeit with the proviso stated above and are used to capture and record useful evidence before seizure is affected. These are stealth type applications designed to operate without the user's knowledge. Some of them have the capability to report over the back channel of the user's Internet connection. Most of these tools have the capability of recording many things including keystrokes. Normally, the recorded data is encrypted and compressed before being stored so that it will not be recognizable to the user should it be seen accidentally.

Some examples are STARR¹⁶, D.I.R.T¹⁷, ABCKeylogger, Ghost Keylogger and the FBI's recently announced Magic Lantern. All of them must be installed on the target machine, however, that installation is accomplished in a number of different ways. Some are installed through a Trojan, others are installed by having physical access to the target machine, and still others are installed through the computer virus vector (as admitted in the Magic Lantern's description by the FBI). No matter what the vector, this class of surveillance tool has produced good results.

Encountering encrypted files can be dealt with in many instances, however, the notion that "breaking the code" is the way to solve the problem may not be the answer that produces results. This paper has attempted

¹³ *Nicodemo Scarfo* - Under investigation by the FBI for several months prior to being indicted in December 2000. Scarfo used strong encryption to hide his alleged illegal activities.

¹⁴ *KeyKatch* - This device is produced by Codex Data Systems at: www.codexdatasystems.com/keykatch.html.

¹⁵ *KeyGhost* - This device is produced by KeyGhost Ltd. at: www.keyghost.com.

¹⁶ *STARR* - This is a PC & Internet Monitor produced by Iopus Software at: www.iopus.com.starr.htm.

¹⁷ *D.I.R.T.* - Data Interception by Remote at: www.codexdatasystems.com/menu.html.

to introduce the reader to the potential methods that can be used to circumvent encryption and to pave the way to producing good evidence from what might have previously been considered too hard.

One last comment: on encountering data that is encrypted, it might be natural to assume that the suspect is guilty merely because he/she has chosen to use this powerful privacy tool. That would be a wrong assumption. In 1948 more than 100 nations adopted the Universal Declaration of Human Rights¹⁸, which enshrines in Article 12 the most basic of human rights - the right to privacy. Everyone, good and bad, has the right to opt to maintain their privacy and should, in no way be penalized for choosing to exert that right.

10. VALIDATION OF FORENSIC EVIDENCE GATHERING TECHNIQUES

Whenever new techniques and/or tools for gathering evidence are put forward in a court of law certain issues must be addressed. In the US precedents that structure the validation of such techniques or tools have evolved over the years. In 1993 another precedent was set (called the Daubert Test) and was based on the case *Daubert v. Merrell Dow Pharmaceuticals* (92-102), 509 U.S. 579 (1993). This promulgates five elements that must be satisfied before evidence gathered in a new way will be deemed to be admissible in a court of law.

These elements are: 1) Whether the theory or technique can be and has been tested, 2) Whether it has been subjected to peer review and publication, 3) The known or potential error, 4) The general acceptance of the theory in the scientific community, 5) Whether the proffered testimony is based upon the expert's special skill.

EnCase, which is one of the better-known tools for gathering computer evidence, has been subjected to the Daubert test and it and the techniques surrounding computer forensics have been validated and accepted in several cases. This, however, is still a very new evidence gathering technique and has yet to be proven across jurisdictions around the world.

11. CONCLUSIONS

The Computer Age has brought with it the ability for each of us to extend our intellectual capabilities by enabling improved information storage and manipulative capacity. This can be equated to an extension of our individual intellect, memory and evaluation processes – our mind. However, what you think can be kept private by not exposing it to anyone – controlled by the individual. What you type into your computer cannot be kept private in the same way. This fact makes it possible and likely that information otherwise protected by being in our mind may now be stored in electronic form thus making possible the gathering of forensic computer evidence. This paper has introduced the reader to this new and important technique and outlined various topics that demonstrate ways and means to undertake an electronic evidence investigation.

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¹⁸ *Universal Declaration of Human Rights - Article 12* - No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks. - Adopted and proclaimed by General Assembly Resolution 217 A (III) of 10 December 1948.

THE APPLICATION OF SERVICE QUALITY GAP MODEL TO EVALUATE THE QUALITY OF BLENDED LEARNING

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ABSTRACT

Blended learning has become a common challenge for many institutions of higher education. Being able to assess the quality of a learning process composed of traditional teaching practices, computer-based teaching and online education becomes a crucial skill for universities trying to remain competitive. The paper discusses the application of the SERVQUAL model to measure the quality of modern teaching techniques at the University of Information Technology and Management in Rzeszów, Poland. The project is expected to result in the framework for measuring quality of teaching services, applicable at institutions of higher education. The main challenges are aligning traditional SERVQUAL model and finding the best possible set of statistical methods that would help to constitute quantitative and comparable metrics of such concept.

KEYWORDS

Service quality, teaching quality, SERVQUAL, blended learning.

1. INTRODUCTION

The system of higher education in Poland is peculiar. For several decades there were no private schools or private universities. After the political transition fourteen years ago, the new democratic parliament and government regulated the existence of private property. The system of higher education is now composed of two sectors: public and private. There are several fundamental differences between them. Although there are twice as many private universities as public, they attract only about 30% of students (1.7 million overall). There are a few reasons which explain that:

- The private sector started to develop only after 1990.
- The private sector is not financially supported by the state.
- Students are obligated to pay tuition (public education is free of charge).
- Continuing belief that the quality of education is much higher in public schools (they have earned their reputation for decades).

The further development of the private sector is highly dependent not only on the quality of teaching but also on the number of students enrolled. In this competitive market only these institutions will last, which gain their competitive edge through the highest quality/price ratio. The trendy idea which may lead both to an increase in the effectiveness of the learning process and to cost reduction is so called blended learning – the use of state-of-the-art information and computer technology in order to enrich the process of knowledge transfer, consolidation and evaluation. It is also important to mention that most of the public schools, confident of their position, usually neglect the deployment of computer-aided teaching techniques.

The University of Information Technology and Management in Rzeszów (UITM, south-east Poland) is one of the oldest private universities in Poland. For the last seven years the school has managed to place itself among the top-ranked private educational institutions. Current enrollment is approximately 10,000. Several semesters ago, the University board decided to launch the e-learning program that consists of CBT format (Computer Based Teaching) and the more professional and fully interactive WBT format (Web Based

Teaching), which requires the use of a learning management platform. Students starting their education next year will have a chance to enroll in an almost total distance education program. As the school has the experience of over 30 various multimedia courses taught already, it has become essential to measure somehow the quality and the resulting effectiveness of its online courses.

2. RESEARCH

Parasuraman's conceptual model of service quality and the approach for defining and measuring service quality referred to as SERVQUAL can make a significant contribution to measuring the quality of modern learning processes consisting of a combination of traditional learning experience and modern ICT encouraged practice. Also, several later evolutions of the model may serve as the basis for such customization. SERVQUAL model provides formal means to identify and correct gaps between desired levels and actual levels of performance. It is used by organizations to analyze certain processes of any division of their company.

The universities that deployed academic programs inclusive of significant remote-learning aspects (computer-based teaching, e-learning, etc.) seek measures for the quality of their service. The quality issue of services in the case of universities is important as it affects the efficiency of the organization in meeting its goals.

2.1 Goals

The main goal of this project is to find a general framework for assessing the quality of service at institutions of higher education. The services of these institutions, for the purpose of the project, should be understood as the teaching efforts composed of blended learning aspects.

The sub-goal is to establish and validate the set of statistical methods which would allow to conduct the empirical research and produce quantitative and comparable results.

2.2 Method

SERVQUAL applied to measure the service quality of the teaching process slightly changes the gaps defined in the traditional model. The new set of quality gaps, which will determine the overall service quality, would be as follows:

- Gap 1: Difference between student expectations (customer expectations in the traditional model) and university authority level perceptions of student expectations (management level perception in the traditional model).
- Gap 2: Difference between authority level perceptions of student expectations and service (teaching) quality specifications.
- Gap 3: Difference between service quality specifications and the service actually delivered.
- Gap 4: Difference between service delivery and what is promised about the service (teaching outcomes) to students.
- Gap 5: Difference between student expectations and perceptions.

Aligning the model to the universities' needs also changes the meaning of the service quality perceptual dimensions. These five dimensions are:

- Assurance – i.e. to earn the student's confidence by performing services in a knowledgeable and professional manner.
- Empathy – the ability to communicate care and understanding through the interpersonal skills of the teaching staff and student-friendly policies and procedures (mainly those affecting the teaching process).
- Reliability – the accuracy and dependability with which the teaching service is provided
- Responsiveness – the demonstration of an eagerness to provide quality service and a commitment to act in the best interest of students.

- Tangibles – the more physical aspects affecting the teaching process such as technology availability, etc.

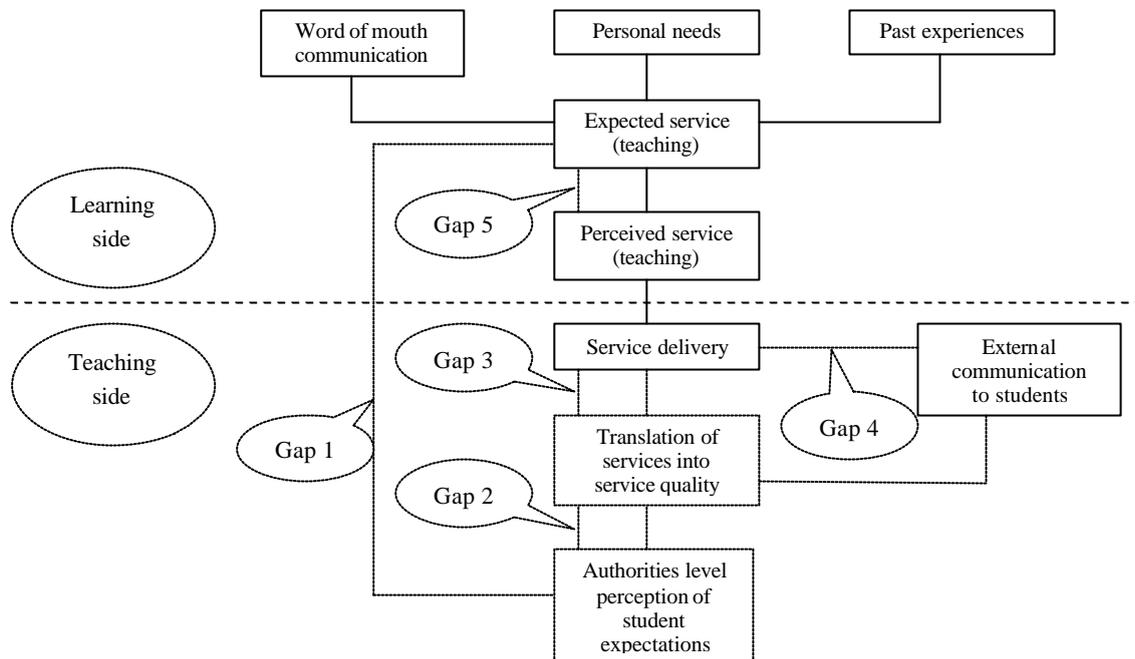


Exhibit 1: Conceptual model of service quality at universities.

The traditional expanded model of service quality will also need some updating before it becomes applicable to interpreting the items affecting the occurrence of service quality gaps.

Several items affecting the gaps which are significant in the traditional approach are inadequate and several of those remaining take on the original meaning.

Gap 1: Difference between student expectations and university authority level perceptions of student expectations.

- Research: An effective medium through which university authorities can learn about student expectations are various kinds of research tools like questionnaires, dialogues, etc. In that manner the nature, extent and quality of research can widen or lessen this gap. The effectiveness of this concept is also influenced by the fact that effective communication of research results can affect authority level perceptions of student expectations.
- Upward communication: The best way of communicating expectations is face-to-face discussion. The face-to-face contact in blended learning will be rare thus it may severely affect the trainers' perception of student expectations. Also, the way teachers communicate their ideas of student expectations to the university authorities will be meaningful.
- Accessibility of top level authorities: This item evolved from the 'levels of management' item in the traditional approach. It will also affect the university authority level perceptions of student expectations. The question here is what chances does the student have to communicate messages to the university decision makers.

Gap 2: Difference between authority level perceptions of student expectations and service quality specifications.

- University board commitment: Gap 2 might suffer if at the management level there is no commitment to establishing the service quality specifications or if any other goals such as cost reduction take precedence.
- Task standardization: Standardizing tasks in a way that they become the combination of wise substitution of hard technology and human efforts as well as constant improvement in teaching methods may significantly narrow Gap 2.

- Perception of feasibility: Gap 2 is seriously affected by the perception of feasibility at the authority level. The main question is whether the university board believes that it is feasible to meet the student expectations. In the case of non-profit organizations such as institutions of higher education, cost reduction is always a factor influencing feasibility.

Gap 3: Difference between service quality specifications and the service actually delivered.

- Trainer job-fit: The question concerning this issue is whether the teacher possesses the skills necessary to guide students through the online part of education that is a new experience to them and that might be confusing.
- Technology job-fit: Appropriateness of tools and technology used in the teaching process. As large parts of classes are online courses this issue becomes crucially important.
- Supervisory control system: This item reflects the means undertaken to control the education process and to evaluate the output quality.
- Role conflict: This issue involves difficulties in selecting the academic subjects and which of their parts should be taught online or traditionally. Problems might also develop further: if there should be online content, then which form of the course would be the most efficient.
- Role ambiguity: Several teachers might find it difficult to accept the dual teaching methods (traditional and distance learning). Some may specialize in one form only and a quality gap may widen as a consequence.

Gap 4: Difference between service delivery and what is promised about the service (teaching outcomes) to students.

- The main issues affecting Gap 4 are communication problems within large organizations and its departments which would be of importance especially at large universities. Such schools are usually divided into several smaller institutes, faculties etc. which are self-governing.

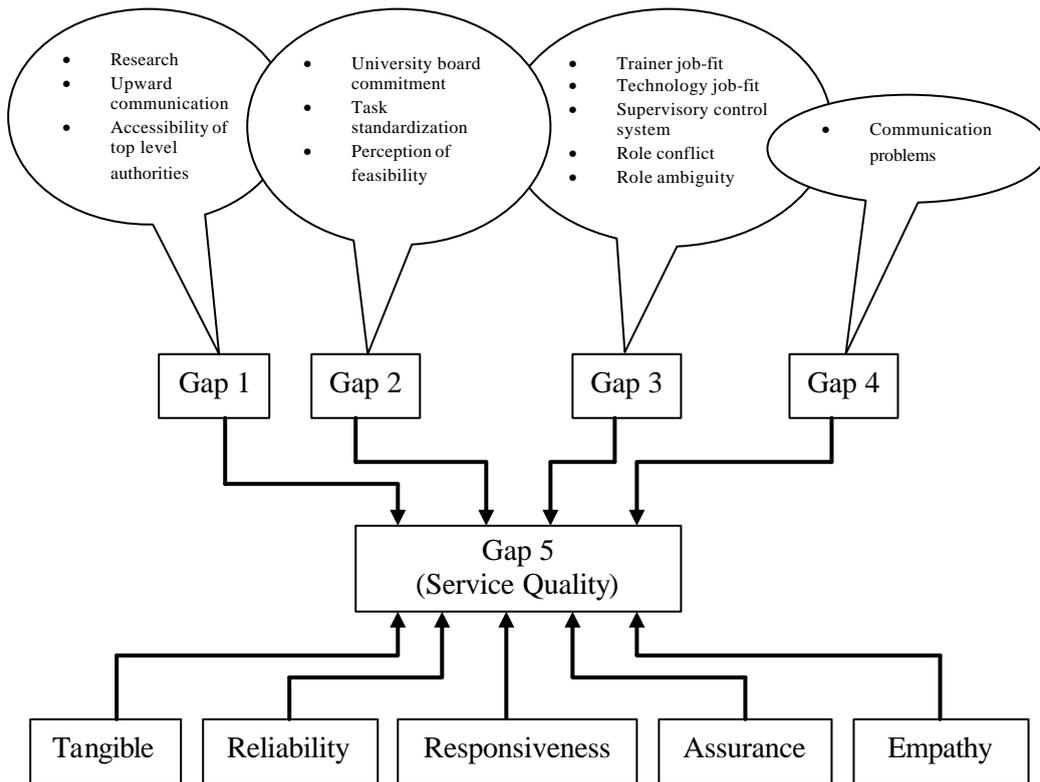


Exhibit 2: Extended model of service quality at universities.

2.3 Questionnaire

At the end of January (the end of winter semester), a survey was carried out at UITM. During the last semester, 7,500 UITM students had, depending on their major and specialty, up to four lectures conducted in the form of blended learning. The purpose of the survey was to study the quality of the e-learning program on the basis of the conceptual guidelines of the SERVQUAL model customized to the universities' needs. Another, perhaps even more essential aspect of the questionnaire, was to find and verify the statistical methods which could be associated with the customized conceptual model.

It would be difficult from the organizational perspective to study the entire population of those students, thus it has been decided to rely on sampling to conduct the study. Since a studied population of the UITM students could be considered as heterogeneous, where certain homogeneous or similar sub-groups (strata) can be isolated, the use of stratified sampling was legitimate. In this sampling technique, the whole population is initially divided into homogenous, exclusive sub-groups and then units are selected from each strata in proportion to the share of each sub-group in the whole population.

Several different groups can be spotted within the student population at UITM. One of the most useful, from the research point of view, is the group of exceptionally capable students. As many previous studies (also these regarding quality of teaching in the traditional manner) have proven that the results obtained from this strata are highly representative for the whole student population, the research was limited to this strata only. The results obtained seemed attractive enough to encourage the search for appropriate statistical methods. Nevertheless, having in mind that some weaknesses of such approach might occur, the research will soon be repeated within other sub-groups (stratas) and final responses shall be confronted.

3. FURTHER WORK

The prospective stages of the project will be connected with efforts to set up and validate the set of quantitative metrics. Comparing the metrics values will allow to assess the quality of teaching services and help in decision making at the university authority level. The project still requires several questionnaires and data processing works to be carried out. Pre-analysis of the results seems to be promising enough to continue the SERVQUAL customization which would eventually constitute the method of assessing the quality of blended learning.

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THE FIRST NEED IS A LEARNING COMMUNITY: JUST DO IT!

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ABSTRACT

The Italian economy is heavily dependent on Small and Medium Enterprises (SMEs), so it's important that these remain strongly competitive. However SMEs tend to have trouble understanding the possibilities information and communication technology (ICT) offers their business and, consequently, hesitate to adopt ICT. We have tried to design and implement a method to provide SMEs that are approaching ICT with strategic vision and to support the birth and development of learning and/or practice communities. Two major problems need to be addressed: defining, on a 'logical' basis, an integrated, sound and effective set of services for ICT-challenged SMEs, and creating a technological infrastructure (with a special attention to a suitable e-learning platform) to support the designed set of services. The experience gained so far in the "Just Do It!" project has shown us that, among these services, the most important consists of the chance to be part of a learning community.

KEYWORDS

Collaborative Learning, E-Economy, E-Learning, Learning Communities, Virtual Communities

1. INTRODUCTION

A series of phenomena, clearly related to ICT and the Internet (such as processes of disintermediation, new transactional models, the obsolescence of the reach-richness model – due to new hyperarchical relationships, the emerging virtual supply chain), seem to indicate that we are facing a gradual but relentless transition from a physical goods-based economy to an excess of information-based one, where the truly scarce resource is decision makers' attention and knowledge management. In these conditions, response time, flexibility, and adaptability are increasingly emphasized, among competitive factors, as crucial to survival, and, as a result, the 'network paradigm' seems to be the winning organisational system. In such a context, the crucial function of networks (both formal and informal) is to support learning and collective intelligence (and the organization of information). But managing the technological innovation required, especially for a small or medium enterprise, means comparing one's progress to continuously changing and evolving standards.

Since the Italian economy relies heavily on (networks/communities of) SMEs¹, it is important that these remain highly competitive. However, Italian SMEs (and particularly districts) suffer from growth problems. They tend to experience difficulties in understanding the opportunities that ICTs offer their business - and consequently fail in attempts to adopt ICT, mainly because of lack of information. This was recently demonstrated by the EU Adapt² project. (As a matter of fact, the SMEs involved in the project, segmented on the basis of having an internal informatics networks and Internet access, when asked about how demand for

¹ SMEs employ the 80% of the working population: small businesses (less than 100 employees) employ the 70% of the working population (35-40% in the rest of OCSE), while medium enterprises employ another 10% (against the 20% in the rest of OCSE).

² See: <http://adapt.formaper.com/home.htm>

ICT arises, showed that a direct relation between enterprise size and the use of ICT indeed exists, but they also replied that the major hurdle to adopting ICT is almost always lack of technical knowledge/skills/know-how).

2. THE “JDI!-JUST DO IT!” PROJECT IDEA AND LOGICAL STRUCTURE.

While the SMEs’ major challenge seems to be comprehending the strategic potential that derives from the Internet, commercially available training in these areas - copious and varied - seems neither to match the SMEs’ need for personalized training (see Figure 1) nor to respect their constraints of time and money (since the target for standardized commercial ICT training usually involves professionals who need to re-qualify themselves or large companies). Bearing this in mind, we began to wonder if and how our experience with

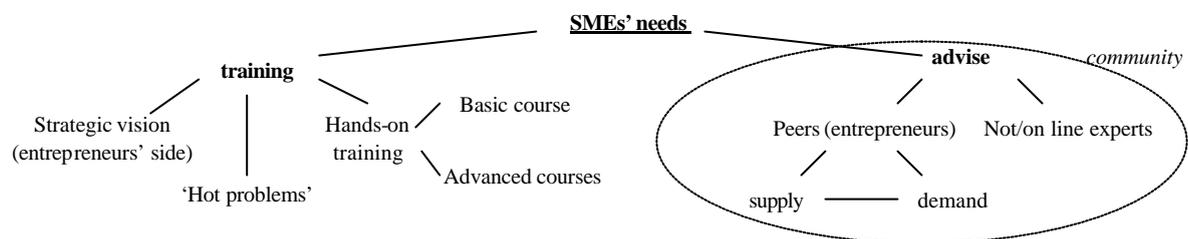


Figure 1. Training Structure for SMEs ICT Information Needs

both (virtual) communities³ and ICT could help design a new methodology (repeatable and designed according to a contingency approach) for creating a strategic vision in SMEs approaching ICT and for supporting the birth and the development of learning and/or practice communities. To this end, the “Just Do It!” project was started in spring 2002. We needed both to find the right way to make up for the SMEs’ lack of information/skills in ICT and to allow them to ‘experience’ ICT’s potential for their business, while creating a ‘protected’ environment, expressly developed for SME needs and free from ‘business interests’, in order to make them feel confident about the quality and honesty of the services and information supplied. At least three sets of different major problems – on both the design and implementation levels - required our attention: first, defining, on a ‘logical’ basis, an integrated, sound, and effective set of services for SMEs challenged by ICTs; second, creating a technological infrastructure that could support the designed set of services; and, last but not least, involving SMEs in the project in order to assure that project goals were consistent with SME needs. While designing the set of services, we kept in mind two major goals, derived both from our experience and from the direct involvement of several small business owners (through focus groups aimed at better comprehending SME needs in the ICT field):

- the creation of the best environment possible for networks/communities of small-business owners to be born and to develop, where they can find peers with whom to share their experience (this point is essential to the specific reality of Italian SMEs, which is built on strong interpersonal relationships), thus creating an effective self-certification system for ICT services and suppliers;
- the definition of a repeatable model to provide personalized service and training in ICT.

Thus we created an environment (see Figure 2) made up of several different integrated (yet independent) tools, supplying a complete and sound training service that matches the structure of SMEs’ ICT needs (as derived from focus groups and shown in Figure 1). The JDI! environment includes:

³ The Civic Informatics Laboratory of the Milan University Information Science Department has, since 1994, run the Milan Community Network (RCM), a citizens’ virtual community of about 14000 users, and has a significant experience in hands-on ICT training of citizens and public servants.

- training services: e-learning (to deliver courses about the innovative use of ICTs to support business activities), off-line learning (to build collaborative relationships among students), online office-automation classes, document sharing, etc.;
- community: to enhance collaboration and the development of entrepreneurial networks through learning communities and communities of practice;
- training tools;
- “the experts answers...”: forums to discuss specific problems (related to the use of ICT for business) with experts in the field;
- “tools for being online”: simple and flexible tools specifically conceived to help enterprises manage their online presence by themselves (e.g. to build intranet/extranet, Web pages, etc.)
- other services: such as technical support, newsgroups, mailing lists, useful links, etc.

3. JDI! AND JLI! TECHNICAL INFRASTRUCTURE

To support the logical infrastructure described above, we decided to adapt and integrate several existing or already-developed tools (for networking, “the expert answers”, mailing lists, documentation, newsgroups, etc.). However, this was impossible in the case of the e-learning platform, because none of the products we examined (either commercial or open-source) supported as strong an integration with community tools as we required. To address this problem we opted to develop our own e-learning platform, starting from Adept (<http://adept.sourceforge.net>), an open-source project, even though its latest version was substantially less than a beta release. The overall technological infrastructure is outlined in Figure 2.

From a technical point of view, because the Adept prototype presented several architectural problems, we needed to redesign the whole structure of the application, as well as making several features external (e.g. discussion forums only implement a logon interface between the “JLI!-Just Learn It!” e-learning platform and the external community application). Moreover, to assure easy and flexible integrability (e.g. through Lightweight Directory Access Protocol, LDAP) in implementing the data base layer, all the calls to user-management functions have been isolated in a library. JLI!, as the overall infrastructure, was developed to be an upgradable open platform, easily integrable with other ‘products’ to achieve the needed interoperability among the different tools used in the JDI! environment. The system is platform-independent, and runs in an Apache/PHP environment, using MySQL Data Base Management System (DBMS).

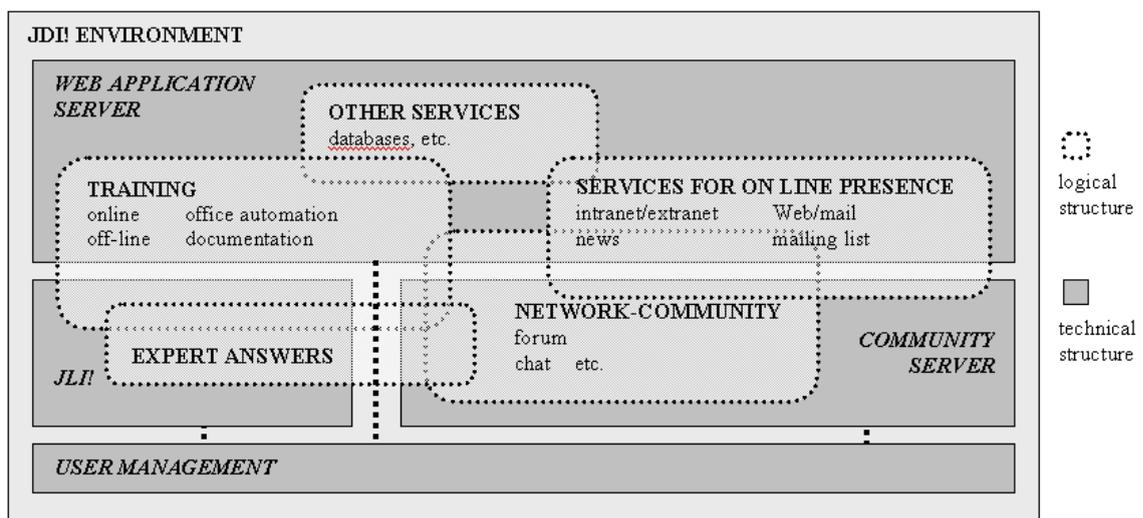


Figure 2. “Just do it!” Logical and Technical Infrastructure (main features)

From a functional point of view, during the design phase, there are several main features we focused on in order to achieve the community integration mentioned above. First, we needed to create intuitive and simple interfaces, since users’ skills in software tools use are very limited. On the opposite, teachers’, side, we needed to supply a flexible and easy-to-use tool. Current e-learning platforms usually ‘publish’ ready-to-use

courses, but we could not be sure users' requests for personalized training would match something that already existed. For this reason, teachers need to be able to create new courses (possibly even outside from commercial-standard constraints) very quickly, with few and low-cost resources (since there is no guarantee of the critical mass required for heavy investments - e.g. in graphics). In particular, we developed a what-you-see-is-what-you-get interface to create immediately usable HTML content and we allow teachers to upload and/or link any other resource they may consider useful (i.e. video, documents, etc.) and to include, in the course, frequently asked questions (FAQs) and glossaries (which may even derive from the direct interaction with the community forums and/or chats).

4. CONCLUSIONS AND NEXT STEPS

Since the involvement in an interactive learning environment seems to be very important to SME owners, a rather huge effort was made to analyse Italian SMEs' difficulties in approaching ICT, so as to develop a technical environment that supports training methods based on pairing customized training with self-training through the interaction in a virtual community (made up of both peers and ICT experts). The JDI! environment was thus designed and developed, while also assuring its ready expandability, so as to enable us to plan, in the medium term, its integration with several other services (to be supplied in ASP mode) that support everyday SME operations (e.g. document and/or project-management tools) in order to help SMEs cut costs and lower skill-barriers to ICT adoption.

While the technological structure is now ready and – as far as possible - designed in response to users' needs, we now face a crucial step: involving an initial set of 'pioneer' small-business owners. As a result, our current major challenge is creating useful content to fill the training JDI! environment and developing it alongside the users. We thus hope to transform a research-oriented project into something truly useful for SMEs.

AKNOWLEDGEMENTS

Many thanks to the Cariplo Foundation, which funds the "Just Do It!" project. Thanks also go to Formaper – a special agency of the Milan Chamber of Commerce - and Iriscube, our precious partners in the JDI! project. A big thank to Philip Grew and Aurora Ghini, who patiently tested our JLI! platform, giving us useful feedback, derived from their many years teaching experience.

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USING BLUETOOTH FOR INFORMATIONALLY ENHANCED ENVIRONMENTS

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ABSTRACT

The continued miniaturization in computing and wireless communication is about to make informationally enhanced environments become a reality. Already today, devices like a notebook computer or a personal digital assistant (PDA) can easily connect to the Internet via IEEE 802.11 networks (WaveLAN) or similar technologies provided at so-called hot-spots. In the near future, even smaller devices can join a wireless network to exchange status information or send and receive commands.

In this paper, we present sample uses of a generic Bluetooth component that we have developed and that has been successfully integrated into various miniature devices to transmit sensor data or exchange control commands. The use of standard protocols like TCP/IP, Obex, and HTTP simplifies the use of those devices with conventional devices (notebook, PDA, cell-phone) without even requiring special drivers or applications for these devices.

While such scenarios have already often been dreamt of, we are able to present a working solution based on small and cost-effective standard elements. We describe two applications that illustrate the power this approach in the broad area of e-commerce, e-learning, and e-government: the BlueWand, a small, pen-like device that can control Bluetooth devices in its vicinity by simple gestures, and a door plate that can display messages that are posted to it e.g. by a Bluetooth PDA.

KEYWORDS

Human-Computer Interaction, Ubiquitous Computing, Wireless Communications (Bluetooth)

1. INTRODUCTION

Bluetooth is becoming more and more popular to connect peripherals like keyboards and mice to a computer, or to exchange data between a desktop computer and mobile devices, e.g. cell-phones and personal digital assistants. Both applications follow the Bluetooth design-goal to replace cables with a wireless link. But the Bluetooth technology can also be used beyond these two well-established paradigms. Since Bluetooth does not require physical presence of cables, sockets, or plugs, users do not need to be aware of the devices they are connecting to. If security considerations allow, they even do not need to be involved in creating a connection at all. This facilitates many new usage scenarios, that allow the user to perceive all the information devices in her vicinity as one connected informationally enhanced environment rather than a collection of separated gadgets.

To illustrate these ideas, we have developed a small, generic Bluetooth component that is based on a tiny Bluetooth module and a power-efficient microcontroller. This component can be merged with various sensors or actuators to create different embedded control-units for specific applications:

- The BlueWand, acts as a generic input device for applications and appliances that can be controlled via simple gestures (cf. figure 1). Accelerometers and gyroscopes detect the BlueWand's position and movement in 3D-space and transmit the so gathered data to devices that offer to be controlled by the BlueWand. The user does not need to take her cell-phone out of her bag to dial a number, or search for a control panel somewhere at the wall to adjust the air-condition. The required feedback-channel can be assumed to be provided by other Bluetooth devices, e.g. an ear-phone.
- The BlueMP3 is a hybrid gadget, a mobile storage system and a high quality head-phone (cf. figure 2, left). The two functions could also be implemented in two separate devices.

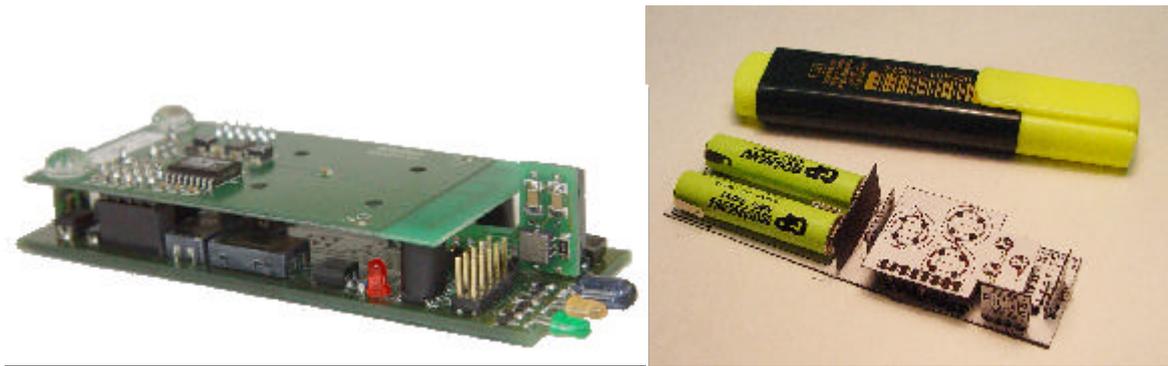


Figure 1. After the re-design the BlueWand (current version, left) will only be the size of a thick pen (model shown on the right, actual device available end of February).

The mobile storage provides personal documents, music files, etc. in environments that do not have sufficient connectivity to the Internet, e.g. in vehicles or during outdoor-activities. The MP3-headphone can not only play back high-quality music files but also replay acoustic information from the environment, e.g. read out commands that can be selected by the BlueWand. (If quality does not matter any off-the-shelf Bluetooth-ear-phone can be used for the latter.)

- The BlueCup is a Bluetooth-enhanced artifact that transmits sensor data of a coffee or tea mug to the surrounding Bluetooth devices (cf. figure 2, right). The cup detects movement and position of the cup as well as temperature and level of the beverage in the cup. The measurements are so exact that they can detect the size of individual gulps. These pieces of information can be used to infer the user's behavior and mirror it accordingly in the informationally enhanced environment, e.g. prepare fresh tea or coffee if the cup is about to be empty or if the beverage got cold.
- The BlueChair is another Bluetooth-enhanced artifact. It transmits both the pressure a person exerts on a chair and the chair's movements. This again enables the information infrastructure to infer the behavior of the persons living or working in this environment.
- The BlueDoorplate can be easily mounted next to office doors to display various information, e.g. when the respective person is absent. Messages can either be placed on the door plate explicitly, or implicitly by combining information gathered by the other Bluetooth devices in the vicinity. E.g., if the user takes her coffee mug out of her office and shortly afterwards enters the conference room, the door plate can display an according message: "I'm in a conference"

Unlike traditional notes, the BlueDoorplate can issue its contained information in various ways, e.g., remotely via a web-service or via a Bluetooth ear-phone to visually impaired people.

The door plate can also be used by visitors to stick notes to, e.g. about the purpose of their visit, combined with a request to be called back. Since our Bluetooth implementation is fully based on standard protocols, users can use almost any current Bluetooth device to stick notes to the door plate, e.g., their PDA or cell-phone.

2. TWO CASE STUDIES

The following two sections give a brief overview of some applications of the described technology in the broad area of e-commerce, e-learning, and e-government.

2.1 BlueWand

The achievements of modern electronics have led the size of many high-tech gadgets already beyond the size that can easily be handled by unaccustomed people. Additionally, such user interfaces are often not well suited to the use-cases of a wirelessly connected world: Each device provides its own user interface with display, key-pad or touch-screen, microphone and speaker. If a user wants to take notes during a phone-call, she is forced to additionally grab her PDA from the bag. If she wants to add the caller's number to the notes, she has to initiate that transmission at the cell-phone.

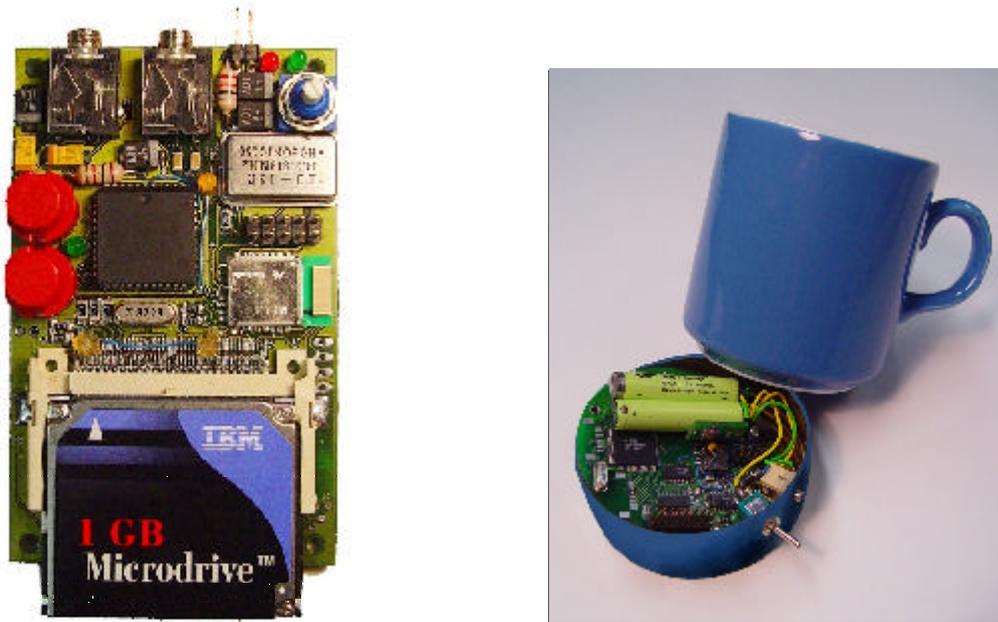


Figure 2. The BlueMP3 and the BlueCup are based on Bluetooth component described in this paper

In contrary, the BlueWand pursues the idea to separate the input and output functionality of the user interface. Each mode of a multimodal interface is provided by a specialized device while the core of the appliance can remain unnoticed in a bag, a piece of clothing, or somewhere in the room. The BlueWand itself can measure its relative movement in space, i.e. it can act as pointer, virtual slider, or detect simple gestures. It is accompanied by e.g. a Bluetooth ear-phone or – if technology proceeds further – by a Bluetooth-enhanced head mounted display. Depending on the actual application, feedback can sometimes be given on a fixed display in the room. E.g. for virtual laser-pointer applications no additional output device is needed besides the beamer that is already in use. The same holds for the on-screen-display of a TV set or video recorder.

Since – in the user's perception – the BlueWand is only linked virtually not physically to the controlled device, the user has the feeling to directly interact with the information environment. The actual devices vanish from the perception.

In a tele-cooperation or tele-learning scenario, a student or teacher might grab a BlueWand provided in the room to demonstrate some physical layout or process to a remote partner. Unlike conventional video-transmission based approaches that require an outside view onto the person in question, the BlueWand is very well suited for mobile environments, where no such view can be provided. If the BlueWand's core is built into the various objects used in an educational environment, a remote teacher can easily follow a student's activities and provide hints where necessary. The same applies to scenarios where a layperson has to perform some difficult task (first-aid, mechanical repair jobs, etc.)

Since gestures also bear subtle individual features, the BlueWand can be used to provide some level of user-identification, too. When combined with other biometric means, this can lead to an improved security of many e-commerce and e-government applications.

2.2 BlueDoorplate

The Bluetooth-enhanced doorplate demonstrates another feature of our Bluetooth implementation: Since it is entirely based on standard protocols, it does not require any special software on the devices communicating with the appliances described here, at least as long as standard software is used (web-browser, address book, notepad, etc.).

If the door plate is connected to the local Ethernet, information can both be loaded onto the plate and retrieved from it via a web-service from anywhere in the world. Visitors can not only view the information on the door plate but also fetch and upload (parts of) this information to their mobile Bluetooth devices, e.g.

PDA's or cell-phones. They can stick a note to the door plate, leave their phone number, or receive a number. Although such notes may be stored in the door plate, these notes need of course not be visible on the display of the door plate.

If the door plates cannot be connected to a wired network, they can still organize a (low-bandwidth) wireless network using the Bluetooth link. If an office-space has a sufficient density of such door plates (or other devices based on the same core technology), full connectivity is still maintained. If at least one of the devices, e.g. a Bluetooth-capable desktop PC, has Internet access, the whole network is again connected to the Internet.

This inter-device communication is also used to gather information from the bye-passing devices. E.g., a coffee mug that is carried out of one room and then enters another room, can be used to derive the information that the respective person went to another office. (Leaving a room is detected by sensing a mug approach the door plate and then leave the scope of the door plate's Bluetooth link entirely.) If such information is matched against other information, e.g. that this person has scheduled a meeting with the other person, the information environment can even know that the meeting actually takes place. It can then, e.g., refrain from disturbing the participants with the now unnecessary warning that they are supposed to be in a meeting. A regular annoyance of today's technology. (Note that the BlueCup can easily be substituted by a PDA or a cell-phone, so that it becomes very likely to be able to identify a specific person by the Bluetooth devices they carry around. Although, the fact that the BlueCup knows when it is carried around makes things a little bit easier.)

3. CONCLUSIONS AND OUTLOOK

This paper describes how Bluetooth can help to separate input and output devices from the core appliances that form the informational enhanced environments of the digital age. In doing so, the users get the feeling to directly interact with the information itself rather than with the individual devices accessing the underlying storage or communication systems. Unlike many publications in this field, we have not only described dream-scenarios but presented actual devices that are currently being used in our lab to explore the use of such mutually interacting Bluetooth devices.

Ideas of creating a link between the physical and the virtual world are not new: tangible [3]Jullmer01millenniumchapter or graspable user interfaces [2], context-aware objects [1]gellersen00adding, and augmented reality applications [4] have long been discussed. In distinction to many of such activities our approach greatly benefits from the use of standard protocols and Bluetooth. We are thus not depended on specially equipped rooms and infrastructures but can operate in an everyday office or even home environment. The devices we have build so far are small and cost-efficient. All this makes us confident that our technology has the potential to be deployed in many more scenarios and applications which hopefully will again raise interesting settings for further studies.

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TELEWORK IN POLISH ECONOMIC ORGANISATIONS

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ABSTRACT

The paper presents the most important issues related to telework. The results of surveys conducted among managers of Polish enterprises are discussed. Telework is a new form of work organisation and thus its aspects such as place of work, time of work, communication forms and employer – employee relations are discussed.

KEY WORDS

Telework. Information technologies.

1. INTRODUCTION

Throughout centuries we have been witnessing the effort human beings put into minimising the expenditure connected to particular tasks. As automation of certain manufacturing processes developed, the aim of decreasing work costs as well as improving work conditions resulted in the establishment of new work organization forms [Jasinski, 1999]. Flattened organization structures, small number of units handling the basic organization activity, combined with effective application of computer and communication technologies all create the opportunity of dynamic development of flexible work organization forms [Grudzewski, et al, 2001]. Tele work is one of the flexible work organisation forms. The notion of telework is still evolving and broadening, including more and more complex distance work organization forms. Presently, the term relates to numerous flexible systems of distance management of human resources. Employees do their job away from the company seat, applying computer and communication technologies. They may work in different places, such as their homes, satellite offices, telecentres or even hotels and airports.

2. SURVEYS ON TELEWORK

In May 2001, a survey on telework trends entitled “Telework Development in the Era of Information Society Formation” was conducted within a research project financed by KBN (Polish: State Committee for Scientific Research) 5 HO2D 001 20. The survey was aimed at establishing the factors influencing telework development as well as the attitudes and policies of managers towards the possibility of exercising certain tasks away from the company seat. The subjects researched were companies of the following branches of economy: tobacco, telecommunication, education, construction, information, medicine – both state and private ones. The survey was designed so that the respondents could answer the questions asked or freely elaborate on certain issues. A number of opinions and judgements on particular problems was thus collected.

Telework may be classified according to numerous criteria. The most important ones include: place of work, time of work and communication (interaction) method.

3. PLACE OF WORK

Telework classification according to the **place of work** criterion may concern the following issues:

- Placing an employee permanently away from the company seat, contractors, customers, material resources, etc. (home-based telework, work in telecentres or satellite offices).
- Placing an employee temporarily away from the company seat. Such a situation results from a temporary or urgent need of placing a certain employee away from the company e.g. in case of business trips (mobile telework).

Place of work as a telework criterion allows for its classification in the following way: home-based telework, mobile telework, work in telecentres. Table 1 presents the classification.

Table 1. Telework classification according to the place of work criterion

Place of work / Telework type	Home, employee's apartment	Office equipped in information structures	Work exercised during business trips
Home-based telework	Employees perform their duties at home		
Work in telecentres		Employees perform their duties in places equipped in IT, without the necessity of covering large distances to the company seat	
Mobile telework			Performed by specialists who spend most of their time at the clients', maintaining contact with their office thanks to telecommunication and information technologies

[Source: own analysis on the basis of [Smolag, 2001]]

4. TIME OF WORK

Time of work determines the form of communication between the employees of a particular organisation. There are two methods of communication: in synchronous and asynchronous time. The form of communication depends on the work exercised. Some tasks are exercised asynchronously and the place of work bears no importance. Such situation concerns mostly all individual tasks, such as: translation, data compilation, etc.

Figure 1 presents the relationship between the time of work and place of work criteria.

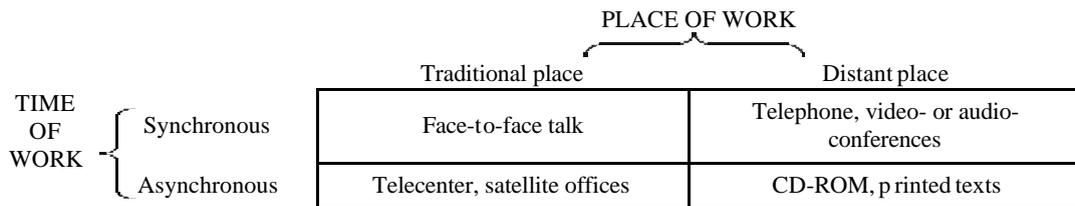


Figure 1. Comparison between the time of work and place of work criteria

[Source: own analysis on the basis of [Daniels, et al, 2000]]

5. FORM OF COMMUNICATION

In every work model a form of communication is an important element of the relation between the employer and the employees. In case of telework, communication between the employer and the employees is enabled by the application of information technology (IT). One may distinguish two levels of IT application:

Low level: telephone, computer. Tasks and results of work are sent via the electronic mail.

High level: telephone, fax, computer, peripheral appliances such as scanners, printers, connection to a computer network – Internet, Intranet or Extranet. Tasks and results of work are sent with the application of telecommunication and information or internet technologies. Audio- and video-conferences.

Depending on the IT solutions applied, a certain level of communication is achieved. Table 2 presents a comparison of different communication media.

Table 2. Comparison of different communication media

	Face-to-face talk	Written form - document	Oral form - telephone	Video-conferences	Electronic mail
Accessibility/synchronisation	Synchronisation of place and time	Asynchronisation of place and time	Synchronisation of time, asynchronisation of place	Synchronisation of time, asynchronisation of place	Asynchronisation of place and time
Consciousness/understanding	Dependant on the communicator	High level of understanding	Dependant on the communicator	Dependant on the communicator	High level of understanding
Social context	Strong	Moderate	Moderate	Strong	Weak

[Source: [Vartiainen, 2001]]

Telework classification according to the form of communication criterion covers proper work relationships as well. Shaping proper work relationships in an enterprise is related to the issue of work humanisation. Work humanisation is an important element, introducing balance between corporate social and economic objectives [Gableta, 1998].

The survey conducted enabled the definition of a crucial telework classification criterion, namely the relationship between an employer and an employee. Table 3 presents telework classification according to the criterion: the relationship between an employer and an employee.

Table 3. Telework classification according to the criterion: the relationship between an employer and an employee

Telework aspects	Type of activity, division of labour	Tasks implemented in the form of telework	Place of work	Time of work	Form of communication	Technical aspects	Organisational aspects
Civil contract Contract agreement, mandatory contract	Small group of employees	Individual work, team work	Home-based telework, mobile telework, telecentres	Constant, independent	Direct or indirect	Low level, high level	Adjusted to telework. Work conditions defined in a contract.
Regular employment Contract of employment	Large group of employees	Individual work, team work	Home-based telework, mobile telework, telecentres	Constant, independent	Direct or indirect	High level	Adjusted to telework. Career opportunities and trainings ensured, full social package

[Source: Own analysis on the basis of a survey entitled "Telework Development in the Era of Information Society Formation", conducted within a research project financed by KBN (Polish: State Committee for Scientific Research)]

This criterion is mostly determined by the legal aspect. It thus concerns legal relations that may occur between an employer and an employee. The criterion is strictly connected to the definition of the place of work, time of work and the method of communication. Moreover, in the light of telework introduction, a full analysis of the relation between an employer and an employee may influence the process of work reorganisation.

One may distinguish dependent (on somebody else's account and on somebody else's behalf) and independent (on one's own account and on one's own behalf) telework.

One may classify employment forms in Poland according to the criterion of legal contracts in the following way:

- Contracts subject to employment regulations – labour relations,
- Civil contracts – contract agreement, mandatory contract [Labour Law, 1999].

Independently executed telework may take the form of own business activity. This type of employment is called self-employment. Self-employment is a form of telework discussed in numerous European Union reports within the EMERGENCE project. In the author's opinion, running own business activity and performing certain tasks for other economic organisations within its scope may be classified as one of electronic commerce forms. It should be stressed that telework performed on the basis of a contract of employment implies a direct relation between a tele-employer and a tele-employee [Huws, 2001, www.emergence.nu].

6. SUMMARY

The survey conducted enabled the definition of telework classification criteria. The criteria discussed point to two key areas in which telework should be considered, namely:

- organisation: classification of tasks into those that may be performed in the form of telework and those that require employees to stay at the office;
- technical aspects: scope of information technology application.

The first aspect is undoubtedly connected with managing the teleworking employees. Effective co-operation and communication strategies should be worked out. Moreover, the legal problems of employment should be solved as many people in Poland are employed on the basis of mandatory contracts instead of contracts of employment.

The second aspect implies the need to consider the issue of fast and effective application of information technology. Data safety should also be ensured [Smolag, 2002].

Telework development and implementation in a particular business activity does not depend only on the availability of computer networks, efficiency of technical equipment or investment and maintenance costs. Telework depends to a great extent on particular tasks performed by employees of a given organisation as well as on the knowledge of employers and employees on the factors determining its development.

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FLEXWORK INTRODUCING FLEXIBLE WORKING TO SMES IN RURAL AND REMOTE REGIONS

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ABSTRACT

Flexible working (or eWorking) is being able to work with customers, suppliers and employees independently of distance and time barriers. Small and Medium Enterprises (SMEs), especially those in rural or remote regions, could gain enormous benefits from flexible working. Some have already done so, overcoming problems of isolation and becoming 'smart' organisations that can instantaneously combine the knowledge of all the individual members and respond dynamically to customers' requests or new business opportunities.

However many small businesses are intimidated by the technology and find it difficult to obtain good advice on what tools and techniques would suit them best. Small Business Advisers, working for Regional Development Authorities or Chambers of Commerce, have an important role to play in helping local businesses adopt flexible working techniques. However the technology is evolving rapidly and these Business Advisers need a structured approach to selecting and implementing a package of flexible working tools and techniques that will progressively improve an SME's competitiveness and speed of response. This includes monitoring the effectiveness of the package and refining its contents in the light of experience.

FlexWork offers them such an approach, together with access to an extensive range of back up materials on all aspects of flexible working.

This paper presents the FlexWork project funded by the IST Programme (IST-2000-26367) and the package of resources to help small businesses and their advisors to implement different forms of flexible working.

For further details see: <http://www.flexwork.eu.com> or mail to: info@flexwork.eu.com.

KEYWORDS

Teleworking, Flexible working, e-Working.

1. INTRODUCTION

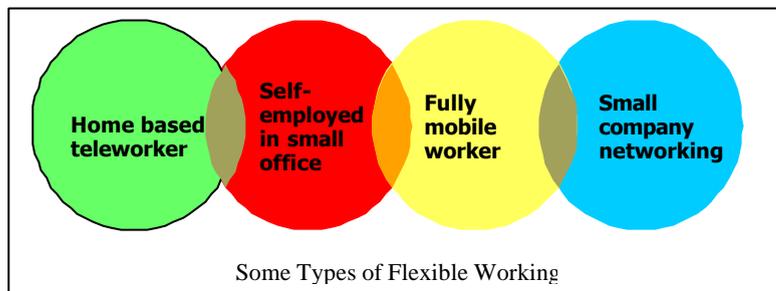
The FlexWork project funded by the EC IST Programme (IST-2000-26367) is running from 2001 to 2003. In the first two years some very relevant products were created and tested along the European Union. These products include a "Flexible working Handbook", a set of "Blueprints for flexible working" and some others described in detail below. Flexwork builds particularly on telework projects funded by the EU in the Employment area (ADAPT, EMPLOYMENT, EQUAL), Regional Development (LEADER), Research and Technological Development (TAP, ACTS, ESPRIT).

2. BODY OF PAPER

‘Flexible working’ is about using Information and Communications Technology to help companies and individuals work more efficiently and/or exploit new types of business opportunity. The technology is used to extend, rather than replace, many traditional models of work. For example:

- Working at home is not a radical new concept, but flexible working allows home workers to carry out a much wider range of tasks and work together more effectively as members of teams.
- Salesmen have traditionally been nomadic workers, regularly visiting their customers in search of new orders. Flexible working makes them much more effective nomadic workers - e.g. by answering all a customer’s questions and closing the deal without referring back to head office.
- Freelance professionals and ‘journeyman’ workers have always formed short-lived teams to tackle specific tasks, e.g. making a movie or building a bridge. Flexible working makes it possible to form such teams more quickly and also to address new types of task that require ‘virtual’ teams which seldom, if ever, meet physically.
- Every business has a valuable ‘network’ of contacts - suppliers, customers and associates. Flexible working broadens and merges these networks, so that members can respond more rapidly to a wider range of business opportunities.

Teleworking replicated the tools needed to do existing jobs, so that workers could do them at home, on the move or whenever it suited them. Flexible working goes further by providing workers with better tools for doing their jobs and can eventually transform the nature of the jobs themselves, by giving individual team members immediate access to the information needed to solve unexpected problems. In other words, teleworking creates distributed organisations for carrying out existing tasks, whereas flexible working creates ‘smart’ organisations, which can rapidly put together the plans and teams needed to respond dynamically to business opportunities.

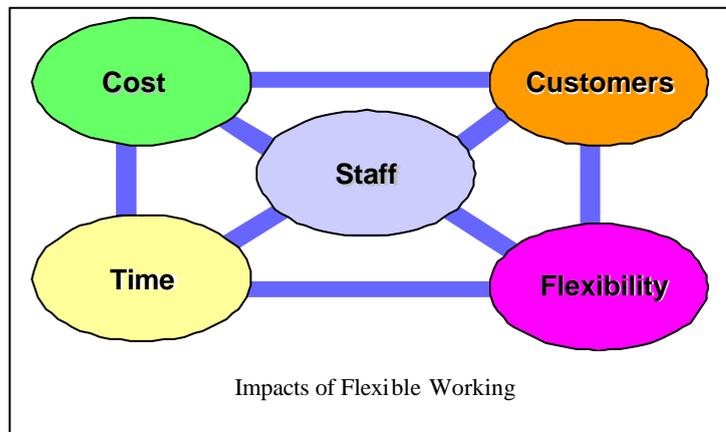


Flexible working makes it possible for companies to become partners in one or more virtual, global and dynamic enterprises. As well as helping them to overcome time and distance barriers, it can provide them with rapid access to information about resources, suppliers, and customers. It allows skills to be drawn into a project whenever they are needed and from wherever they are available.

Flexible working and small businesses

Small and Medium Enterprises, especially those in rural or remote regions, could gain enormous benefits from flexible working. Some have already done so, overcoming problems of isolation and becoming ‘smart’ organisations that can instantly combine the knowledge of all the individual members and respond dynamically to customers’ requests or new business opportunities.

However many small businesses are intimidated by the technology and find it difficult to obtain good advice on what tools and techniques would suit them best. Small Business Advisors, working for Regional



Development Authorities or Chambers of Commerce, have an important role to play in helping local businesses adopt flexible working techniques. However the technology is evolving rapidly and these Business Advisors need a structured approach to selecting and implementing a package of flexible working tools and techniques that will progressively improve an SME's competitiveness and speed of response. This includes monitoring the effectiveness of the package and refining its contents in the light of experience.

The IST project 'FlexWork' offers them such an approach, together with an extensive range of back-up materials. Its website: www.flexwork.eu.com provides small businesses and, more particularly, their advisors in Regional Development Authorities with access to a rich and up-to-date set of resources on all aspects of flexible working.

What FlexWork offers to small businesses and their advisors

There is no 'one-size-fits-all' prescription for flexible working. The flexibility can take many forms, e.g.

- Where and when the work is done,
- Management styles and processes,
- Organisational structures,
- Individual skills and responsibilities,
- Contractual relationships between the players involved,
- Workplace social culture.

FlexWork has therefore put together a package of resources to help small businesses and their advisors. These allow companies to examine the type of business they want to become and select a mix of flexible working tools and techniques that will help them achieve their ambitions.

The FlexWork resources include a **Handbook of Flexible Working**. This starts with a guide to the basics of flexible working, presenting various approaches, the technologies available to support them and the benefits that can be gained from adopting them. The handbook then identifies and discusses a number of issues, which should be considered by any company thinking of introducing flexible working techniques. These include:

- Selecting suitable tasks and people
- Managing flexible workers
- Equipment and technology
- Health and safety
- Virtual teamwork
- Training and career development
- Contractual and legal matters

The final section of the handbook presents a structured approach to introducing flexible working within a small business. This guides the user through the process of developing a flexible working **implementation plan**, analysing the **costs and benefits** of different approaches, and presents a **model for phased introduction** of the chosen tools and techniques.

The template for the **implementation plan** guides a company through examining why it wants to introduce flexible working, comparing the various tools and techniques available, identifying key issues, and deciding how to monitor the effectiveness of the selected tools and techniques. The template is backed up by detailed checklists for analysing critical factors.

Because many of the effects are qualitative or only achieve payback in the medium term, traditional approaches to cost-benefit analysis tend to offer a pessimistic view of the potential of flexible work. FlexWork therefore presents a methodology and software tool for **extended economic efficiency analysis** – a way of extending cost-benefit analysis to cover criteria relevant to flexible work (e.g. productivity improvement, corporate image, employee satisfaction), which cannot be directly expressed in financial terms.

Other software tools include the **FlexWheel** – a flexibility analysis tool, which helps a small company select the types of flexibility best suited to its business situation and organisational culture.

FlexWork resources include

- Flexible working Handbook
- Blueprints for flexible working
- Success Stories
- 'Do-it-Yourself' templates and checklists
- Tools for flexibility and cost-benefit analysis
- Management briefings on important issues
- Case Studies
- Regional workshops for SMEs and Business Advisors

The empirica model for phased introduction of flexible working adopted by FlexWork identifies six phases:

- Preparation
- Feasibility study
- Concept
- Implementation and pilot operation
- Monitoring and controlling
- Extension and correction

Templates and checklists are provided for developing detailed plans for each phase.

As well as the handbook,

FlexWork has produced a series of ‘blueprints for flexible working’ showing SMEs how to implement a number of contrasting, but widely used, styles of flexible working. These blueprints explain the types of business situation to which the style is best suited, outline the kinds of benefits which can be expected and introduce the tools and techniques available for implementing it. Each blueprint includes templates and checklists to support ‘Do It Yourself’ implementation plans, and is accompanied by a set of ‘success stories’ describing how individual SMEs have already benefited from that particular style of flexible work.

A series of technological tools was developed in the European Union in the framework of the different Research and Technological Development programmes over the last decade. ACTS, ESPRIT, TAP AND IST projects developed a wide range of tools which constitute the ‘Technology Case Studies’ featured in our web site. ‘Regional Case Studies’ are also featured as a result of Regional development initiatives, some of which were launched in the framework of Community programmes such as LEADER, EMPLOYMENT, HORIZON and ADAPT. ‘SME Case Studies’ illustrate real world use of Flexwork methodologies and techniques by SMEs located in various countries across the European Union.

The FlexWork website complements the handbook and blueprints with a series of management briefings on important commercial and technical issues associated with flexible working and also provides a comprehensive set of links to other established sources of information. These allow SMEs or Business Advisors to dig more deeply into topics of particular concern to them.

Spreading the Word

The FlexWork resources are being promoted to all of Europe’s RDAs through EURADA, the European Association of Development Authorities. The service is free but users are encouraged to register so that feedback can be gathered about the usefulness of the material provided.

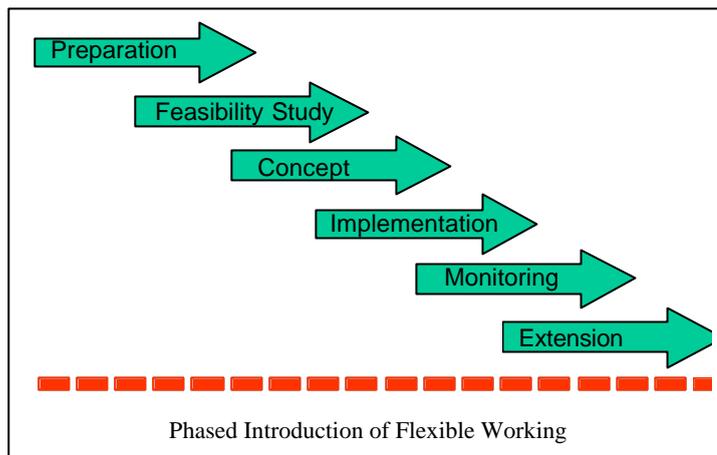
FlexWork has been working closely with a number of Regional Development Authorities in Denmark, Germany, Ireland, Portugal and the UK to better understand the requirements of small businesses for information about flexible working and to refine its package of support materials.

A programme of regional workshops was set up to actively promote the FlexWork resources to a wider group of regions in EU member states. The project has also brought on board a number of additional partners from Bulgaria, Hungary, Poland and Slovenia to refine the material for use in accession countries and promote its use there.

Contact Details

The FlexWork partners:

- Waterford Institute of Technology (IRL)
- Portuguese Association for Telework Development (P)
- Danish Technological Institute (DK)
- empirica (D)
- Interaction Design Ltd (UK)
- Telscom Consulting GmbH (CH)



- University of Brussels (B)

Add-on partners

- Virtech (Bulgaria)
- ALP Peca (Slovenia)
- ITTI (Poland)
- MONA (Hungary)

have extensive experience in advising on the adoption of flexible working and have active representatives throughout Europe.

The project website is:

www.flexwork.eu.com

and more specific enquiries can be e-mailed to:

info@flexwork.eu.com

THE POTENTIAL OF WEB COMMUNITIES FOR MARKETING: THE GIRLAND CASE

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ABSTRACT

Since the advent of Internet different groups have studied how to harness and make use of its potential as a marketing tool. More recently, with the diffusion of web communities, there has been greater interest in marketing strategies that rely on an understanding of consumer behaviour. By analysing members of a community, companies can have information about consumer awareness (what the customer knows about the product) as well as about consumers themselves (as the target market). The creation and management of a community, and the development of mechanisms that enable us to obtain this knowledge, constitute a real opportunity to build a database to refer to when planning strategies for sales and building customer loyalty. In this paper we present the virtual community GirLand to illustrate the most important aspects of marketing in web communities and the learning mechanisms developed within them.

KEYWORDS

Web community, marketing strategies, e-marketing, consumer behavior, members' relations.

1. INTRODUCTION

To illustrate the potential and innovative features of web communities¹ in marketing it is first necessary to look at the evolution of this discipline, which tends increasingly to reach the consumer with an iterative approach.

In the early 1900s marketing activities were limited to managing the logistics of the offering channels, while in subsequent decades, accompanied by greater industrialization, its function was redefined to include communication with the consumer: television, radio and print media thus became key marketing tools, and the Internet being the most recent addition. The communicative potential of this new media was immediately understood by marketing specialists who saw not only the possibilities of one-to-many communication (one-way communication from the source to a large audience) at lower costs compared with television or radio, but more importantly the possibility of one-to-one communication with the user (personalized messages from the company and the possibility to create a reciprocal relationship).

At the same time the role of marketing activities in companies evolved, currently acting as the interface between the company and target environment, that is the group of important interlocutors so as to reach the objectives of the company. Now more than ever having a thorough understanding of the target environment translates into a strategic resource and key to success. In this new approach to marketing the consumer

¹We prefer to use the term web community to identify a community existing on the Internet because some authors have used the term virtual community also to refer to a community existing in the real world.

becomes a principal interlocutor for the company, and thanks to the ability of Internet to strengthen communication and transmission of information, the relationship can move from a one-to-one interaction pattern to a network of relationships among actors involved in the target environment, thereby following a many-to-many pattern. Consumers therefore have the possibility to exchange information with each other and with companies easily; companies for their part interact directly with consumers in order to gather information, the result being the development of a learning process based on dialogue and interaction.

For our purposes in this paper, the term “learning”, often referred to as community dynamics, can be understood as a process having an exchange of knowledge, interaction among participants, and sharing of knowledge. Given that Internet technology is able to promote greater contact between company and consumer, it is similarly able to favour more direct learning between the two entities.

The more innovative Internet tools, deemed highly useful in implementing many-to-many interaction patterns and able to recreate learning mechanisms, are the web communities, the subject of the next section.

2. WEB COMMUNITIES, MARKETING AND LEARNING MECHANISMS

A community can be defined as a group of people who have a common purpose, activity or interest, this implies that the members interact with each other and develop relationships. Communication, therefore, plays a fundamental role within the community (Kim, 2000). This concept is also valid for on-line communities where the virtual meeting place is of great importance insofar as it permits members to exchange ideas, discuss issues and establish personal relationships. In accordance with the type of user and virtual community, it is possible to develop specific, targeted marketing policies that are coherent with the focus of the community and also look to improving communication and interaction with and among members (see also the document <http://www.cs.unitn.it/~etourism/pubblicazioni/n14.pdf>).

The innovative impact of web communities for marketing lies in the possibility to integrate communication and interaction with strategies aimed at learning. *Supponiamo di voler acquistare un televisore: entrati nel negozio è possibile valutarne i diversi modelli, prezzi, discutere con il commesso le specifiche di ogni apparecchio, reperire cataloghi aggiornati con illustrate le diverse caratteristiche.*

È possibile inoltre visitare il sito delle case produttrici per ricevere altre informazioni, ma rimane sempre il dubbio se l'acquisto di un determinato televisore sarà poi soddisfacente.

Spesso ci si affida quindi ad esperienze o al consiglio di qualche amico o conoscente che ha già effettuato l'acquisto, capace quindi di garantire o informare sulla bontà dello stesso. Si ricerca quindi uno scambio di conoscenze fra utenti, consumatori; questa finalità è il principio che regge l'esistenza di comunità virtuali rivolte a supportare le transazioni.

Spesso le comunità che soddisfano queste tipologie di esigenze subiscono una naturale evoluzione integrando anche l'e-commerce e quindi la possibilità di perfezionare, oltre che valutare, l'acquisto.

Learning in a community means learning actively within a tight network of relationships, developing the interaction patterns necessary to promote an exchange of knowledge and information; to be considered learning communities, web communities must favour and support the development of these activities. Companies are continuously searching for information on the behaviour and dynamics of the actors involved in the target environment. Web technologies and web communities enable companies to create information exchanges that expand the company's capacity to innovate, providing vital information on the context in which “partners” operate and exist. Web communities therefore provide a learning opportunity not only for the consumer but also for companies, which are able to interact with users via web and moreover to study their behaviour and identify their needs. Web communities provide companies a selection of active users who are grouped by interest, operativeness, or buying habits, and the company can interact with them to build its own knowledge base, a determining factor in successful decision making. The acquisition and diffusion of knowledge occurring in web communities is therefore reciprocal: consumers gain information about the offering while the company receives important information about consumers, their needs and behaviours. In the next section we analyze the virtual community GirLand and the objective is to highlight the potential for innovative marketing policies in on-line communities.

3. THE GIRLAND VIRTUAL COMMUNITY

Founded in October, 1999, the web site www.girland.com was initially designed to support the campaign to market a videogame, the site soon thereafter began to grow; it quickly became a meeting place for girls desiring to talk together about the game and mostly about general topics.

A peculiarity of Girland—related to the aim of the videogame—is that it is based on communication. For this reason the site provides different sections where the girls can exchange messages: Bulletin Board, Problems and Advice, Touching Moments (or Warm Moments), Embarrassing Moments (or Cringe Moments), Reviews pages, Internal Mail System (IMS), Chats. Members receive points, credits or recognition by operating actively within the site, writing messages in prescribed areas, voting on them or taking on other responsibilities described above, all of which results in a certain hierarchy among the users.

The GirLand community currently lists about 175,000 members. The average number of pages requested per month is about 12,500,000 and the average number of individual users per month is 125,000.

The marketing policies in GirLand are characterized by the presence throughout the site of banners, sponsorships and links to other sites. Users also receive periodic newsletters containing advertising messages related to the banners and links; in addition, advertising campaigns are conducted via SMS sent to members' mobile phones. These tools permit both one-to-many and one-to-one communication, based on the personalized information gathered and users' profiles. Alongside these more straightforward and traditional approaches was carried out a highly innovative marketing project that harmonized perfectly with the logic of the site and with the concept of the community as a learning opportunity. The sponsorship of several interested companies led to the creation of virtual shops within the community, many in the three-dimensional chat environments.

A distinguishing feature of GirLand is the possibility for members to create their own virtual personality called avatar. The new identity can be used in chat rooms, for example, or in beauty contests (Catwalk Diva). The personalization of avatar takes place by visiting virtual shops and purchasing articles for the new "identity;" thus the shop has two functions: 1) a display window for real products offered by companies by means of describing, advertising and showing products, and 2) an integral part of the game played by community members. Users can select and try the goods through their avatar personality, and also interact with a virtual "shop assistant" who is able to understand user messages by using a complex language filter and can therefore "speak" with users to answer questions about products or describe them, and even to make suggestions in response to needs expressed. The information that GirLand members provide through their needs as expressed and eventual choice of products (from among many) can then be analyzed and organized into meaningful data for interested companies. Another useful marketing tool for sponsor companies are forums, subdivided by category, where the girls can freely express their own opinions and post reviews of actual products; the forums include discussions, information sharing, opinions and testimonies regarding products purchased – particularly for products advertised and available at the site. Interaction in this section is guided by the specific rules of GirLand, which allows members to express agreement or disagreement with the message posted in the forum, and also to vote on the messages, receive votes and therefore earn credits that augment the member's reputation and level in the community hierarchy mentioned earlier. The community is known for the honesty and frankness of contributions, which tend to be realistic and well considered. Messages and comments lacking these qualities result in a loss of credibility and reputation of the member within the community, and moreover the loss of credits with their corresponding advantages.

It is now possible to look in greater detail at the innovative marketing mechanisms applied in a community like GirLand and analyze the advantages gained through sponsorship that includes "setting up" a virtual shop within the site: we look at the specific cases of a well-known cosmetics firm and a leading sport clothes manufacturer. Once a company has offered its products within the community it is possible almost immediately to have feedback from users in the reviews forum. Reproducing the entire collection or offering of the company in its virtual shop, it is also possible to study the number and features of consumers expressing interest in the real version of the product as well as the choices of members who buy a virtual product. The preferences expressed by users by virtue of their purchases are neither random nor thoughtless inasmuch as they imply the use of accumulated credits which, as mentioned, are the "currency" of the community. Moreover, the goal of dressing up the virtual personality (avatar) is to gain approval and obtain votes in the Catwalk Diva, always useful for improving one's position in the social hierarchy. Using these tools, it is possible to indirectly obtain information regarding which products or cosmetics attract attention

and stimulate curiosity among the girls, but with the added component of a game and within the rules of the community. This means of gathering data from a sample of girls can essentially be considered a kind of survey, distinguishable by the relatively low costs involved.

Community members are therefore able to expand their familiarity with real products not only by reading the information published at the site but principally by interacting with other users in the forum, gathering opinions, feedback, and personal testimonies. At the same time companies acquire valuable information on consumer awareness, needs, and behaviour by looking at how consumers interact and react to products. Companies are thus better prepared to plan marketing strategies and to interact with customers in real time.

4. CONCLUSIONS

Web communities can be understood as a model of business existing on Internet; they enable companies to apply and improve on-line marketing strategies based on communication and innovative interaction and information-sharing activities.

Worth remembering, however, is that not all groups of users interacting on Internet can be considered web communities, and moreover not all communities are equally adapted to favor marketing strategies. Communities must aim to build user loyalty and to provide incentives for active participation, meaning some form of remuneration and monitoring of user activity. The optimal solution is to arrive at a convergence between content and interaction, thereby offering a virtual environment in which user interaction adds value to the community and, most importantly, creates a context from which companies can extract useful feedback and commentaries. In the GirLand community both the content and interactions are based on real topics. In this context companies therefore can take advantage of the user conversations, critiques, articles posted and preferences expressed (explicitly or implicitly) to refine and apply learning strategies, in addition to strategies aimed at consumer persuasion.

The "culture" and the mechanisms of learning on-line, have been applied by relatively few pioneers in the sector, while the majority perceive web communities largely as a means to strengthen promotional activities. Furthermore, a look at the financing and actions of marketing specialists and advertising agencies reveals how they target Internet investments predominantly at advertising and one-way communication, working through portals rather than communities. On one hand the lack of a culture of marketing on-line, the absence of measuring standards and rigorous analysis of user traffic at sites (Foan, 2002), and the inability to evaluate the results of marketing policies, all represent as yet unsolved problems that limit a full understanding of Internet communities. On a more positive note, examples like GirLand show how building a community focused on meeting user needs and providing incentives for active participation of members opens the door for the effective integration of traditional marketing tools with new and innovative marketing strategies that can add marked value to both consumer and business.

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MANAGEMENT OF KNOWLEDGE FOR A VIRTUAL COMMUNITY

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ABSTRACT

This paper describes the development of a web-enabled information service for constituents of the Information Resources Management College. The constituents of the College, who include graduates, current students, and prospective students, typically work in the Chief Information Officer (CIO) office of United States federal agencies. The web-enabled information service, known as "Knowledge Net," is intended to tie the College constituents located throughout the world into a virtual community – sharing technical information, emerging problems, and potential solutions. Knowledge Net has evolved over a three-year span from a skunk-works project of several faculty members to an institutionalized system supported by the University. The most significant lessons learned to date include the requirement for a web-enabled content management system to ease posting of information to the website and the need to adjust administrative policy to encourage faculty to take on and integrate Knowledge Net related activities into their ongoing academic responsibilities.

1. INTRODUCTION

The Information Resources Management (IRM) College of the National Defense University is a Corporate University for information technology executives in the Department of Defense (DOD) and other federal agencies. The IRM College, located in Washington D.C., offers several graduate-level programs dealing with policy, strategy, development, and management of information technology systems.

One of the major programs offered by the College is the Chief Information Officer (CIO) Certificate program. This program, attended by mid-to-senior level managers in federal agencies, leads to a CIO Certificate acknowledged by the Federal CIO Council.

There are perhaps twenty thousand people worldwide serving in the CIO organizations of federal agencies. The IRM College has the capacity for handling a maximum of 2,000 students per year. How should the College support the other 18,000 individuals? How can it better serve the graduates of its program? These twenty thousand people are also in need of continuing development and support. They work in the field of information technology that changes radically in the requirements for management oversight. How will conversion to a wireless strategy change the fundamental way business is accomplished? How can the greater demand for information security be balanced with increasing concerns of information privacy? The people who work in federal CIO organizations worldwide are continually bombarded with new demands and challenges for which they were unprepared by educational programs taken just six months earlier. In addition, even though there is a commonality of issues through which all members of federal CIO staff must work – whether at an outpost in Korea or at a government research facility in North Carolina – each unit tends to do so individually, on its own. They are on their own – keeping up with the technology as best they can, testing out their own solutions until their next opportunity to occupy one of the limited slots for attendance at the IRM College.

2. KNOWLEDGE NET

The World Wide Web offers a supplemental approach for achieving the mission of continuing education. The model conceived to take advantage of the evolving capabilities of the Web - beyond conducting formal courses online - has been designated as the NDU Knowledge Net (<http://www.nduknowledge.net/>).

2.1 The Information Service

The NDU Knowledge Net is a web-enabled service seen as an alternative Information Age strategy for the University to deliver just-in-time critical information to its constituency. As originally conceived, it provided the following web-enabled services for each of the ten competencies identified by the Federal CIO Council:

- FAQs: Frequently Asked Questions and answers concerning fundamental concepts
- NEWS: Summary and links to recent developments concerning the competency
- GUIDES: Software tools, decision aids, and “How to” guidelines to do things.
- EVENTS: Links to training/educational programs and conferences related to the competency
- EXAMPLES: Success stories and sample products of real-world applications
- RESOURCES: Annotated links to related references on the Web

Two additional services were envisioned for the information service:

- DISCUSS: Threaded discussions on topical issues facilitated by faculty and users
- LIVE: Entry to scheduled real-time discussions and briefings on topical issues

The home page for the original Knowledge Net provided direct access to each of the ten competency areas (e.g., *policy, strategic planning, leadership...*). Access was also provided to a search engine for searching all the Knowledge Net content, a statement of the web policy governing the Knowledge Net web site, a glossary of terms associated with the CIO position, and links to related sites.

When the user clicked on the name of a competency on the home page, the NEWS page for the selected competency area opened. From here, the users had a number of options. They could...

- scroll down the summaries of articles until they find one in which they are interested, and then click on the arrow icon to open that article in a separate window.
- open a different kind of page for the same competency (e.g., EVENTS, GUIDES,...) by clicking on one of the tabs near the top of the display.
- access the same kind of page in another competency area (e.g., *policy, strategic planning, leadership...*) by clicking on one of the icons at the top of the page .
- access any of the general purpose pages (e.g., search, glossary, contact us,...) by clicking on an appropriate section of the image map in the upper left section of the display.

One Content Manager was responsible for each of the ten CIO competency areas. Volunteer faculty members with technical specialties in the associated competency accomplished these roles. They searched for relevant content, in part to support their normal course development and teaching duties, and in part to maintain the currency of the Knowledge Net competency web pages for which they are responsible.

As the Content Managers identified items for their Knowledge Net area, they entered the required information into an electronic form designed for this purpose. Their submissions were entered into a database. At this time, items were uploaded from the database to the Knowledge Net server manually by a Webmaster, to allow for a quality control check.

2.2 Lessons Learned

The initial phase of Knowledge Net development covered in this paper is restricted to the web publishing function – the posting of relevant information for users. The discussion and streaming capabilities will be introduced into Knowledge Net sometime in 2003.

In the earliest stage, the Content Managers created and updated pages (*News, Events, ...*) associated with their assigned competency area using a web editor software package. Updated pages were sent to the University Webmaster who in turn would upload the pages to the server. This approach proved disastrous. Firstly, although IRM College faculty members are quite proficient in management concepts associated with information technology, their expertise with web editors varied considerably. The updating process required that the Content Managers first download the current page from the web server (to assure that the page being revised included all current changes), update it with the web editor, and then send it to the Webmaster for uploading back to the server. This did not always happen this way. Occasionally, a Content Manager would update the web page on his or her local drive and send it to the Webmaster without first downloading the most current page from the server. If the page on the server was a more recent version than the page on the Content Manager's local drive, this action would overwrite previous changes and corrections. In other words, configuration management of the website was a nightmare. Plus, the lack of capability with web editors by some Content Managers led to some very strange looking web pages uploaded to the server.

This problem was solved fairly easily by hiring a part-time Graduate Research Assistant as the Knowledge Net Webmaster. The new Webmaster quickly created simple web-based transaction forms and scripts to elicit new content items from the Content Managers. In this situation, a Content Manager wishing to update a page with new information accesses a web-based form customized to the type of page being updated. After entering the requested data (e.g., *title, date, link, summary*), the Content Manager can preview the appearance of the new item and then click on the Submit button to send it to the Webmaster. Content management no longer required the use of web editors and configuration management was completely in the hands of the Webmaster. The Webmaster was asked to upload new items to the server within three days of receipt, a requirement that was generally met except during periods of illness, vacation, and competing academic pressures on the Research Assistant. More recently, the Webmaster created a new system in which new items submitted by the Content Managers are entered directly into a database that, in turn, generates the updated web pages on the fly. In other words, as soon as a Content Manager submits a new item, it is immediately displayed on the Knowledge Net website. Content Managers now also have the ability to edit and delete items from the database themselves. They are now, indeed, *content managers*.

Another problem led to a major overhaul of the Knowledge Net website this year. Up until recently, the Knowledge Net areas were based on the ten competencies originally specified for Department of Defense CIO's. As such, ten IRM faculty members were recruited to serve as Knowledge Net Content Managers, one for each competency. The selected faculty members undertook this new incremental task with varying degrees of enthusiasm. Some were highly excited about the prospect of managing a portion of a website devoted to a content area associated with their own intellectual pursuits. These faculty members saw their content management responsibility as an opportunity, spending several hours a week in the search for new relevant content, publishing new items almost every day, and integrating the website into their academic courses as a major information resource. However, other faculty members were more reluctant to embrace their content management responsibility. They seemed to see their role in Knowledge Net as a burden, almost a distraction to their ongoing academic duties. As a result, the content on web pages associated with these competency areas might not be updated for weeks on end. This is a serious problem for a web-based information service such as Knowledge Net. Websites of this sort must have fresh content in order to attract and bring visitors back.

The proposed solution to this issue led to a redesign of Knowledge Net. The number of competency areas has been collapsed from ten to six and these six areas are now aligned with the organizational structure of the College. The six areas are now *e-Government, Performance Management, Enterprise Architecture, Systems Acquisition, Technology Capabilities, and Information Assurance*. Each of the three academic departments in the College now has responsibility for two Knowledge Net areas. Department Chairs at the IRM College have supervisory responsibility over faculty. The redesign was based on the belief that a more consistent level of performance will be attained by reducing the number of required Knowledge Net Content Managers (i.e., it should be easier to find six personally motivated faculty members than ten such individuals) and by

delegating their selection and management to the Department Chairs. This change was initiated about six months ago and, although performance has been more consistent, it is too early to declare a success.

3. CONCLUSION

3.1 Benefits to the Constituents of the College

Knowledge Net enables the 20,000 thousand people working in federal CIO officers to continue their professional development, even when they are unable to enroll in formal College courses. They have access to current information about the field anytime and from anywhere – information that has been selected and filtered by faculty experts in the CIO competency. When the full functionality of Knowledge Net comes online in 2003 with streaming video and discussion boards, users will also be able to hear and see guest speakers at the College talk about advanced topics related to the field, and discuss issues with faculty, peers, and experts around the world.

Moreover, Knowledge Net benefits the College's constituents by helping improve their job performance – it serves as a kind of electronic performance support system. They can more easily find resources to help do their jobs, just when they need them. Using the discussion boards, they can note how things should be done and how others are actually doing them – noting what works and what does not

3.2 Benefits to the Institution

Knowledge Net benefits the College by strengthening its relationship with its constituents. Certainly, the information available on Knowledge Net is a resource available to students currently enrolled in courses, both residential and online. It provides a searchable database of relevant information useful for papers required in the academic programs. As mentioned previously, Knowledge Net is also available to graduates of our programs for continuing education and development. Alumni thereby remain connected to the College long after graduation. Knowledge Net can also attract new students to the IRM College.

3.3 Implications for Other Organizations

The Knowledge Net strategy would have value for other corporate universities, provided they see their missions as developing and supporting the job performance of constituents, rather than just conducting training and education courses. In fact any organization seeking to support constituents with a common set of competencies and that possess a group of specialists who are willing to adapt web technology to serve their role can implement a Knowledge Net strategy.

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AN E-COMMERCE SYSTEM INTEGRATING DATA MINING FUNCTIONALITIES

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ABSTRACT

The plan behind this article is to explore a semi-automated data mining system that can be used to create and maintain web based content through interactive mining operations in a hierarchical arrangement. We will prototype an Online Department Store that integrates interactive mining operations. In this e-commerce system, the data mining algorithms have been encapsulated into Microsoft SQL Server stored procedures. What we have achieved through this project is to utilise the techniques that go behind data mining for specific supplier hunting, sales statistics, promotional campaigns and e-mail marketing. We have developed a bare bones version of this e-commerce system integrating data mining. This project provides a good start in the direction of integrating data mining into e-commerce systems.

KEYWORDS

data mining, e-commerce, active server pages, SQL server, promotional campaign, e-mail marketing

1. INTRODUCTION

Data mining tools aid the discovery of patterns in data [Agrawal 1993][Agrawal 1994][Agrawal 1996] and e-commerce provides a perfect workbench for data mining [Ansari 2001][Kohavi 2001]. It is ideal because many of the ingredients required for successful data mining are easily satisfied: data records are plentiful, electronic collection provides reliable data, insight can easily be turned into action, and return on investment can be measured. To really take advantage of this domain, however, data mining must be integrated into the e-commerce systems with the appropriate data transformation bridges from the transaction processing system to the data warehouse and vice-versa. An integrated solution can also provide users with a uniform user interface and seamless access to metadata [Cooley 1999][Berendt 2001]. The plan behind this article is to explore a semi-automated data mining system that can be used to create and maintain web based content through interactive mining operations in a hierarchical arrangement. We will prototype an Online Department Store which mainly sells books and software, etc. This e-commerce system integrates interactive mining operations. In this e-commerce system, the data mining algorithms for supplier hunting, and sales statistics, promotional campaigns and e-mail marketing have been encapsulated into Microsoft SQL Server stored

procedures. Such an SQL implementation of data mining algorithm has several advantages. The first advantage of SQL-based mining algorithms is fast and easy development since they are declaratively

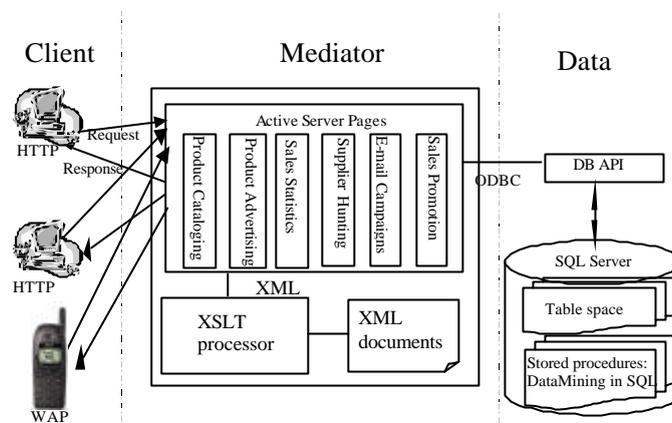


Figure1. Three-tier architecture for the online department store integrating data mining functionalities.

specified as set of SQL queries. The Boolean association rule framework can be easily augmented with non-trivial extensions to handle complex mining tasks. Secondly, one can make use of the database indexing and query processing capabilities thereby leveraging on more portable, scalable, and concurrent. The mining results will be stored back into the relational database.

2. INTEGRATED ARCHITECTURE

A multi-tier application model is divided into several modular tiers, each of which may be located on a different physical computer. In the Online Department Store, three-tier architecture is used as shown in Fig.1.

The data tier maintains all of the information needed for an application. Most often this information is stored in a database. In this system we use Microsoft SQL Server as our database platform. The database contains product analog, product advertisements, customer information, transaction information, membership policies, promotion policies, messages, events, calendar, etc. Each transaction and each item is uniquely identified by an integer. The two column representation is implied by the set characteristic of the transactions. That is, the number of items typically contained in a transaction may vary largely. Moreover, a maximal transaction size may not be determined in advance.

The middle tier of a multi-tier application acts as a sort of “mediator” between the data in the data tier and users of the application. All user requests for data (e.g., a request to view the catalog of products) go through the middle tier before reaching the database. Likewise, responses to requests for data travel back through the middle tier before reaching the user. The middle tier implements business logic and presentation logic to control interactions between users and data. Business logic enforces business rule (e.g., a promotion policy) and is used to ensure data is reliable before it is updated in the database or retrieved for the user. Business rules indicate how this data can and cannot be accessed and updated. For example, an online department store has a business rule requiring that a user’s user name and password are verified before the user’s request is dealt. Business logic implements this business rule by obtaining the password from the table prepared in advance and performing the verification. Once this verification is successful, the business logic would update the database to indicate the user’s request is dealt. The middle tier is also responsible for preparing data to the user. The middle tier accepts a user request for data, retrieves the data from the data tier, and then transforms the data into a suitable representation for the user. In our system, the middle tier transforms databased data into HTML or WML documents, which are then presented to the user.

The third tier is the client tier, which provides a user interface for the application. Users and/or system administrators interact directly with the client tier through the user interface. For our online shopping system, the client is a HTML or WML-enabled web browsers. The user or administrator also makes requests through the user interface in the client tier.

3. SERVER-SIDE SETUP

In order to build this online system we have implemented several different tools. Active Server Pages (ASP) provides business logic and presentation logic in the middle tier of the online system. Every request that a user makes for data goes through this middle tier. The ASP engine then processes the request, retrieves data from or updates data to the database and processes the data to be sent back to the client. The ASP transforms the data built from the database into HTML or WML for display on the client. ASP provides several built-in objects to offer programmers straightforward methods for communicating with Web browser or WAP devices, gathering data sent by an HTTP or WAP request and distinguishing between users. The Request object is used to access the information passed by a GET or POST request. This information consists of data provided by the user in an HTML or WML form. The Request object provides access to information, such as “cookie”, that are stored on a client’s machine. This object can also access binary information (e.g., a file upload) as well. The Response object sends information such as HTML, WML or text, etc, to the client. The Server object provides access to methods and properties on the server. The Server object provides a method (CreateObject) to instantiate other objects. We can create instances of built-in objects, ActiveX components, etc. HTTP does not support persistent information that could help to distinguish between clients. Session tracking and cookies enable a Web server to distinguish between clients, which are crucially needed to provide services for a number of clients at the same time.

As business logic components, the ASP used in this system, interact directly with the database. Class Server (Object, through ODBC) is used to connect to the database and execute queries to retrieve and update data. The ASP retrieves data from a database and generates WML documents that describe that data. If a user has successfully logged in, an instance of class Server is used to query the user.mdb database. When a query is performing on a database, a ResultSet object is returned containing the results of the query. (It is also possible to insert values into a database.) Initially, the ResultSet is positioned before the first record. ResultSet method next returns a Boolean indicating whether the method was able to position to the next record. If the method returns false, there are no more records to process. An SQL SELECT statement counts all the returned records, falling in a certain period, from PRODUCTS, CUSTOMERS, PROMOTION CAMPAIGNS, EVENTS and MESSAGES table, respectively. Once the information has been retrieved, the user is presented on his /her browser with these information.

Data mining is one way to analyze information collected from visitors [Agrawal 1993][Agrawal 1994][Agrawal 1996]. Data mining uses algorithms and statistical tools to find patterns in data gathered from customer visits. These patterns can improve our marketing campaigns by helping us to better understand our customers [Pitkow 1997][Sen 1998][Zaiane 1998]. In the case of mining transactions the situation is rather straight forward. The basic task is to generate all association rules that satisfy certain thresholds on the quality measures. In this e-commerce system, the data mining algorithms for supplier hunting, sales statistics, promotional campaigns and e-mail marketing have been encapsulated into SQL Server stored procedures. Such an SQL implementation of data mining algorithm has several advantages including that one can make use of the database indexing and query processing capabilities thereby leveraging on more portable, scalable, and concurrent [Meo 1996][Sarawagi 1998]. The mining results are stored back into the relational database. The drawback is the need to “install” the stored procedure in the database (see Fig.1). This requires additional database access privileges. Furthermore, running unfenced stored procedures, that is code running in the address space of the database management system, may become a security issue.

The operation of expressing the mining algorithm in the form of SQL queries will be demonstrated by using association rule mining as an example, as shown in Fig.2. Counting support to find frequent itemsets is an important step in association rule mining. This is the most time-consuming part of the association rules algorithm. We use the candidate itemsets C_k and the database T to count the support of the itemsets in C_k .

```

Insert into Fk select item1, ...itemk, count(*)
From Ck, T t1, ... T tk
Where t1.item=Ck.item1 and
      .
      .
      .
      tk.item=Ck.itemk and
      t1.tid=t2.tid and

```

```

      .
      .
      .
      tk-1.tid=tk.tid
group by item1, item2, ... itemk
having count(*) > minsup

```

Fig.2. A sample code for SQL-based support counting algorithm.

4. TESTS AND RESULTS

We have developed a bare bones version of an Online Department Store that integrates interactive mining operations. At the printing time of this article, the project is still under development, and it will finish in 2004. Prototypes are out and technology is maturing. In this e-commerce system, the data mining algorithms have been encapsulated into Microsoft SQL Server stored procedures. What we have achieved through this project is to utilize the techniques that go behind data mining for specific supplier hunting, sales statistics, promotional campaigns and e-mail marketing. The tight integration between the three components of the architecture allows for automated construction of a data warehouse within the Analysis component. The shared metadata across the three components further simplifies this construction, and, coupled with the rich set of mining algorithms and analysis tools (like visualization, reporting and OLAP) also increases the efficiency of the knowledge discovery process. This project provides a good start in the direction of integrating data mining into e-commerce systems.

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EXPLORING THE TOTAL CUSTOMER EXPERIENCE IN E-COMMERCE ENVIRONMENTS

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ABSTRACT

When considering the design of Web sites for E-Commerce, the HCI literature leans predominantly towards the usability of the core Web site. This is important, as the Web site constitutes the front-end of the E-Commerce environment. However, usability is only one aspect within the 'E-Commerce environment'. In this paper we are concerned with examining the Customer to Business (C2B) interaction from a customer's perspective. This stretches across all touch points of the E-Commerce environment. We have employed the phrase 'total customer experience' (TCE) to encapsulate the additional interactions between the customer and E-Commerce that occur beyond the Web site. Creating a valuable TCE is important for E-Businesses in order to acquire customers, but more importantly to retain customers. This paper reports findings from studies that investigated barriers which can prevent customers from achieving a satisfactory experience with an E-Commerce environment.

We examined the TCE and in particular those factors that lead to the demise of a valuable TCE. We employed a selection of complementary techniques that enabled us to build an understanding of what constitutes a TCE, and which factors mar the customer's experience. This paper intends to first, illustrate the importance of considering the TCE when developing E-Commerce Environments and second, to describe the methodology that we used to study the TCE.

KEYWORDS

E-Business; E-Commerce; Total Customer Experience; Customer Retention; Usability; User observations

1. INTRODUCTION

An *E-Commerce* environment implies not only the front-end of the E-Commerce, which is the Web retail site, but also the back-office systems such as the security of credit card handling, delivery of products / services, pre and post-sales support and contact with staff. The *TCE* therefore encompasses all stages of a customer's interaction with an E-Commerce environment. The stages of (C2B) interaction constitute a *service encounter* (Gabbott & Hogg, 1998): a pre-encounter stage, an encounter with the E-Commerce site, and finally a post-encounter (or post-transaction) stage (see Figure 1). The breadth of the TCE highlights that it is not only the physical design of the Web site - the retail front-end of the organisation and its usability, or the price of the product / service, but the entire purchase (and after care) experience that influences customer satisfaction and perception of value. A customer is willing to do business with an E-Commerce environment only if he gets *value* from his service encounter.

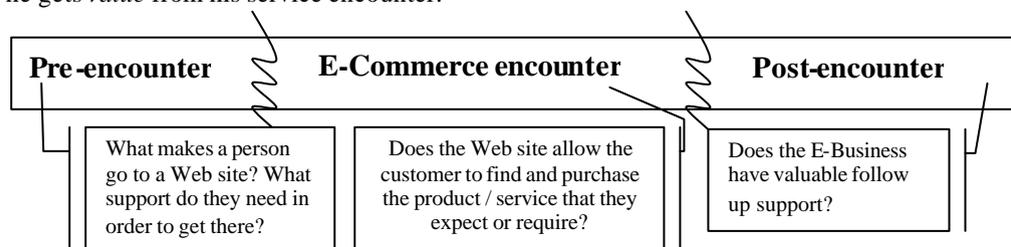


Figure 1. The Total Customer Experience.

Value from a customer perspective may be defined in terms of satisfaction with, and perceived quality of, the service received in the course of the TCE. E-Businesses can therefore benefit from *continuously* providing value to the customers in order to attract customers but more importantly to build up customer loyalty. The emphasis, therefore, is shifting from *customer acquisition* to *customer retention*.

However, in the Human-Computer Interaction (HCI) literature, research into the success or failure of Business to Consumer (B2C) E-Commerce sites has focused primarily on the usability of the core Web site (e.g., Nielsen et al., 2001). Central to this has been how design criteria such as ease of navigation, optimal response time, and appropriate content can be managed to create usable customer-focused E-Commerce sites. Research in HCI / Usability concerning E-Commerce has largely been concerned with identifying heuristics or guidelines for designing 'usable' Web sites.

Whilst some E-Commerce research has centred on the cultural needs of local customers (French et al., 2002), others have been concerned about the internationalisation of E-Commerce environments, that is, designing for the global market. Becker & Mottay (2001) discuss that many dot-com failures have happened because of lack of corporate vision in addressing global aspects of on-line marketing. They argue that cultural diversity and sensitivity must be considered in order to ensure that the E-Shopping experience is the same for every customer regardless of locality. Becker & Mottay (2001) propose the use of a Web-based usability assessment model that promotes customer satisfaction and on-line experience as an integral part of an E-Business development process. Some of the usability factors in this model are page layout, navigation, design consistency, reliability, security, information content, and cultural sensitivity in contrast to the 'local needs' approach.

In this paper, we present a user observation study that centers on the E-Commerce customer, looking beyond usability and towards the TCE (here we use the terms 'customer' and 'user' interchangeably). In this study we were able to identify factors, which we termed 'obstacles', or situations that were considered to diminish the value of the TCE. From the obstacle data, patterns or themes emerged which could then be developed into a catalogue of obstacles. The catalogue encompassed issues of service quality, usability, cultural and social influences, and individual customer expectations, amongst others. Whilst it is beyond the scope of this paper the authors would be happy to provide information about the catalogue of obstacles or any other element of the data elicitation process to interested colleagues.

In the following sections, the approach employed to understand the TCE is presented. The data collected by using this methodology was rich and relevant reflecting the benefits that such an approach could offer.

2. A METHODOLOGY FOR UNDERSTANDING THE TCE

Because our intentions were to look beyond the task-based usability of the Web site, we needed to adopt a flexible, opportunistic methodology that would support the observation of real customers experiencing real E-Businesses. We considered that it was vital for the users to be self-motivated and therefore carrying out genuine tasks in a natural environment. Only *in situ* observations of authentic interactions would encompass the customer's complete interaction environment (physical, social, and psychological) and hence have the potential to expose 'obstacles' not predicted – or possibly not attended to – by existing research. Consequently, we decided against more controlled task-based approaches such as user-observations, hierarchical task analysis, and GOMS (goal, operation methods and selection rules) (Preece et al., 2002) as these might 'design away' the very focus of the study.

2.1 User Observation

Two researchers observed ten adult users over a period of one and a half months. Eight out of the ten users were female and two were male. The group was culturally diverse including six nationalities and four non-native English speakers. All were already Internet and ECommerce users. That the group may not be representative of the broadest, multi-cultural ECommerce user population is clearly a matter for further work. However, the aim of this study was to identify obstacles that prevented a positive TCE, and for this initial demonstration, it was sufficient to have a group selected on a pragmatic basis.

During the study, on an average, each user interacted with 10 Web sites. Each observation session lasted between 40 and 90 minutes. The observed tasks included browsing, comparing products, searching for

information, and ordering services / products. Because the users were observed in their own settings, they used their own machines, ensuring access to their personal Internet links, shortcuts, e-mail and telephone. For a number of the users, the fact that they were in their natural settings helped them to achieve their goals.

The researchers took extensive observation notes in addition to making a video record of the screen and audio recording of the user's utterances. Users were encouraged to comment about what they were doing throughout the session. Directly after each session, the observers carried out a de-briefing interview with the user in order to address any questions or queries that had arisen during the session. Additionally, this enabled the user to draw on past experiences, preferences and expectations in order to support the discussion and clarify intentions and actions.

Because the data collected during the observations was qualitative, it seemed necessary to employ a formal data analysis technique. To do this we developed template for an obstacle index card to document each obstacle. This ensured that obstacles could be examined in a systematic and context-embedded process. The headings in this template were derived from the critical incident technique (Bitner & Booms, 1990). There were, in total, 132 obstacle index cards derived from 10 customers. From these obstacles a total of 15 themes emerged, which were then represented as categories in the obstacles catalogue.

2.2 Workshop to explore the TCE

In addition to the user observations, we carried out a workshop in which six users and two researchers discussed their experiences with using E-Commerce environments. Again, this session was video and audio recorded. The workshop was based upon the technique of focus groups (Vaughn, et al. 1996), and aimed to elicit users' perceptions and attitudes of interacting with ECommerce environments. The session was introduced by one of the researchers, who described two memorable experiences of using ECommerce environments: one good, and the other that had been problematic. The goal of this introduction was two-fold: first, to highlight the focus of the workshop to the participants, and secondly, it was hoped that it may trigger some reactions from the group regarding their own experiences with E-Commerce.

The main body of the workshop was structured in four themes: the kinds of services or products people buy on E-Commerce sites; their motivation; their perceptions of trustworthiness and trust; and the TCE. By discussing each of these issues in turn, the user group was encouraged and reminded of encounters, both good and bad, with E-Commerce. The majority of the narratives that emerged from this session concerned the 'E-Commerce encounter' and the post-encounter experience (see Figure 1). This supported and extended the understanding that we had already developed about these two stages of the TCE via user observations and illustrated the need to consider the value that is offered by the E-Business over the TCE.

3. OUR FINDINGS

By combining the naturalistic user observations with a structured workshop, we were able to build a broad understanding of the TCE. The user observations allowed us to examine the pre-encounter and encounter stages whilst the workshop focused on the encounter and the post-encounter stages. In this section we present a flavour of our findings, which we feel, will illustrate the richness and clarity of the data collected.

The influences exerted upon a customer when choosing an E-Commerce site were varied, yet important. The customers that we observed exhibited a range of factors that had drawn them towards a particular Web site, such as personal recommendations, experiences with off-line stores, catalogues, advertising, and ad hoc searches. Additionally, customer inertia motivated a user to return to a site. For example the hassle of having to register their details with another site would increase the likelihood of the customer returning to a site.

We observed a number of customers who had developed mechanisms to prepare themselves for the E-Commerce encounter of the TCE. These involved users finding out about specialist information prior to logging on to the Web, using credit cards obtained only for use on the Web, and so on.

In addition to the usability and service quality issues, most of which are covered in the relationship marketing and usability literature, a number of social, personal and cognitive factors were observed. These involved expectations of ECommerce based on experience with using the Web, references to analogous experiences, and personal influences that affected the encounter, amongst others. Through the discussions that arose during the workshop, all of these factors combined were seen to influence the customer's

perception of the E-Commerce experience. For example, one customer said that he would not be put off completing a transaction with a site, providing that he felt confident with the security of their payment methods. This was weighed up against the accuracy of the product information provided by the site. Product information could always be found from other sites. On the whole customers were happy to pay a little extra for a service or a product providing that the TCE had been positive. Another customer had signed up to her second choice in broadband provider because her first choice of provider had not offered customer support during the pre-encounter stage. She was therefore willing to move to a competitor site that was a little more expensive, but which provided a superior customer service.

There was a growing body of evidence to reflect the post-encounter stage of the TCE. These factors emerged primarily as problems and negative experiences of interacting with customer services, concerns about delivery timings or of returning products, advertising emails / newsletters, and so on.

4. CONCLUSIONS AND FURTHER WORK

The data gathered using the range of techniques described here provided us with rich data. We were able to develop a high-level understanding about the TCE and begin building a catalogue of obstacles that could lead to a diminished TCE and thus, a reduced perception of value. These obstacles can provide a framework that could be used by Web designers and E-Businesses to anticipate the obstacles that might mar a customer's experience and hence to create a more effective E-commerce environment designed to minimize obstacles and improve customer's retention.

We now plan to investigate each stage of the TCE in detail. In the next phase of our research programme, we intend to go back to the users of the first user observation study (reported here) and carry out structured interviews. Our aim is to uncover the concluding experiences of their service encounter – did the products arrive on time? Were there any communication problems with Customer services? Was the billing in order? This data will help to further our understanding of the post-encounter stage of the TCE.

Next, we plan to explore the pre-encounter stage. Again, we believe that a naturalistic study, on the same lines as the one reported in this paper, would provide the depth and richness of data to understand the complexities of this stage of the TCE. We believe that the proposed research will provide insight into providing value and expected service quality to customers, which is so critical for customer retention.

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E-LEARNING COURSES IN THE MULTIPES SYSTEM

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ABSTRACT

In this paper we would like to introduce two developed e-learning courses in the MultiPeS system. These courses are being developed and introduced to lessons at the Department of Cybernetics, Faculty of Electrical Engineering, Czech Technical University in Prague. The course is Cognitive Processes that is an obligatory course in full-time form of Master study. The e-learning courses are used as supporting tool for students. In addition to multimedia tools, the e-learning courses developed in the MultiPeS system contain a number of modules that significantly help students with easier acquisition of information, creating relations among pieces of information and their successive remembering and refreshing. Courses developed in MultiPeS environment can be run both in on-line and off-line mode.

KEYWORDS

Information and communication technologies, e-learning, HTML course, multimedia, cognitive processes

1. INTRODUCTION

At present the scientific and technical disciplines develop very fast. Students should acquire large volumes of new knowledge and skills during their education. Issuing new books, lecture notes and other publications react to these “novelties” with certain delay and even if the authors do their best several printing error usually appear in the publication. Great advantage of an e-learning system is the possibility of continuous additions and improvements of the content. E-learning system contains learning text as for example lecture notes but it can be completed with a number of electronic features (e.g. interactive links to related topics, animations, video sequences, audio recordings, graphics, schemas, automatic evaluation of tests).

At the Department of Cybernetics, Czech Technical University in Prague, Faculty of Electrical Engineering, research in the area of artificial intelligence and biocybernetics has been developed for many years and has background of high quality. In the frame of research projects, a number of high quality results both of theoretical and practical character have been reached. Our aim is to reflect results of our research in education. Therefore we have been forced to develop a simple tool for generating interactive courses. This system for development of elearning courses is called MultiPeS (Multimedia Pedagogical System). Our main aim is to develop an e-learning system as a general tool that enables students to acquire large volume of new information and skills. Result of our effort will be a general tool that will serve as support of educational process but not its replacement. This system is described in (Fejtová 2003). E-learning system is suitable for individual study of students. In addition to providing students with study material in an attractive form, the courses ensure feedback from students in the form of responses to testing questions, multiple choice, or solution design. Thus students are actively involved in educational process and acquire broader overview with links to related areas.

2. E-LEARNING SYSTEM MULTIPES

Hypertext lecture notes represent fundamental of each our e-learning course and enable students effective access to each information saved in text. It is simple, comprehensive and suitably structured text that

provides students with several advantages in comparison with study of classical books or lecture notes. For example, student need not turn over the leaves of a book and search for related topics, connected links or explanation of a certain term. In hypertext lecture notes, it is „just enough“ to click on a hypertext link and the system searches all in place of a student. For example, if student does not understand a certain term that is explained in other part of the lecture notes he/she clicks on unknown expression and the system finds corresponding explanation. Information in lecture notes are didactically ordered and use suitably accompanying multimedia elements of presentation (image and sound animations) and continuously verify correct understanding of content in all relations and in certain system that is hierarchically ordered according to importance and difficulty. Texts constructed in this way represent undoubtedly significant progress from the point of didactic processing and each student goes through the whole text not only with his/her own speed but also this text respects input knowledge, skills and experience of the student that in certain parts need not go through known information and possibly solve tasks that are redundant from the point of view of knowledge. Hypertext lecture notes are available to students in the format suitable for printing or in standard e-Book format.

Another advantage of such a system is the possibility to use instructional video sequences or animations. In the past the lecturer had to visit with students various specialized laboratories (in particular in courses focused on biomedical engineering topics – Cognitive Processes, Fundamentals of Biocybernetics, or Bionics) where experts showed students a number of specialized devices, as for example magnetic resonance, ECG, computer tomography. In such an e-learning system these excursions may be replaced by instructional video sequences.

Above-mentioned interactive tests with automatic evaluation realize in process of studying elearning course the so-called internal feedback. In its frame the student, based on automatic evaluation, standardized criteria, or solution key, evaluates whether and to which extent he/she has fulfilled study requirements. Self-evaluating elements verify understanding (acquisition) of study, ability to apply acquired knowledge to given or generated examples or in other training situations (in interactive tests, case studies, etc.).

E-learning system consists of two parts. The first part is the developing environment in which the e-learning courses are generated and the second part represent the e-learning courses. The developing environment is programmed in Microsoft Visual C++ 6.0 programming language under Microsoft Windows operating system. In this environment the lecturer himself/herself can create in a simple way hypertext lecture notes with links to related topics, instructions, individual solved and unsolved examples, study support, interactive tests with automatic evaluation. There are prepared tools for simple insertion of further multimedia information (video sequences, sound), all in HTML language, as well.

There are several advantages we see in application of HTML language to preparation of elearning course. HTML language is a very simple, well structured and easily understandable programming tool. Therefore it is no problem for an „informed“ lecturer to accomplish the courses with new parts. Thus the lecturer has the possibility to insert new lines of programming code into HTML pages generated by the system that fulfills his/her above-standard requirements on e-learning course. HTML pages enable students simple course study using their internet explorer. Thus the study does not require installation of additional program package. Further significant advantage is possibility of placing the course on web pages of the educational institution.

Now we come to another advantage of our e-learning system. The system works both in on-line mode (the educational course is placed on web pages of the educational institution), and in off-line mode (student can get the course on a CD-ROM), that is more suitable for home study. Students that do not have internet connection at home are not discriminated. And even students having internet connection save financial means. However indisputable advantage of on-line education is the possibility of e-mail communication of the student with the lecturer.

As we have already mentioned we prepare the educational system for introduction to education at our department as support and extension or accomplishment of education with latest knowledge. We assume that the system will be first used in courses of life-long learning (e.g. Fundamentals of Computer Literacy) or in large courses (e.g. Fundamentals of Biocybernetics, Bionics, Biological Data Processing, Fundamentals of Artificial Intelligence). Our next aim is to extent options for seminar works of students that may participate both in accomplishment of the system, and in modifications and improvements of e-learning courses, whose content must be continuously developed.

E-learning courses developed at the department have following structure: introduction – general information about the Department of Cybernetics and its research, introduction to the elearning system,

syllabus of the course, information about target student group, course news, time schedule of the course, content of individual lessons, prerequisites (presumptions), goal of the lesson, input test (repetition of the last lesson), explanation of new topic with check points, repetition – simple tests, summary, evaluation of the lesson, educational video sequences – video sequences with sound tracks, tasks with defined extent and time limit (solved examples, unsolved examples with suggested approach, unsolved tasks with solution presented only after lesson, unsolved tasks – testing tasks), instructions, list of terms, hypertext index, frequently asked questions, references and links to related publications.

3. COGNITIVE PROCESSES

This course is offered to students in full-time form of Master study. It belongs to the category of obligatory courses having two hours of lectures and two hours of seminars or laboratory work per week. Each year it is attended by approximately 50 students. The aim of the course is to introduce to students following topics: structure and basic functions of human brain, processing of information from receptors. The lecturer presents description of functions of human vision and hearing systems and compares them with technical systems for image and speech processing. Then problems of adaptation and learning, their significance, realization and application in biosystems and technical systems are presented. Special attention is focused on interaction of body and brain, motion control and intelligent man-machine interface. All these topics are scheduled to 14 lectures and 14 connected seminars/labs, where students have the possibility to train practically on examples the presented topics. We show in following text few examples from the course.

3.1 Interactive Learning Page

Electronic textbooks are used in areas that are developing very fast and thus it is necessary to up-date the content very frequently. Their indisputable advantage is that using hypertext links and key words it is possible to find related information without necessity of search in printed textbooks. In addition to that, interactive learning page offers the student certain help for finding relevant information. It offers the student the best suitable approach to acquisition of information (e.g. form of help or successive uncovering of solution with explanation) and to understanding of the topic as a whole.

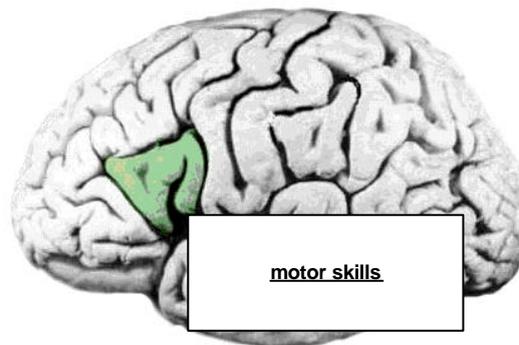


Figure 1. Interactive learning page

3.2 Learning Video Sequences

Polygraph Brain Scope is a system for digital recording, saving and archiving of EEG signals. It is equipment that non-invasively measures electric brain activity. Such equipment is not only very expensive but also very demanding on staff. Therefore students must be instructed before they start the laboratory measurement. The instruction is provided in the form of learning video sequence that is part of the course. The content of the video sequence is not only video recording with accompanying sound track describing measurement of EEG activity where functions of individual parts of the whole measuring system are shown and explained but also a certain instruction how to perform various types of measurement (figure 2).



Figure 2. Video recording with EEG signal measurement

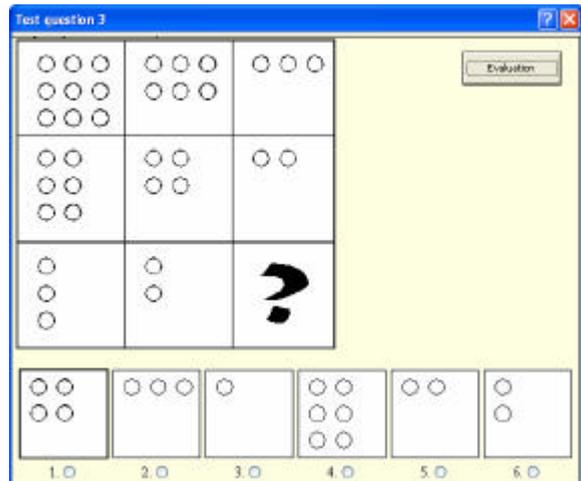


Figure 3. Interactive test

3.3 Interactive Tests

A significant part of the course are interactive tests. It is important to explain to students new topic but in addition to that find out using feedback whether the students understand the topic as the whole. For this purpose the MultiPeS e-learning system contains a tool for generation of interactive tests. Example of such a test is shown in figure 3.

4. CONCLUSION

We offer students and their teachers new tool for improvement of the educational possibilities, namely interactive e-learning courses created in the MultiPeS e-learning environment. Using these courses we try to open up new approaches to study, to enlarge volume of communicated information, to make skills and latest scientific knowledge accessible to students. These courses enable students to focus on certain topics they are interested in. Another indisputable advantage is that the students can actively participate in development of such learning courses.

ACKNOWLEDGEMENT

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WEB-BASED INTELLIGENT COMPUTER-ASSISTED LANGUAGE LEARNING SYSTEM FOR YORÙBÁ(YiCALL)

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ABSTRACT

In this presentation, we describe a web-based Intelligent Computer Assisted Language Learning (iCALL) system for the learning of Yoruba Language (YiCALL). YiCALL development is based on the integration of ideas from computer aided education; computer mediated communication as well as techniques in artificial intelligence. The system is designed for access over the internet. Various design and implementation issues with respect to components of the system are here discussed and the direction of ongoing work highlighted.

KEYWORDS

e-learning, speech synthesis and recognition, CALL

1. INTRODUCTION

Computer-Assisted Language Learning (CALL) provides the basic technology for assisting language learners to acquire important communication skills in a given language. Recent advances in Computer Mediated Communication (CMC), CALL, and World Wide Web (WWW) facilitates the integration of these technologies in the development of powerful language education systems. We present a general framework underlying a pioneering research work -to the best of our knowledge this is first such project on Yorùbá language- focused on the development of a web-based intelligent CALL (iCALL) system for Yorùbá language. It is important that aCALL system possess the ability to adapt its behaviour to the goals, tasks, interests, and specific needs of individual users or groups of users (Brusilovsky, 2002). The central goal of modern approached to language learning and teaching includes, communicative language teaching, goal-oriented learning and process approach to writing. Basically, language learning strategies seek to enhance student's autonomy and control over the learning process (Warshauer, *et al*, 1996). Since speech and writing are the basic media of human communication, a CALL system that exploits them would provide a better language learning environment. This paper provides an overview of ongoing research into the development of an intelligent web-based iCALL for Yorùbá.

Yorùbá is one of the four major languages spoken in Africa. Other languages in this category include Arabic, Hausa, and Swahili. In Nigeria, Yorùbá is one of the three major native languages (Hausa and Igbo) spoken alongside English, which is the official language. In Nigeria, the homeland of Yorùbá lies between longitudes 2^o 30' and 6^o 30' East of the Meridian and Latitudes 6^o and 9^o North of the Equator (CIA, 2001). Yorùbá is the native language of people in Lagos, Oyo, Ogun, Ondo, Ekiti, and Osun states of Nigeria. It is also spoken in some part of Edo, and Kogi states of Nigeria as well as in Central Togo, East Central part of Republic of Benin and in Sierra Leone (where it is called Aku). There are 25 letters in the Yorùbá language alphabet. This is made up of 18 consonants (*b, d, f, g, gb, h, j, k, l, m, n, p, r, s, t, w, y*) and seven vowels (*a, e, ɛ, i, o, ɔ, u*). There are five nasalized vowels in the language (*an, en, in, ɔn, un*). Yorùbá is a tone language with 3 contrastive tone and 2 allotones. There are about 30 million speakers of Yorùbá language in the South Western part of Nigeria. Students cite many reasons for studying Yoruba, including personal interest in West

African cultures, research interests, and fulfilment of foreign language requirements (CIA, 2001). African-American students often study *Yorùbá* out of interest in their own heritage, since many of the slaves brought to North America during the 18th and 19th centuries came from *Yorùbá*-speaking areas (Ajolare, 1974).

2. OVERVIEW OF YiCALL ARCHITECTURE

The basic configuration of YiCALL is as shown in Figure 1. There are three basic modules in the system architecture namely; user interface, language resource, and intelligent learning control modules. The user interface module comprises; (1) Automatic Speech Recognition (ASR), (2) Text-to-Speech (TTS) synthesis and (3) Natural Language Processing (NLP) sub-modules. The language resource module comprise of the orthography (or written) and voice knowledge base and language curriculum. The intelligent control module control and coordinates the learning process based on some evaluation criteria that takes account of student's ability. Each of the technologies applied in this work have been used to develop commercial applications, but they still have some limitations (Kohler, 2001).

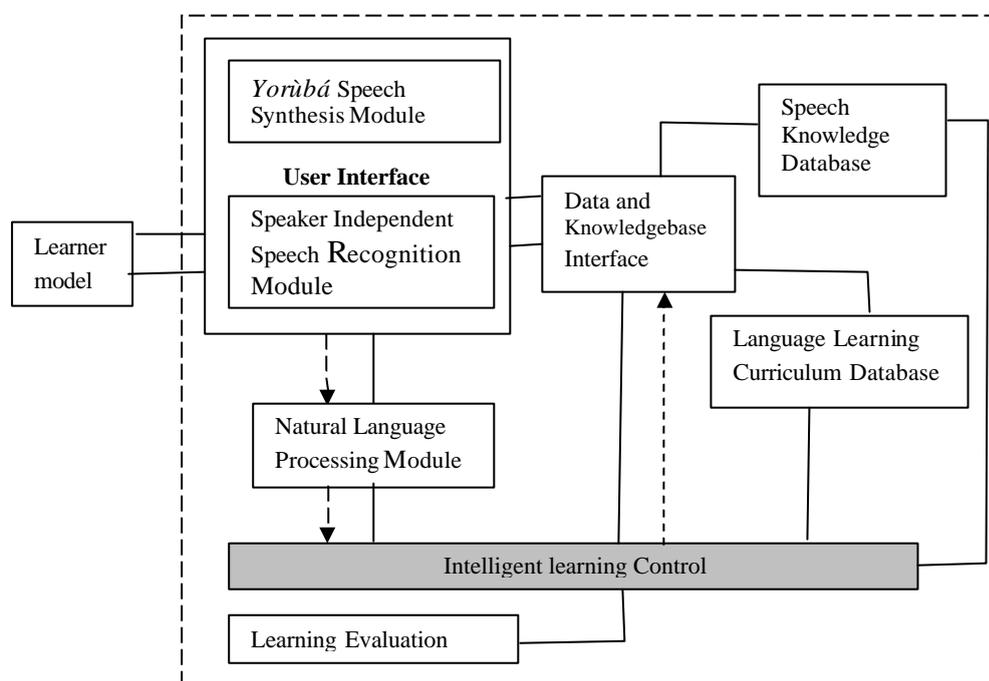


Figure 1. The overview of architecture *Yorùbá* iCALL prototype

2.1 YiCALL User interface

The TTS sub-module implements the text-to-speech conversion task in the user interface by converting *Yoruba* text, typed by learners, into synthetic speech. Spoken equivalent of system response could also be generated while displaying corresponding texts. To provide a flexible learning environment, the speech synthesis process is based on the concatenation of tone-syllable units from a pre-recorded and annotated speech corpus (Lee and Vox, 2002). Information extracted in respect of the syntax and semantics of input sentences are used to generate the intonation and rhythm of the synthesised utterance. Since semantics and pragmatic analysis of unrestricted text is difficult, heuristic methods are being applied in determining the accent and phrase structure which are important in determining prosodic parameter of the synthetic speech (Portele and Barbara, 1997; Black *et al*, 1996).

The ASR sub-module serves as the voice interface to capture learner's pronunciations. It also provides voice feedback during learning. ASR technology provides the means for the tutoring system to capture the voice of the learner. Features are extracted from captured voice signal and used to determine what was spoken. The substantial progress achieved in automatic speech recognition in the past two decades has led to

a variety of successful demos and some commercial products using speech technology. In a CALL environment, where potential users may be non-native speakers of the language, ASR systems have to deal with variety of speaker accents. Result of research in multilingual recognition and spoken dialog systems (Adda-Decker, 2001; Kohler, 2001) is being exploited for solving this problem.

The Natural Language Processing (NLP) module provides the formal framework for modelling aspects of the syntactic and semantic structure of Yorùbá language. A trigram language model of Yorùbá based on the Hidden Markov Model (HMM) is being developed. NLP techniques, such as parsing and semantic analysis, play important role within language tutoring systems (Kupiec, 1992). Holland and Kaplan (1995) have discussed the significant trends in the exploitation of these techniques, design issues and tradeoffs, as well as current and potential contributions of NLP technology with respect to instructional theory and educational practice. We intend to annex NLP tools and techniques in providing an effective language model for YiCALL.

2.2 Language resource and intelligent control

Text and speech corpuses emanating from two local newspapers and their spoken equivalents, recorded by an adult male native-speaker, form the basic language resource. The content area selected for the learning is the Yorùbá greeting environment. The basic structure for greeting is; <Eku>{Situation/event}. That is, the word <Eku> before an event or situation signifies a greeting. The context and situation of various Yorùbá greeting were compiled into the curriculum of six lessons. Each lesson has four levels and the level selected for learning is dependent on learner's profile. The Knowledge and Database Interface (KDI) selects learning module and exercises, interpret learner's input, and compiles appropriate response to guide the learner. The KDI is design around object oriented model. It contains a structured curriculum for Yorùbá language as well as those for learning the alphabet, phonology, morphology and phonetics of the language. The language resource is designed in line with standard speech application language resource requirement (Holland and Kaplan, 1995).

The activities of the KDI and the user interface are under the control of the Intelligent Learning Control (ILC) sub-module. The ICL controls the learning process based on the learner's model and level of proficiency. It determines what module to present to learner and control the activity of the speech generation and recognition process.

3. LEARNING AND LEARNER'S MODEL

The learner model stores the characteristics of the learner relevant to the system's tutoring strategies. The learner model defined in the system specifications comprised of data objects which describe the following parameters; (i) personal details of the learner, (ii) the system estimates of learner's grammatical and oral proficiency in Yorùbá and (iii) a function describing the relative stable characteristics of the learner. The learner's model is updated via the parsing and analysis of contextual information which includes error classes, potential causes of errors, the response strategies selected by the tutoring module and the level of help that was sought by the learner.

To implement the tutoring process, the learning prototype is based on two strategies, namely; *Reinforcement learning*, for drilling and proficient learning stage and *Learning by analogy*, for introductory and intermediate learning stage. A five-tuple finite state automaton was used to model these learning process as follows; $Learner := \langle S_L, S_p, S_u, S_F, S_s \rangle$. Where: S_p is the present state; S_u is the set of possible learning units, S_L is the set of possible learning states; S_F is the final or desirable learning state, S_s is a step in the strategy. In this context then, $S_p, S_F \in S_L$; $S_s: S_p \times S_u \longrightarrow S_p$ and $S_p = S_s(S_p, S_u)$. Thus, using the present learning unit and applying the next unit step in the leaning strategy to the present state will make the learning to move to another state in the learning process, say S_{pi} . If $S_{pi} = S_F$ then the learning process is complete and the learner is expected to have achieved a predefined communication proficiency in the language.

4. IMPLEMENTATION

Implementation of the learning, language and user models are specified using finite-state compilers and algorithms, and the results are stored as finite-state transducers. Creating, validating and verifying the proposed implementation specification is an ongoing work. The information flow in the web-based implementation of YiCALL is as shown in Figure 2. The aim is to make learners have access to YiCALL using any WWW browser. At present we are experiment with SALT (Intel, 2002:<http://www.saltforum.org>), Speech Application Language Tag, which is a mark up language for implementing speech interface. Other optimization and customization programmes to make YiCALL easily accessible via a WWW browser would be developed around Java *Jdeveloper* toolkits.

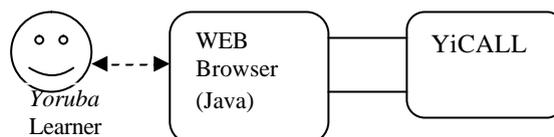


Figure 2. Information flow in web-based- implementation of YiCALL.

5. SUMMARY, CONCLUSION, AND ONGOING WORK

To facilitate a flexible and yet user friendly CALL, the system should, as much as possible, exploit available medium of communication in natural learning process. There are two media of communication in natural learning environment, namely; speech and writing. In a flexible and goal oriented learning environment, it should be possible for the learner to interact with the computer using speech and writing. The focus of current work is the computational analysis, design and implementation of YiCALL based on the integration of ideas from speech synthesis, speech recognition and artificial intelligence. At the same time we seek to make the system widely available via the internet. The limitations of speech recognition, speech synthesis and natural language processing as well as the inherent problem of integrating the system with AI techniques is generating unique challenge in the design and implementation of the proposed system.

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ARCHITECTURE OF AN ONTOLOGY BASED E-LEARNING ENVIRONMENT ONTELE

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ABSTRACT

This paper proposes an integrated approach for providing productive and reusable e-learning environment. ONTELE system applies ITS ontology that consists of a number of separate ontologies. A key feature of system is adaptable student model which ensures the personalization in learning thus adapting the learning environment to the current knowledge state of each student.

KEYWORDS

e-learning, ontologies, student modeling

1. INTRODUCTION

In order to provide a highly productive and reusable e-learning environment we developed ONTOlogy based E-Learning Environment ONTELE system for distributing and presenting the knowledge to the students, and testing the students understanding of presented material. The main aim in building such system is to enable teachers to easily formalize learning concepts and lessons, and to students, easy access to the learning material and testing.

The main idea of ONTELE system is to apply knowledge modeling techniques to make the presented domain knowledge, problem solving methods, student model and other modules easily accessible and reusable among different e-learning environments.

As a key figure in ONTELE system is an adaptable student model, which ensures the personalization in learning, adapting the learning environment to the current knowledge state of each student.

Applying ontology base in the ONTELE system we assure the uniformity of presented concepts, knowledge sharing and reuse among different applications of ONTELE system. Also, having an ontology of student model it is possible to exchange, communicate and reuse current student profile through different systems and agents [1].

We assume that *ITS ontology* consists of a number of separate ontologies and we shall design ontologies for each agent constituent. Such design principle is already known and accepted in ontology community [3], and also suggested for ontologies to be available in small composable modules, so that the needed knowledge can be assembled [2]. All agents will commit to this ontology so that they can communicate about a domain of discourse and their observable actions should be consistent with the definitions in the ontology. Furthermore, we advocate that all ontologies should have the same starting point, meaning that the first step in representing such meta-knowledge concepts assumes having a unique formalism for representing all possible concepts.

Having stand alone student model ontologies enable easy communication in collaborative learning environments providing system with necessary defined concepts for communication between students .

2. AN ARCHITECTURE OF ONTELE

The proposed ONTELE project consists of the five main modules: student and teacher interface, pedagogical model, student model, domain knowledge and testing module (Figure 1).

As it can be seen we assume having two different types of interface: student and teacher interface. These separate interfaces are natural solution, since of the different tasks and goals of student and teacher, and are responsible for student-teacher-system interactions. Such construction is also useable in extending environments like collaborative learning environment [6].

Pedagogical module is responsible for planning instructions and defining the answers. It makes decisions about choosing the most appropriate teaching strategy for a certain student and situation, and creates actions for learning support, again taking into consideration a current student model.

Student model states here as the most important module, since it contains all the knowledge about a certain student that system has. If this knowledge is complete and good structured system will be able to adopt itself to the specific student needs and to make appropriate actions. Student model is dynamically changing by getting and updating every student move. It is also responsible for delivering the information about the student. In order to have a reusable student model we based it on the *Student model ontology*, presented with a gray box. Student model is committed to Student model ontology, and can be shared and reused among different applications under ONTELE system or can be used for an agent communication in a collaborative learning environments.

Domain knowledge is another significant module in the system, since it contains the learning material that students have to adopt. Its organization and content is based on the *Domain knowledge ontology* which implies a variety of learning concepts and knowledge representation techniques that can be applied to different teaching strategies.

Testing module provide us with returning information about the student understanding of a domain. It fills a student model with valuable information about correctness, bugs, misconception and student improvements. It is also based on the *Ontology of testing* which ensure correct question formalization.

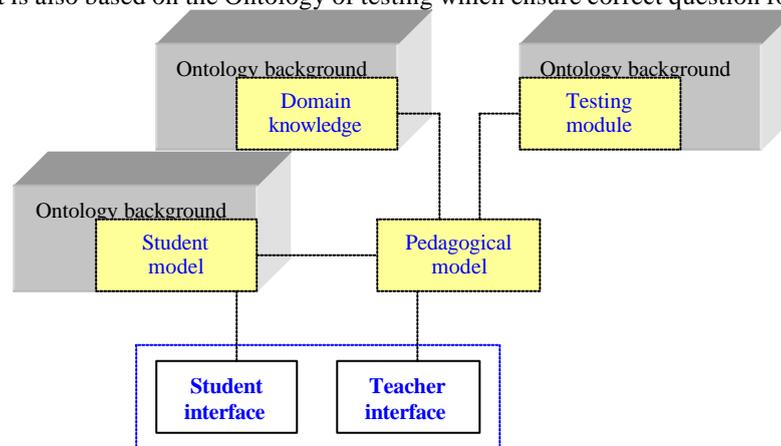


Figure 1. The ONTELE project

As stated in [3] some of the reasons for defining ontologies are to share common understanding of the structure of information among people and software agents, to enable reuse of domain knowledge and to separate domain knowledge from the operational knowledge. All these reasons make the ontology background a natural thing in the e-learning environments.

In ONTELE system we assume that our ontology consists of a number of separate ontologies and we shall design ontologies for each agent constituent. Such design principle is already known and accepted in ontology community [4], and also suggested for ontologies to be available in small composable modules.

Each ontology has its own vocabulary, with a validate rule of inclusion among them [3]. We treat the *Student Model ontology* as an inclusion of two ontologies (*Personal Student Model* and *Student History Knowledge*). This design enables e.g. *Personal Student Model ontology* to be integrated in some more general ontologies.

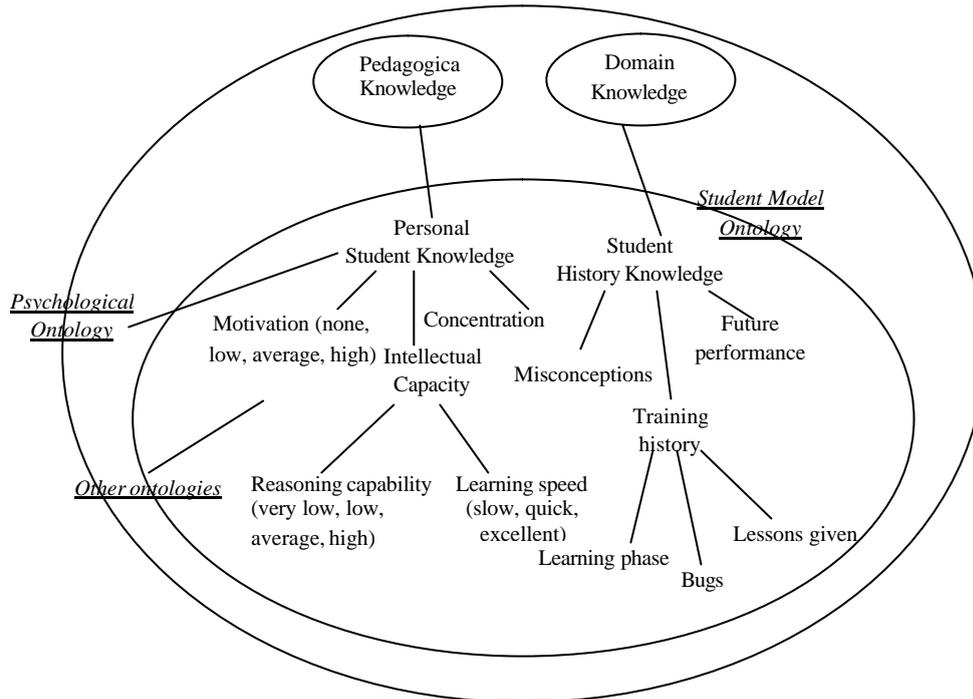


Figure 2. A part of the ONTELE Student model ontology

The student model represents a dynamically changing of a student state, and has to communicate with other modules. As committed to the Student model ontology, this student model can easily communicate with all other student model in ONTELE system, and makes it easy to construct a report statistics about all students who are using this application.

3. IMPLEMENTATION OF ONTELE

ONTELE system is based on XML/Java technology. Domain knowledge is represented through topics, where each can contain several sub-topics, and so on, creating a network of topic units-lessons as defined in appropriate *Domain knowledge Ontology*. Every lesson is a single XML document that complies with corresponding XML schema.

XML schema for defining constraints and relationships in XML documents, being more robust specification than DTD, can also define simple and complex data types, type derivation and inheritance, element occurrence constraints and namespace-aware element and attribute declarations [5].

The Figure 3 shows a screenshot from a student testing application – HTML course. Preceding the test, student was taking course lesson- subtopic HTML Tables and Student Model is being updated with the information.

The procedure of testing consists of several steps:

- 1) Log in – Student fills the form including its personal information (first name, last name, index number). If data is verified, student is allowed to proceed. At the same time, Student model is being invoked checking if student was already using system, or if this is the first time user, a student model of a new student is being created. Student model is being updated with the information about student taking test again/first time. Depending on information that *Student model* delivers to the system, system is being adopted to the knowledge level of a student, presenting the appropriate difficulty testing level.
- 2) From the *Domain knowledge module*, according to student’s profile, using overlay model, system is forming an appropriate sub-base of questions. From the sub-base, system is randomly generating some number of questions that will be presented to student. Number of questions is defined either by human teacher if selected so, as an option during the knowledge material loading, done by teacher, or

number of questions is automatically generated by the system according to student profile delivered by *Student model*.

- 3) Questions are generated using Java servlet technology, where a servlet is responsible for converting XML data (questions and lessons) into a tree of Java content objects using Sun's JAXB classes (Java for XML Binding)[5] (process of unmarshalling and marshalling).
- 4) Questions are being presented to student, and test is being done for a specific amount of time (namely 20 minutes). The system provides feedback information about student's results. At the same time, the student model is being updated with the results student achieved during the test.

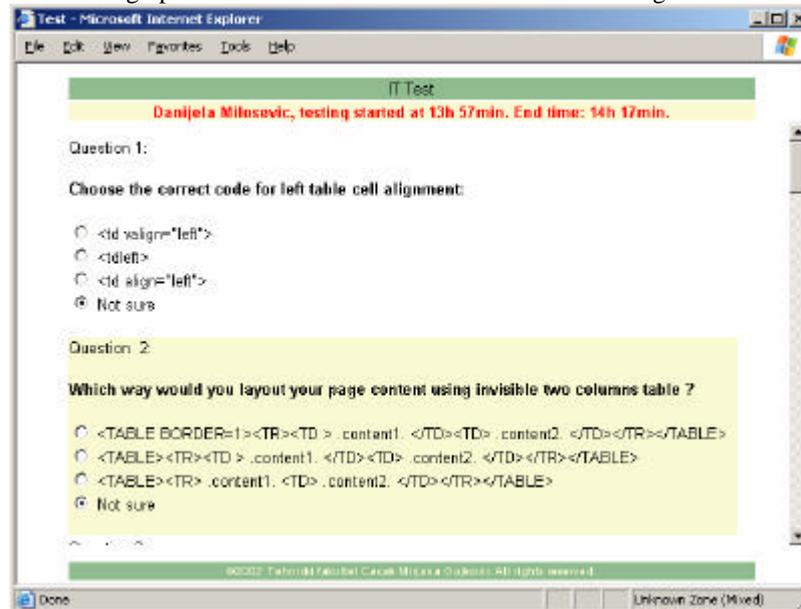


Figure 3. A sample screenshot of a Testing module

4. CONCLUSION

The need for specified ontologies in the e-learning environments is certain. Having once well-defined ontology would gain to the more cost-effective component based e-learning software. The prescribed ontology standards installed on the web would be of a great help to any e-learning applications. Furthermore, they will enable the knowledge interchange between different intelligent tutoring systems and also what is of a great significance, it will enable a knowledge reuse. Since many e-learning systems have much domain-independent knowledge which should be reused, the process of building a component based elearning systems which commit to the specified ontologies would be more simplified and standardized.

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E-LEARNING TOOL FOR TEACHING ORGANISATIONAL MULTIMEDIA

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ABSTRACT

This paper describes an experience undertaken with higher education students, which consisted in utilising an E-Learning Tool to serve as an aid in teaching *Organisational Multimedia*. This course is taught to 4th year students at *Escola Superior de Ciências Empresariais* (Higher School of Managerial Sciences, Setúbal, Portugal), where the first author teaches.

Further referred to in the paper, the model used for the planning, development and evaluation of the above-mentioned tool, which resulted from the integration of the model presented in the first author's Master's thesis with methods, methodologies and guidelines proposed by other authors. In relation to the resulting tool, the way it was applied and its evaluation are also presented. The results obtained are interpreted and future developments are proposed taking into account that the *Escola Superior de Ciências Empresariais* is developing an e-learning project, which will be implemented in the short term, and will benefit from these type of studies and resultant E-learning Tools.

KEYWORDS

E-Learning Tools, E-Learning Applications, Multimedia Tools.

1. INTRODUCTION

In the last years, Information Technologies have become more commonplace in many areas. The traditional education system also had the necessity to adapt to this new society [Chambel,T.,1998] and has benefited quite a lot from the contribution of these types of technologies/tools [Azevedo,B.,1997; Hartley,K.,1999]. The "professional philosophy" evolved to life long learning [Ryan,S.,2000] and professional careers are becoming increasingly demanding, implying a rapid adaptation and constant education in less time, and preferably, without employees being absence from their place of work [Abbey,B.,2000; Chute,A.,1999]. Therefore, Long Distance Learning (LDL) has emerged as a way of bringing flexibility to education resources, often being the only possible alternative for many [Santos,A.,2001] and what started as an education project via postal mail, is now often based on e-learning systems [Machado,S.,2001]. E-learning, can be defined as a teaching method, which utilises Internet technologies to supply, by distance, a set of solutions (E-learning Tools), for the acquisition and/or updating of knowledge and there are many authors involved in its refinement [Machado,S.,2001; Rosenberg,M.,2001; Ryan,S.,2000]. The main reason for the growing popularity of this teaching method is due to the fact that it combines the advantages of using Information Technologies in education [Azevedo,B.,1997] with the advantages of distance learning [Machado,S.,2001; Rosenberg,M.,2001]. This was, therefore, the reason that led us to choose using an E-Learning Tool to serve as an aid in the teaching of *Organisational Multimedia*. As it is an obligatory course, we verified that the resulting classes were very heterogeneous, collecting students from five different academic areas. Given that the students had different time schedules and study conditions, this naturally

implied difficulties in teaching the course. To overcome these difficulties, to facilitate access to information using the new instructional model "anytime, anyplace and anybody" [Aggarwal,A.,2000], and simultaneously, to benefit from the advantages of using Information Technologies (namely Web-based technologies) as a teaching support and, finally, to contribute to the modernisation of the study methods used by the students, an E-Learning Tool was developed and made available to serve as an aid in the teaching process of the above-mentioned course.

In order to plan, develop and evaluate the E-Learning Tool, it was necessary to use an adequate model, which is briefly referred to in Section 2 of this paper. As to the resulting Tool, its content is explained in Section 2 and the way that it was applied and evaluated is presented in Section 3. Interpretation of obtained results and opinions on future developments can be found in Section 4.

2. E-LEARNING TOOL

The model used for planning, development and evaluation of the E-learning Tool resulted from the integration of the model presented in the first author's Master's thesis [Prata,A.,2000; Prata,A.,2002a] with other methods, methodologies and guidelines proposed by other authors [Drener,D.,1998; Driedger,J.,1999; Fernandez,J.,2000; Lynch,P.,1999; McGloughlin,S.,2001; Nielsen,J.,2000; Olsina,L.,1999; Salmon,G.,2000; Sutcliffe,A.,1999; Tsai,C.,2000; Vaughan,T.,1998; Vrasidas,C.,2000]. The final model, composed of 9 phases grouped in 3 different stages, implies the initial development of a prototype, which, if proven efficient, will serve as the basis for the subsequent development of the final Tool

Students, which could not attend classes, were considered to be the target group for the E-Learning Tool. It was developed, however, so that the general student population could use it. But the most important factor was to develop a Tool that would best compensate for a student's absence. All classes of the said course are laboratorial and last 3 hours, of which the first hour and a half is theory and the reminder practical. Given the extension/diversity of the course content and given that the model used assumed the initial development of a prototype, the Tool will be, from this point forward, designated as prototype. The prototype comprises 3 different Sections: the Section with the content of a laboratorial class on Sound, namely the practical part of it, the Frequently Asked Questions (FAQ's) Section and Exercises Section (which the resolution included). Out of several themes that are part of the practical classes (image, graphics, text, sound, animation and video), sound was chosen for being, in terms of complexity manipulation and transmission, an intermediate component when compared with the others. Other reasons for our choice were because we were trying to use some knowledge of a similar experience made in another course [Prata,A.,2002b] and we had already implemented and tested practical classes on image [Prata,A.,2003a] and on animation [Prata,A.,2003b]. This was a challenge given that, although a lot has been achieved in terms of improving compression algorithms and increasing band width/access speeds to the Internet, we are still far from achieving the ideal.

3. EVALUATION METHOD AND DATA ANALYSIS

Some students participated in the final evaluation made to the prototype (82 out of 120), which consisted in an experiment and in the application of a questionnaire both described as follows:

3.1 The Experiment

- 82 students participated in a one-hour and a half theoretical class on sound;
- After being characterised they were distributed into two groups of 41 each. Each group comprised of 13 students without any experience in using the Internet, 8 students with experience in using the Internet and sound and 20 students with experience in using the Internet but without experience in using sound. Each group occupied a separate classroom;
- One group was submitted to the other hour and a half class, which corresponded to the practical part of the laboratorial class. Meanwhile, in the other group, each student had, during an hour and a half, access to the

prototype that was meant to be a substitute for the practical class. The students were observed whilst using the prototype;

- The prototype was installed on a public server, and each user achieved speeds similar to that of a 56Kb-modem connection (the most frequent type of connection speed achieved amongst the student population);
- Afterwards all students were submitted to individual practical exercises.

The idea behind this type of evaluation was to verify if the students felt enthusiasm in using the prototype but of special interest was if both groups had the same facility in solving the exercises and would be able to achieve comparable results. This way we could try to evaluate the efficiency of the prototype.

We noticed that in a general way, all students easily resolved the exercises. As to the results obtained by the students who initially attended the practical class and the results obtained by students who initially only used the prototype, there were some differences, namely:

- The results obtained amongst students without a lot of previous experience in using the Internet (26 out of 82) and the results obtained amongst students with more experience in using the Internet but without previous knowledge of sound (40 out of 82) were more or less the same for both groups;
- The results obtained amongst students with experience in using the Internet with previous knowledge of sound (16 out of 82) were very good and better amongst those who attended class (average of 16 against an average of 14). These students had already previous knowledge on sound and as it was probably an interesting subject for them, participated quite actively in class by posing several questions and doubts, which were immediately clarified. Those who used the prototype could also have had their doubts but as they were not immediately clarified (they had to resort using the FAQ's Section) their result was slightly worse.

3.2 The Questionnaire

After finishing the exercises the group that had attended the practical class, was asked to consult and evaluate the prototype. Meanwhile, the group that had used the prototype was lectured a practical class. Afterwards, all students were invited to fill out a questionnaire whereby they could freely and anonymously express their opinions on the prototype. With the questionnaire we were expecting that the students, after being submitted to the two possible situations (attend the class and use the prototype) could evaluate the efficiency of the prototype. The answers are resumed in Table 1, presented below:

Table 1. Answers obtained in the questionnaire

About the prototype:	More Or Less			
	A Lot	A Little	Very Little	
1. Has an attractive design	58	18	6	0
2. The information is well organized	63	16	3	0
3. Simple and intuitive navigation	68	12	2	0
4. The subjects are exposed clearly	69	13	0	0
5. Easy to use	67	13	2	0
6. Motivating	79	3	0	0
	Good	Medium	Weak	Bad
7. Number of examples presented	75	7	0	0
8. Number of exercises presented	50	22	10	
9. FAQ's Section	72	5	5	
10. In terms of speed, the result was	4	34	36	8
11. Is a good method of substituting the attended class	78	4	0	0
12. Global evaluation	51	30	1	0
	Yes		No	
13. A good enough substitute for the attended class?	68		14	

As we can see from table 1, some attention needs to be paid to the results related with the prototype lack of speed. It was noted, as expected, that the 56 students with experience in using the Internet were more demanding and, in fact, were amongst the ones who classified the prototype as being slow. Another discovery was that although all students considered this type of prototype to be "Good" (78 out of 82) or "Medium" (4 out of 82) substitute for attended classes, only 68 out of 82 considered the studied prototype sufficient to substitute class. This indicates that there are still some improvements to be made to the prototype in order to make it more efficient and personalised.

In relation to the open questions, students were asked to identify the strong points, the weak points and to suggest ways on how to improve the prototype. Of the strong points mentioned; it helped students who could not attend classes (80 out of 82); it was accessible from anywhere (75 out of 82); motivating (79 out of 82) and a different and original study method (73 out of 82). The weak point mentioned was slowness (44 out of 82).

4. CONCLUSION

In order to facilitate the access to information from any place at any time, an E-Learning Tool (initially a prototype) was developed to serve as an aid in the teaching of *Organisational Multimedia*, a course taken by 4th year students at the *Escola Superior de Ciências Empresariais*. The final evaluation made to the prototype consisted of two parts, an experiment and a questionnaire, both with the participation of 82 students. As the sample size was small, the results achieved should be considered as merely indicative, being useful, essentially, for improving the prototype.

The experiment consisted in the direct observation of the students whilst using the prototype and in the resolution of some exercises. The direct observation of the students showed us that the majority of them felt quite enthusiastic about using the prototype of the E-Learning Tool. The results obtained with the practical exercises were optimistic because in the two groups (the one that attended the practical class and the one that only used the prototype) the majority of the students achieved similar scores. The only category of students, which had better scores in the group that attended the class, (when compared with the scores obtained in the group that only used the prototype), was the one with previous experience in using the Internet and with previous knowledge of sound (16 out of 82). However, these higher scores resulted from the personality and attitude of these particular students which prefer questions posed directly to the professor and rapid answers rather than browsing around the prototype until finding the answer. We consider that this problem can be solved with a more friendly and personalised FAQ Section.

From the questionnaire we found that students considered the prototype to provide them with autonomy (80 out of 82) and flexibility (75 out of 82) with regards to their studies, and classified it as a motivating (79 out of 82) and different (73 out of 82) teaching/ learning process. It was possible to note that the majority of the students considered the prototype to have an attractive design, well organised information, simple and intuitive navigation, the subject being clearly exposed, easy to use and motivating, presented a significant number of examples and exercises, and was a good substitute for attended classes. In relation to weak points it was also possible to obtain sufficient feedback to improve on the prototype. In reality the only problem pointed out was the fact it was slow in downloading the prototype.

Concluding, we saw a lot of enthusiasm in the usage of the prototype and in general terms we consider that the prototype was efficient because it was able to substitute the practical class with almost the same results. This was encouraging and showed us that the production of this type of Tools should be encouraged. At the time the prototype is being perfected, especially the referred access speed problems.

Regarding to future works, and considering that we had already developed and tested prototypes with practical classes on sound (described in this paper), image [Prata,A.,2003a] and animation [Prata,A.,2003b], now we only have to develop and test a prototype with a practical class on video, which is already in an advanced phase of conclusion. Finally, we expect to implement the final ELearning Tool with all the practical classes of all the themes, which are part of the course. Another incentive to continuing this work is the fact that the *Escola Superior de Ciências Empresariais* is currently developing an E-learning project that will be implemented in the short term, and will benefit from these types of studies and resultant Tools.

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DOLPHIN-FEW - AN EXAMPLE OF A WEB SYSTEM TO ANALYZE AND STUDY COMPILER BEHAVIOR

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ABSTRACT

DOLPHIN is a framework conceived to develop and test compiler components. DOLPHIN-FEW (Front-End for the Web) is the DOLPHIN module that integrates all Web-related functionalities. Initially conceived to monitor the behavior of some routines of the compilers back-end, it is, nowadays, also usable as a visual tool to teach how those code analysis, optimization, and code generation routines work. This paper introduces DOLPHIN-FEW, a software system that takes advantage of the web environment and associated technologies to be a powerful pedagogical tool to teach compiler construction topics.

KEYWORDS

Compiler construction, education, training, e-learning.

1. INTRODUCTION

DOLPHIN is a framework (Matos, 2002), under development, conceived to help in the construction of compilers. It is composed by several software components that can be directly or indirectly applied (by parameterization or by generation) to build new compilers. It is also used as a test-bed to experiment new compiling algorithms.

DOLPHIN-FEW is one of the components, developed using web-based technology, conceived to:

- Offer a (full) compilation system available over the net, that is, accessible through a WWW browser;
- Offer a visual tool to analyze the behavior of several compiler routines;

Moreover, DOLPHIN-FEW also allows to bring out DOLPHIN framework over the web to the compiler developers community.

The compiler takes a program written in a high level language, whose statements are semantically more powerful than the machine instructions and more compact, and converts them to low-level instructions that are semantically less powerful and more extensive. This is done in several stages, some that are responsible for the interpretation of the source code, others that work to generate the output code and even others, that work along the compilation process to optimize the code or to collect information to support these optimizations.

A compiler developed under the DOLPHIN framework contains a set of functionalities that provide information about the code at the intermediate levels of the compilation process. These functionalities are controlled by a set of flags that are activated when the source program is submitted to the compilation. The information generated is very important to understand the effects of the compilation routines, namely those for code optimization. The compiler generates:

- The intermediate code, representing the meaning of source program;

- The information about some source program entities, like identifiers, that is not always explicit in the intermediate code;
- The information about the source program behavior, extracted by the data and flow analysis routines;
- The auxiliary data structures that help the compiler execute his task (i.e. the management of the memory references);
- The auxiliary data structures that help to understand and measure the behavior of the compilation process (i.e. quantify the use of registers, or estimate the execution time).

Initially, all that information was generated as text files. However, the size of the generated information was very large even for a small source program and using a limited number of active flags. This creates a problem: if, on one side, this information is very important, on the other side, its size makes difficult its interpretation. Actually, the problem is even worse since the analysis of that monitoring information places other difficulties, for example:

- To analyze the behavior of a compilation routine, we have to compare the code (and other auxiliary data structures), before and after the execution of the routine. This is a difficult task, mainly when the routine produces severe code transformations that does not allow to easily relate the two stages;
- DOLPHIN builds the upper levels of the intermediate code representation using a set of objects. To analyze these levels, it is important to reference those objects, which is done using the respective memory addresses. But when we deal with thousands of objects, and as consequence thousands of memory references, it is quite difficult to interpret the information;
- At low levels of the code representation we loose some references to the elements that compose the source program, such as the variables and function identifiers, which are replaced by relative memory addresses. This is one more obstacle that difficult the interpretation of the information.

It is important to notice here that the use of the traditional debugging systems does not solve our problems, essentially because those tools act at the execution phase (this is, while the computer is executing the code generated by the compiler), and we are concerned with the monitoring of the compilation phase.

2. THE DOLPHIN-FEW

To solve some of the problems discussed above, we conceived and propose a new system that, by one side, produces a more efficient form of representation and, by the other side, helps the interpretation of the information. This system will rely on the fact that the code representation, used by DOLPHIN framework, is essentially a graph (the Control Flow Graph of the program) with a large set of information attached. Then, our idea was to build a visual tool (a browser) to navigate over that graph and associated data; some required functionalities are:

- To navigate over the Control Flow Graph, jumping from block to block (vertex to vertex);
- To watch inside the vertices of the graph, to identify the operations that constitute each basic block;
- To inspect each operation and the respective operands;
- To see all the information associated with the vertices and the operations;
- To observe the evolution of the information produced by the analysis routines.

Moreover, the browser should enable the navigation between correspondent information of different stages of the compilation process.

Sooner we understood that a hypertext representation for the information under consideration, such as HTML, could be handled directly by an existing web-browser constituting a very good solution to fulfill the above stated requirements. To attain this, we just had to convert the routines that generate the text files described above, to generate the information formatted in HTML.

Figure 1 and Figure 2 show two windows with information generated by the compiler (partial examples); observing them it is possible to confirm the existence of several links that allow the navigation over the code representation.

Surprisingly, the benefits were even better than we expected. For instance: it is possible to relate the memory addresses, at the low level representation, with the correspondent variable identifiers, at the high

level representation; or it is possible to trace the information produced by the compiler. The navigation over the information is easily done using a simple browser (it is not necessary any kind of special tool), which speeds up the inspection of the compiler's behavior, increasing enormously the development productivity.

Suddenly, we got a system that does not only solve most of the established goals, but also opens a new door to the project DOLPHIN – the Web. So we integrated this solution in the web page of the DOLPHIN framework: DOLPHIN-FEW was born at <http://www.labinf.estig.ipb.pt/Dolphin!> DOLPHIN-FEW provides many services for the development of compilers, as well as support for the development of generic applications.

(a) The Control Flow Graph.

Control Flow Graph

- Node:0032B710
 - Root Node
 - Type:Conditional Node
 - Output (true):[0032B9E0](#)
 - Output (false):[0032BF78](#)
 - Var. definition-Expressions (BOTTOM)
 - [a\(0032B060\)](#)
 - [Data Transfer's of the node](#)
 - [Expression's of the node](#)
 - ...

(b) The list of intermediate level expressions.

List of Expression's

- Expression's of the node [0032B710](#)
 - ...
 - Address:0032B8A8
 - Type:Memory
 - Data Transfer:[0032B8F0](#)
 - ◆ Variable: [a](#)
 - Address:0032B798
 - Type:Conditional jump expression
 - Data Transfer:[0032B7E8](#)
 - ◆ Conditional Expression:[0032B8A8](#)
 - ◆ Jump (False Cond.):[0032BF78](#)
 - ◆ Jump (True Cond.):[0032B9E0](#)
 - ...

Figure 1. Partial examples of the intermediate code representation

(a) The list of data transfer operations.

List of DataTransfer's

- Data Transfer's of the node [0032B710](#)
 - ...
 - DT Type:RegAssignment (0032B8F0)
 - Register Address:0032B900
 - Expression Address:[0032B8A8](#)
 - Expression Type:Memory (Address) ([a](#))
 - Dependent List:
 - ◆ [0032B7E8](#)
 - DT Type:VoidAssignment (0032B7E8)
 - Expression Address:[0032B798](#)
 - Expression Type:Conditional Jump
 - Expression (Cond.Exp.:[0032B8F0](#), Output (true):[0032B9E0](#), Output (false):[0032BF78](#))
 - ...

(b) The pseudo-code generation.

Pseudo-code generation

```

L0032B710 :
r0      : ARGUMENT(a)
r1      : MEM(a)
          ASGN(r1,r0)
r3      : MEM(a)
          CJUMP(r3, L0032B9E0, L0032BF78)
L0032B9E0 :
r4      : CNST(0)
r5      : MEM(b)
          ASGN(r5,r4)
r11     : MEM(b)
          ASGN(r11,r4)
          JUMP(L0032C6D8)
L0032BF78 :
r6      : CNST(1)
r7      : MEM(b)
          ASGN(r7,r6)
r12     : MEM(b)
          ASGN(r12,r6)
          JUMP(L0032C6D8)
L0032C6D8 :
r9      : MEM(b)
          RET(r9)
    
```

Figure 2. Partial examples of the intermediate code representation

Our first big project inside the DOLPHIN-FEW, and the one focused in this paper, aims at building an Integrated Development Environment (IDE), which offers to the web users an environment to the full development of software programs. The IDE is not a very original idea, but when we add a multi-language cross-compiler (a benefit of the integration of the DOLPHIN framework), the project gains other dimension. Why? Well, first we are offering an important service for the software developers; second, the service is

available over the net using a simple web browser. Moreover this IDE is also a monitoring tool to study and analyze the behavior of the compilation routines (another benefit of the integration of the DOLPHIN framework). Figure 3 shows the interface of DOLPHIN-FEW IDE.

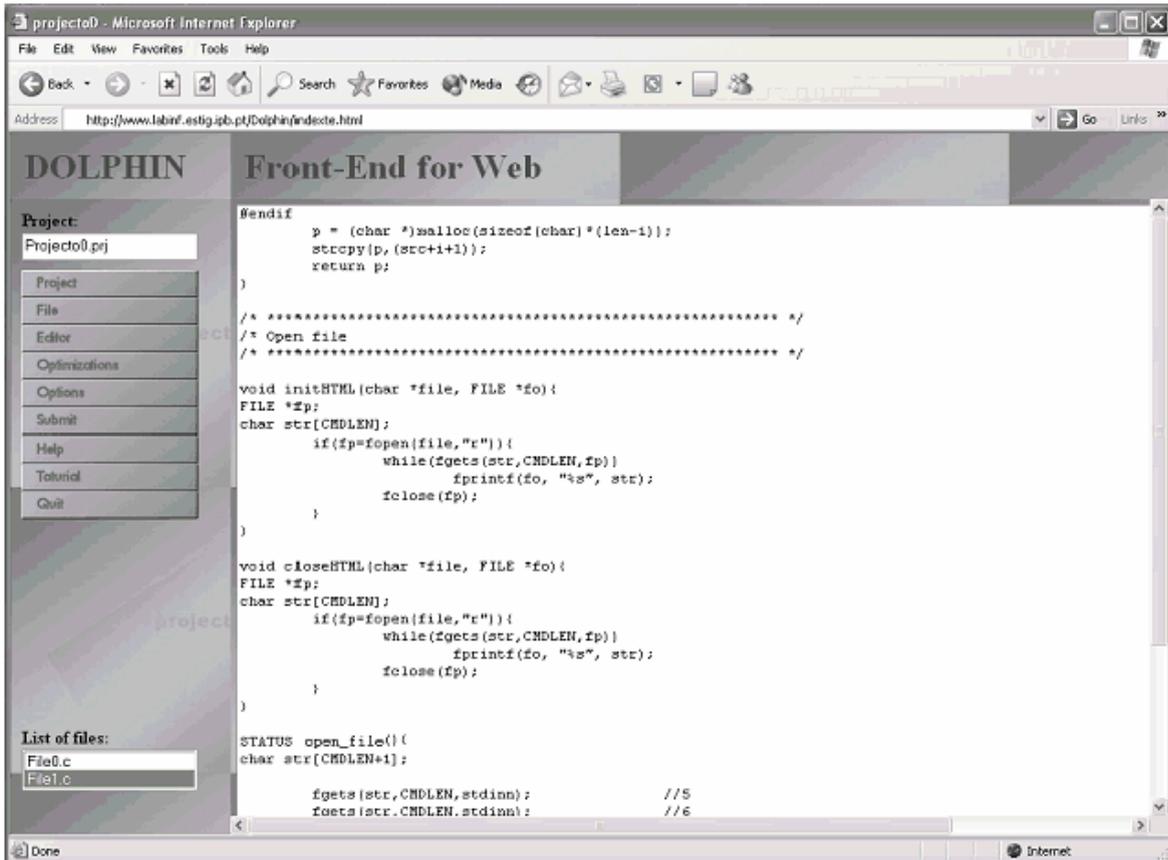


Figure 3. The IDE of the DOLPHIN-FEW

The full implementation of the IDE (and DOLPHIN framework) should enable the:

- Development of complete software projects (programs edition and compilation);
- Use of any of the source languages supported by DOLPHIN framework (one project may contain files written in different languages);
- Choice of the code optimization routines that the compiler should apply;
- Choice of output code that the compiler should produce (DOLPHIN framework supports the generation of Assembly or Binary Code for several computer architectures);
- Choice of the monitoring information (about the compilation process) that should be produced and visualized.

The interaction implemented by DOLPHIN-FEW IDE (to support the user during the development process) follows the traditional client-server paradigm, as illustrated in Figure 4. The user writes the program (in a high-level programming language), sets the compiler control flags (to define the code optimization options, the level of monitoring information, etc.) and then submits the program to the http server. This one calls a small CGI (Common Gateway Interface) that runs the compiler (developed under DOLPHIN framework) with all the active flags. The result is a set of HTML files that are sent back to client. The client-server architecture is stateless, which means that does not save the state between code submissions.

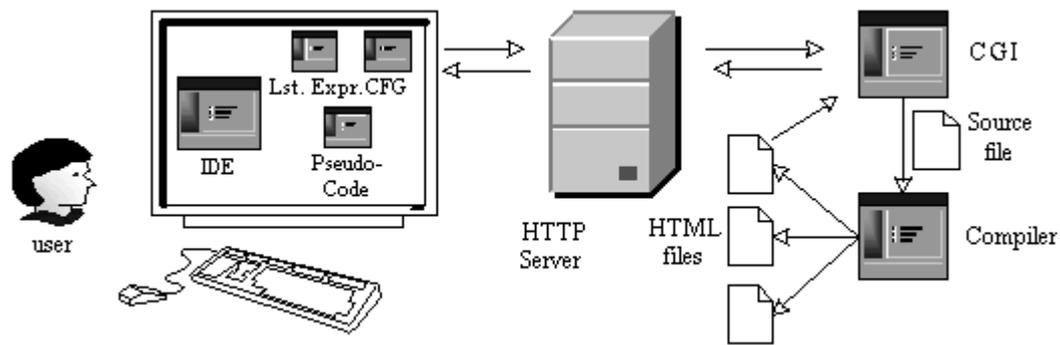


Figure 4. Client-Server of the DOLPHIN-FEW

3. CONCLUSION

DOLPHIN-FEW should not be seen as a case-study for the application of web technologies; instead, we want to introduce it as a nice (simple) web solution to support researchers and teachers in the area of compiler construction. Initially created to solve a concrete problem, the system exceeded the objectives and all expectations defined. However, it is a very young system, still growing in parallel with the associated DOLPHIN framework, for which we still have many more future goals. For the DOLPHIN-FEW IDE we intend to:

- Reinforce the role of DOLPHIN-FEW as a compilation system, multi-language and cross-compiler, available over the net, which implies the addition of front-ends (lexical, syntactic and semantic analyzers), to support more source languages and more code generators for different processors;
- Design one DTD (Document Type Definition) or a XML Schema, for the intermediate code representation in order to adapt the framework to generate XML instead of HTML;
- Implement a solution to visualize and navigate over the intermediate code representation (using Flash/JavaScript based on the XML representation above referred);

But we have other projects for DOLPHIN-FEW. We intend to go a little far away, building an interface to make the full DOLPHIN framework available over the net in such way that the users can develop and test their own compiler components (or even the full compilers). This project should contain mechanism to:

- Facilitate the construction of new compiler front-ends to be integrated in DOLPHIN framework (this implies the publication of the complete formal specification of the intermediate code representation);
- Facilitate the construction of new code analysis and optimization routines (Alt, 1995; Thesing, 1998) to be added to compilers under development in the context of DOLPHIN framework;
- Integrate the components developed by the users with the DOLPHIN framework to build a full compiler and put this one available over the net using the DOLPHIN-FEW IDE.

Even though we already use DOLPHIN-FEW to explain some compilation topics to our students, we believe that DOLPHIN-FEW can be used as an essential tool to teach advanced topics about compilation.

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ESSENTIAL REQUIREMENTS AND SOLUTIONS TO SUCCESSFUL E-LEARNING

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ABSTRACT

Based on an extensive examination of national and international systems for computer supported cooperative learning (CSCL), computer supported cooperative work (CSCW), intelligent tutoring systems (ITS) as well as computer based training (CBT) a collection of requirements to adaptive e-Learning systems is shown. The requirements are categorized and described by actual mechanisms and methods of eLearning. During the discussion the requirements will be compressed to the most important architectural, functional and educational aspects and completed with recommendations for practical solutions.

KEYWORDS

e-Learning, collaborative system, CSCL, requirements analysis, adaptive system, distance education

1. REQUIREMENTS TO AN E-LEARNING SYSTEM

The following discussion bases on a extensive examination of more than 60 international computer systems to support educational and learning effects by the user with the help of CSCL, CSCW, ITS and CBT from 1995-2002.

The list of the requirements to an e-Learning system is a summary of the examination and focused to the development of an adaptive information system as a part of the learning area to enable individual learning results in a specific learning context depends on the learning variables of the user as shown in figure 1.

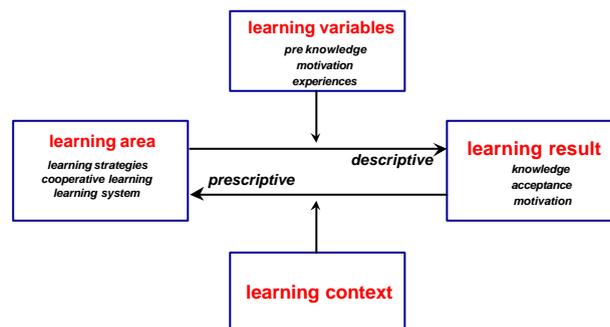


Figure 1. Aspects and dependencies for learning processes

In a first step 50 categorized requirements are described from an overall view of educational and learning aspects [Flor2002]. This description will be refined in a next step and the more common solutions will be detailed to practical recommendations also. Besides the requirements we will examine the systems for CSCL, CSCW, ITS and CBT for strategies to support adaption, styles and roles of learning as well as learning scenarios especially. The results of the examination concerning styles and roles of learning, adaptive information systems and learning scenarios are shown in figure 2 and [Nölting-Flor2002].

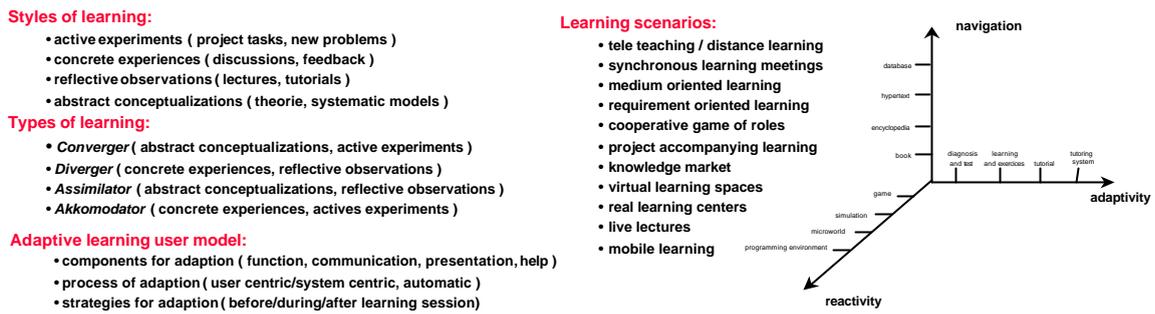


Figure 2. styles, types, adaption and scenarios of learning

2. RECOMMENDATIONS FOR A SUCCESSFUL E-LEARNING SYSTEM

The list of 50 categorized requirements for an e-Learning system from [Flor2002] will be compressed to a list of more detailed and practical solutions for a successful e-Learning system in table 2, organized by the same categories. Important is the focus on the view of learning instead of the technical software system. The user needs a acceptable system to support individual learning effects and enables a communication and cooperation between different users on the same level of learning variables.

The discussion will close with a list of strong recommendations based on the requirements and solutions analysis before. Sometimes the recommendations are very simple but important for the acceptance of the system by the user. Other recommendation are very difficult, because they implicit complex theories and mechanisms of learning aspects, especially to realize constructivistic learning areas and depends on the individual learner characteristics as well as the usage of the e-Learning system in one of the named learning scenarios. That is the reason, why the list is called recommendations.

Table 1. recommendations for the realization of an e-Learning system

category	more detailed practical solutions	recommendations for the realization
motivation	<ul style="list-style-type: none"> flexible dialogue with the user intelligent feedback 	<ul style="list-style-type: none"> personal login and greetings at the learning server a user must be able contacted be able to contacting with participants in the learning system by use of the integrated chat mechanism or email distributors user must be able to evaluate anonymously learning content and single pages directly contact with the author or the responsible learning server
flexible role of teaching	<ul style="list-style-type: none"> system should support cognitive and constructionalistic elements of learning teachers is (only) a supporting coach learning is a self responsible process 	<ul style="list-style-type: none"> a user must be able to have full control of it, who topic area it works on, which chapter and pages it would like to learn in which order, and whether it uses the additionally offered exercises, questions and examples a user must be able to get individual assistance by the integrated chat and/or by a cooperative navigation, guided by the author or the teacher pages should contain links to additional background information intelligent and complex learning feedback can be expected only with the help of teachers or other learners, but not automatically by the learning server

adaptive representation of knowledge	<ul style="list-style-type: none"> • individual possibility of adaptation of the knowledge representation for different kinds of users • distinction of knowledge classes: beginner, progressing, expert • distinction of learning types and roles • user modelling, which ensures a continuous adjustment information presentation 	<ul style="list-style-type: none"> • implementation of a learning model and a consideration of different learning types, • content presentation depends on the different styles and scenarios of learning • implementation of a role model (learner, teacher, author, system)
distance learning	<ul style="list-style-type: none"> • a spatial and temporal independence of the learning from content • teleteaching: learning contents will be presented by transferred audio and video • audiographics: linguistic communication and communication between computers • eMail and news • multi user domain: learning visit a virtual place and community • WWW 	<ul style="list-style-type: none"> • learning server is part of intranet/internet and supports local independent learning • virtual classrooms should be to arrange for the learning a common place of learning • teacher is attainable by chat or eMail
CSCW	<ul style="list-style-type: none"> • groupware applications: cooperative production, exchange and subsequent treatment of multimedia data, independently of place and time • video conference system, eMail • use of hypermedia, distributed data bases, workflow, group editors, chat rooms 	<ul style="list-style-type: none"> • specialized information exchange with classrooms, chat, an eMail distributor and a black board • collaborative work should be supported by a cooperative navigation
structure of hypertext	<ul style="list-style-type: none"> • use of XML or HTML or another hypertext language • intergration of links into the learning content 	<ul style="list-style-type: none"> • the learning server must generate learning contents as XML-HTML pages (hypertext based) • presentation of this learning contents with a local browser
navigation	<ul style="list-style-type: none"> • fisheye views: detailed view of the close environment, less detailed view of the far environment • backtrack functions: recording of the learning path makes gradual retracing • bookmarks • guided route: author-defined optimal path through the information area 	<ul style="list-style-type: none"> • by the graphical navigation help the user must be able to turn back again to any starting point of learning • individual bookmarks to support a purposeful navigation • with the help of the table of contents it must be able to see the chapter structure • each page header must contain a list, in which chapter and/or which subchapter is arranged • by simply clicking of a section name it must be able to arrive at the beginning of a chapter and/or subchapter • at each page it must be able to get associated author information and references • a key word and full text searching function must be integrated
constructivistic learning	<ul style="list-style-type: none"> • hypertext -based learning environment • intergration of simulation and problem solution components • intelligent feedback • learning has full control during processing of learning contents 	<ul style="list-style-type: none"> • the learning must be able to follow sequentially the pages of a topic area as well as to navigate parallel and follow other pages, if these appear interesting • the user has complete free navigation abilities, but guided on demand • the user can navigated by a teacher or he can navigate by himself (cooperative passive and active navigation)

multimedia hypertext	<ul style="list-style-type: none"> • integration of multimedia components into the learning content 	<ul style="list-style-type: none"> • multimedia contents must be integrable into the XML-HTML structure in a simple manner, e.g. pictures, audio, video, software components and links to downloadable programs (multimedia presentations)
adaptivity	<ul style="list-style-type: none"> • adjustment of the cross-linking degree of the system on the needs of the learning • the system tries to present from the complex document the information units co-ordinated with the individual knowledge • the system offers background information to the user • adaptive navigation: annotations to the hyperlinks depending on the learning history of the user 	<ul style="list-style-type: none"> • learning contents must be generated user specific and depends on the style and role and scenario of learning • the goal of a link must be independently definable for each type of learning
user modeling	<ul style="list-style-type: none"> • description of the knowledge level of the user: declarative knowledge, procedural knowledge, problem solution ability, • fault-tracing • integration of tasks and tests: Multiple Choice, yes/no-questions, concrete problem definition situations 	<ul style="list-style-type: none"> • the profile of each user is to be stored in the database and the initial profile should be generated by the administrator r the user • the user profile consists of information such as name, type of learning, role, topic, authorizations • the user profile is basis for the dynamic learning content generation and presentation • for every learning session a statistical model is activated to evaluate the user behavior (navigation, communication, cooperation) and to develop user specific learning strategies
social control of adaptivity	<ul style="list-style-type: none"> • report to the user that a user profile exists • user model must be observable and manually modifiable by the user 	<ul style="list-style-type: none"> • the user needs access to its own profile data to see and change the profile • manual changing of style, type and role of learning is possible
adaptable models	<ul style="list-style-type: none"> • adaptations of a learning through creation of personal notes, generation of own links and cognitive maps • evaluation of the adaptations to get a better adaptivity for the next learning session 	<ul style="list-style-type: none"> • the user must be able to store personal annotations and links, which will evaluated by the statistical model • a bookmark administration must be implemented • the size of the presentation frames should be constant, by zoom functions it is able to get more largely view • user help and chat function should be work independently from the actual frame and must be activated by the user

A realized e-Learning system based on the recommendations should be used as a tool to complete traditional lectures and support individual responsible learning effects by the user. A solution for an e-Learning system based on the requirements analysis and conclusions in this paper is shown in [Flor2003].

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TOWARDS A DIGITAL MODEL FOR STUDENTS' EVALUATION USING E-MAIL

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ABSTRACT

In this paper we describe our experience with the use of e-mail as a mean of collecting evidence of students' knowledge and activities. The digital model under the experiment was called MEDICON3 (**M**odelo de **E**valuación **D**igital **C**ONtinuada del **C**ONocimiento en **C**ONtabilidad), that is a digital model for continuous evaluation of accounting knowledge.

KEYWORDS

E – mail, ECTS, e – portfolio, continuous evaluation.

1. INTRODUCTION

Perhaps one of the main reasons why professors do not use a continuous evaluation system in the university studies is the lack of a digital information system that would provide the information on knowledge, work, participation, etc. of the students, and would facilitate the capture, storage, processing, analysis and interpretation of that information. In fact, the core of our information system consists merely of a student card in which the exam grades are transferred. In the best case we propose an extra work that helps us to evaluate students. The question is why we do not have more information available. Why do we not suggest more activities to our students that could evaluate their knowledge? It is evident that we do not have the adequate resources.

MEDICON3 is an evaluation system much more complete than the traditional one because it considers a lot of aspects besides the exam like: attendance, participation, work in groups and personal work.

This new evaluation system would fit the European Credit Transfer System, ECTS, which will be implemented by the year 2010. The objectives of ECTS are to harmonize curriculums from different European countries and to promote students mobility. ECTS provides an instrument to create transparency, to build bridges between institutions and to widen the choices available to students. The system makes it easier for institutions to recognize the learning achievements of students through the use of commonly understood measures, credits and grades, and it also provides the means to interpret national systems of higher education. ECTS is based on three core elements:

- Information on study programs and student achievement.
- Mutual agreement between the partner institutions and the student
- The use of ECTS credits to indicate student workload.

In order to reach the implementation of this system, universities will have to face different kinds of students, from different countries and cultures. This wide variety of students will need a new evaluation system capable of take into account their personal needs. That is why our project, MEDICON, appears to be a very useful tool for the implementation of ECTS.

2. DESCRIPTION OF THE PROJECT

By means of the MEDICON3 project we have been able to evaluate the viability of a digital information system for students' evaluation based on the use of e-mail. According to the model described below, the students have sent us different items that needed to be evaluated, including the student's card itself, via e-mail. The organization of the information has been carried out automatically with the program Outlook 2000, which provides a rule based programming facility. These rules allow the recognition and classification of incoming electronic messages of every student, with each message having their own specific keyword in the subject field.

Additionally, our aim was to promote the use of internet as a source of information for the study of accounting. This is the reason we have created some pages on our web site where the students can obtain the program of the subject, exam grades, additional literature, solutions of the exams and practical cases, slides, interesting links, etc. (Martínez, 2002)

The elements that we have taken into consideration in our evaluation model are the following ones:

Questions. They are formulated by the professor in class related to previous sessions, other matters and courses, or current matters in relation with our subject. In this case, the student who answers adequately is encouraged to send an e-mail with the key word QUE.

Web search. The student seeks information on the internet about a theme, company, etc. suggested by the professor in relation with the topic that is currently being discussed in class. Then, the student sends the results with a brief comment. In this case, the key word should be WEB.

Comments on readings. Sending of the summaries and/or comments of the readings published on the web page of the subject. (Keyword REA)

Internet resources. In this element we evaluate the effort of the student to find resources on the Internet that can be of interest in the accounting education field. After this, the best resources are added as a link to our web page. (Keyword INT)

Proposal and resolution of practical cases. Students are encouraged to propose and solve practical exercises for publication on the subject's web site. (Keyword PRO)

Consultations. The most frequent questions asked by students, that could be of interest for others, are evaluated and published on the web page under the section Frequently Asked Questions. (Keyword FAQ).

Other. Elements not included in the previous sections like translations, collaborations, web page designs, suggestions about real or imaginary cases, metaphors, parabolas, examples, detection of usual conceptual mistakes. (Keyword OTH)

2.1 Objectives

On one hand, the objectives are to design a complementary system of evaluation in which the above mentioned elements would be considered and whose information system (search, storage, organization, analysis and interpretation) is based on e-mail. On the other hand, we want to use the cyberspace as an additional meeting point with our subject. In this sense, we have tried to take into account students' opinions and cooperation regarding the design and contents of our web page.

2.2 Methodology

Students are required to send the information that has to be evaluated. Each e-mail represents an item identified by its keyword. The items could be answers to the questions raised in the class, expositions of problems, search of the information on the internet, comments on the lectures proposed by the professor, consultations, etc, as described above. This means that MEDICON3 has been present daily in the lecture room as well as in the office.

The evaluation system for the Accounting subject, as shown in table 1, consists of four parts. The first one is a theoretical exam aiming to check students' general knowledge on the topics. The second, a group assignment to show their ability to work in groups and to apply their knowledge in practice (Bonsón, 2001). Furthermore, they are given an individual assignment to check their capacity to work autonomously. Finally, they are expected to complete an e-portfolio containing all of the MEDICON3 tasks. The e-portfolio supported by MEDICON3 aims to test a number of skills such as: class attendance and active participation, ability to work autonomously, will to succeed, concern for quality, initiative and entrepreneurial spirit, creativity, capacity to adapt to new situations, capacity for analysis and synthesis, oral and written communication, information management skills, capacity for organization and planning, elementary computing skills.

Table 1. Evaluation system

Work	Percentage (final grade)
Theoretical exam	30%
Group assignment	30%
Individual assignment	20%
e-portfolio (MEDICON3)	20%

3. CONCLUSIONS

To have an accurate idea of the students' perception of the project, we have conducted a completely anonymous survey. According to the results of this survey, the students have been very satisfied with the project showing their great interest in this kind of evaluation and communication with the professor. However, during the development of the project, one major pitfall has been pointed out. The access to the internet has proved to be one of the major obstacles for the students. Nevertheless, we are confident that this problem can be solved relatively quickly, taking into account that we already have enough computer rooms available. The solution is to provide a more fluid access to the computers within the university.

From the professors' point of view, the project can be qualified as moderately satisfactory. In spite of the very positive results of the survey, the students' participation has been relatively low. This can be explained by the fact that Spanish educational system does not encourage an active role of a student in the classroom as well as outside of the classroom. One of the main objectives of our project is to involve the students in this new model of evaluation, which is considered as a complement and an upgrade to the traditional system. It is designed to motivate them and help them achieve a higher level of knowledge and experience.

With this project we hope to contribute to closing the gap between the European Credit Transfer System and the current Spanish evaluation system. It can be seen as a step toward the primarily student-centred education paradigm as stated in the project "Tuning Educational Structures in Europe" (Tuning, 2002).

ACKNOWLEDGEMENTS

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TRÁS-OS-MONTES DIGITAL AND CES – A CASE OF SOCIAL BENCHMARKING

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ABSTRACT

The Trás-os-Montes Digital project, covering the Portuguese Northeast (a region known as “Trás-os-Montes e Alto Douro”) took a novel approach to the problem of the digital divide: to take the USA model of agricultural extension services and attempt to create a similar model for Information and Communication Technology (ICT). While agricultural extension services distribute knowledge (agricultural techniques) to technology users (farmers), this project must create both the awareness for the benefits of technology and render it available.

KEYWORDS

extension, ICT, digital divide, regional development, Trás-os-Montes e Alto Douro, Trás-os-Montes.

1. INTRODUCTION

The USA Cooperative Extension Service (CES) was created in 1914 by the Smith-Lever Act (Rasmussen, 1989). Its aim is to generalize the use of modern agricultural methods and techniques, so as to increase production levels, as well as to promote overall evolution in rural societies.

Initially, the project yielded poor results, mainly due to lack of motivation on the part of the target population, whose social and cultural setting was highly unprivileged. To reverse this situation, effective means of dissemination were required. The chosen approach was to build upon the momentum of the Youth Clubs. These clubs aimed at creating a healthy community life and an improved sense of citizenship, encouraging young people to develop their critical judgment abilities and fostering personal growth. Primarily established in rural areas and with a membership possessing some measure of know-how and expertise, these clubs were an ideal setting for introducing the CES. Furthermore, the very concept at the basis of the creation of such clubs made them a model to be followed, also at the agricultural level.

Little by little, what became known as the 4-H service (Head-Health-Hands-Heart, seen as the fundamentals of growth) emerged. Nowadays, the CES and 4-H are interlinked: they use similar methodologies and share similar overall goals.

Using these principles as a guideline, the Cooperative Extension Service in Trás-os-Montes e Alto Douro was created in 1999, later renamed “Trás-os-Montes Digital/SCETAD”.

Trás-os-Montes is a region ridden with economical and social hardships. By making available the means for providing citizens with a better knowledge of the world, and working towards their increased use, we hope to contribute towards a more dynamic and active society.

Widespread use of the New Information and Communication Technologies (NICT) – particularly the Internet – are of paramount importance to reach the intended goals. The Trás-os-Montes Digital/SCETAD project aims at filling a gap that has, otherwise, been hard to overcome. Considering the intended outreach, work teams were created for the creation and development of projects.

Although inspired on the USA model, the Trás-os-Montes Digital/SCETAD project follows a slightly different approach, in order to adapt to the field features and goals – using NICT is obviously quite different from using agricultural techniques and knowledge.

A network of Internet-access points was created, called GAC (*Gabinetes de Apoio ao Cidadão* – Citizen Support Offices). These were set-up at selected sub-counties (“freguesias”) and each had a clerk or mediator

(“intermediário”) in order to provide adequate support for the needs of the population. Only by being on the terrain, close to people’s everyday life is it possible to effectively meet people’s needs. However, this initiative was only made possible through the support of the municipalities (“Câmaras Municipais”), where County Extension Agents were located, working within a County Extension Office (GEA, *Gabinete de Gestão Autárquica*). Their mission is to monitor, support and develop the mediators’ activities and act as liaison between them and the Coordination Team at the University of Trás-os-Montes e Alto Douro. All these elements, together, form the Operational Team.

The overall goal of SCETAD can be described as:

“To make the new information and communication technologies an instrument for the improvement of the quality of life, for social and economical development and for the modernization of the corporate fabric, particularly in what concerns rendering local public services and information generally available in the fields of education, health, agriculture, tourism and local government.”

2. THE TRÁS-OS-MONTES DIGITAL/SCETAD EXTENSION NETWORK

SCETAD was developed from a multi-institutional partnership promoted by the University of Trás-os-Montes e Alto Douro, bringing together a highly diversified set of local and regional bodies. Central to this partnership are County governments, as they render possible the geographical dispersion of resources, including the setting-up of the earlier-mentioned offices.

Initially, 10 county governments embraced the launch of the project, and two GAC were set-up in each county. Currently, the second phase of the project is underway, and this network of offices was extended and consolidated: 21 new counties embraced the project, adhering to the original goals. For this second phase, an additional 62 GACs were created. All of these have Internet-access by means of a 64 kbps ISDN line.

Therefore, 31 GEA/Agents and 82 GAC are currently in operation (Figure 1).

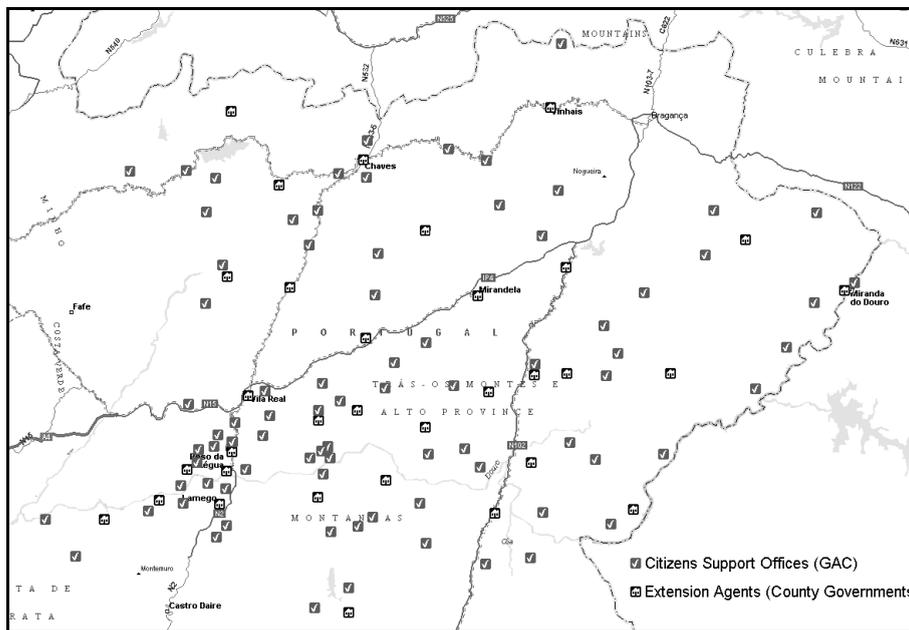


Figure 1. Citizens Support Offices and County Government Offices

3. MOTIVATION FOR THE PROJECT

SCETAD was created under two major guidelines: Information Society in Portugal and UTAD’s mission to act as an element for the development of the Trás-os-Montes e Alto Douro region.

The creation of the Portuguese Government taskforce *Missão para a Sociedade de Informação* (“Mission for the Information Society”) and the edition of the *Green Book for the Information Society in Portugal* (MSI, 1997) were decisive steps for the modernization of the Portuguese Society. A Cooperative Extension Service, being a people-oriented service, is in line with four of the measures set forth in the *Green Book*:

- MEASURE 1.3 – To promote citizen-information programmes;
- MEASURE 1.5 – To foster local administrations’ initiatives, that aim to democratize access to the Information Society;
- MEASURE 2.1 – Drive towards an electronic public administration;
- MEASURE 2.2 – A state administration open to the citizens and businesses;

The region of Trás-os-Montes e Alto Douro, due to several distinct reasons, does not possess neither a developed agriculture nor a developed industry. The population, partly living abroad, is scattered and with low-quality accessibility. It is not easy for citizens to contact the public administration bodies.

Under a regional perspective, SCETAD was launched under the goals set forth at the time for the Portuguese society, Ministry of Science and Technology, under its “Digital Cities” programme:

“...to mobilize and render widespread in society the instruments, techniques, and methods of information-organization, information-communication, and action, used in advanced societies. The application of digital services in an integrated way can, if directed with the goal of improving the quality of living of all citizens, be decisive for the future of many cities. The use of the digital information and communication technologies to improve health care, diminish the administration bureaucracy, empower for the generation of qualified work and tele-work, simplify and render transparent the decision processes; the quality and diversity of the received or processed information; acceptance and recognition of processes for education and professional training; rendering widespread a safe electronic commerce; providing new recreation activities; supporting citizens with special needs, among many other viewpoints, are all elements of the “Digital City” model.

(Excerpt from the speech given by the Minister of Science and Technology, at February 10th, 1998, in Aveiro, Portugal.)

4. THE TRÁS-OS-MONTES DIGITAL/SCETAD OPERATIONAL TEAM

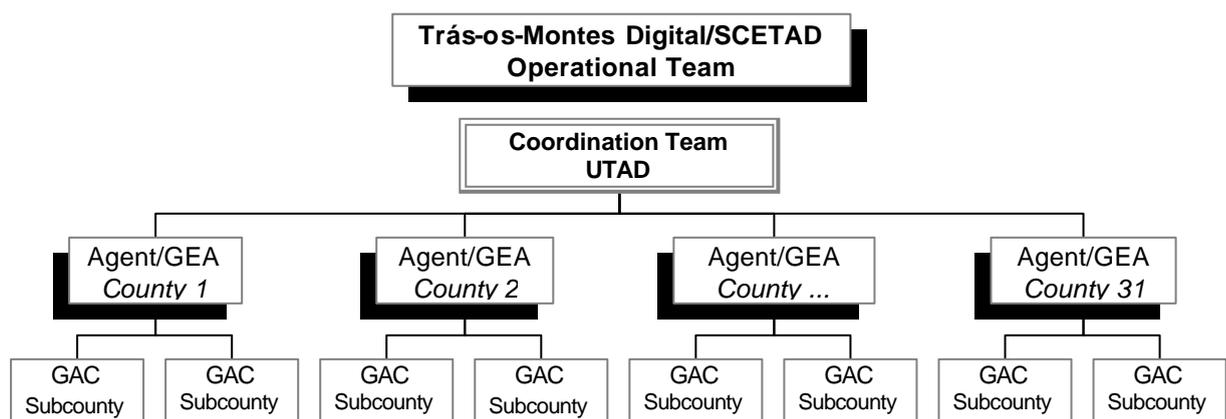


Figure 2. Operational Team -- organization chart

As mentioned earlier, the SCETAD Operational Team comprises Extension Agents and Extension Mediators (directly in touch with the population), and also team coordinators (Figure 2). These coordinators

are responsible for organizing and maximizing the results of the work performed by the Extension Agents and the Mediators. Also, the coordinators cooperate with the remaining SCETAD teams (technical support, educational staff, management staff, and other sub-projects), acting as a communications channel between Agents, Mediators and all the project resources and know-how. In this way, any problems and the solutions thereof are quickly and expediently reported. Coordination tasks also include the development of a regular training plan for the team members (Agents and Mediators). Agents then act as trainers, responding to the Mediators' difficulties and any staff changes that may occur.

Lastly, the coordinators also prepare and launch specific initiatives, deploying them through the agents, in order to establish a direct contact between these and the population, further contributing to the use of the services rendered available by the new technologies. Team coordination ensures that each agent is part of a team instead of being a disjointed speck in a geographical scattering of human resources and skills.

5. NETWORK OF COUNTY EXTENSION OFFICES (GEA)/AGENTS

Each County Extension Office (GEA), equipped with a multimedia computer, a colour printer and a scanner, is located at a County capital. Such facilities are not meant to cater to the public, but rather as technical and physical base for supporting County extension agents.

The main functions of Agents are:

- Face-to-face contact with the county's population, aiming to acquire insights on the needs of the citizens, in order to improve their living conditions;
- Liaise between all municipal bodies (population, county government, sub-county governments, agricultural agencies, organizations, businesses, etc.) and the team at UTAD;
- Whenever a service is requested at a GAC, the county Agent must track its progress, intervening in all cases of severe delay on the part of the organization involved. If such a request is directed to the County Government to which the Agent is directly linked, all efforts must be taken by the Agent to ensure efficient handling of the issue.

6. NETWORK OF CITIZENS SUPPORT OFFICES (GAC)

This network aims at rendering available services and information requested from any of the organizations that embraced the project (County Governments, Regional Office of Agriculture, Regional Office of Health, etc.), in order to prevent needless travel beyond any sub-county.

These GACs have a multimedia computer with an Internet connection (ISDN), colour printer, scanner and NetPin™ terminal (for electronic bank payments). They are installed at the sub-county government offices, open 40 hours a week. A clerk (Mediator) ensures service support (for those who experience difficulty in using the equipment) and ensures adequate office operation.

The major functions of Mediators are:

- Reception desk and instructions to users;
- Submitting citizen's requests for services;
- Making the GAC more well-known and improving its usefulness;
- Communicating to the Agent any information collected, that may contribute for better support of the citizens.

7. EXAMPLE OF AGENT-DEVELOPED ACTIVITIES

The face-to-face contact with the population of the 31 counties allowed the Agents to develop several activities, directly inspired by the population's specific needs. Given the great diversity of such activities, we decided to present just a few, which hopefully show the thematic richness of this approach.

Seasonal Jobs' Gallery

The scarce number of jobs available in the region, the limited offer of labour in some areas, particularly in seasonal, agricultural-related activities led to the creation of a jobs' gallery. This activity, launched in one county, was later to spread to all 31 counties. All interested parties can approach a GAC or contact a county Agent and fill in a form. Initially, this jobs' gallery was operated through the simple use of e-mail; after a trial period that verified its pertinence, a Web interface was developed to manage and operate it.

National Post services made available at the GAC

Many subcounties do not benefit from the presence of a National Post office. Therefore, the GAC's Internet connection was used as a basis for establishing a cooperation protocol between SCETAD and the National Post ("CTT"), so that this agency's services could be made available to the population, dispensing with the need to go to the county capital post office.

Support to Colonial War veterans

Agents perceived that a large number of war veterans were only vaguely aware of the existence of Government diplomas entitling them to a pension plan. Pensions had to be applied for until end 2002, but the sizeable paperwork involved and the entailing trips to county and regional capitals rendered the process difficult. The Agents quickly gathered all relevant information and used the Ministry Of Defense Web site to obtain the necessary forms. Eventually, when such an option was made available, the Agents helped the veterans submit their applications by e-mail.

8. EXAMPLE OF COORDINATOR-DEVELOPED ACTIVITIES

Improved use of e-services

The Trás-os-Montes Digital/SCETAD project rendered available forms for requesting Social Security documents. The Agents were instructed to identify all places, within their allocated county, where citizens might need to obtain such documents. The survey also announced at such places that people could see to matters at the subcounty council or at the GAC, without having to travel all the way to the County capital.

Periodic street surveys

This activity prompted Agents to favour direct contact with the citizens, in order to better identify needs.

9. STATISTICS ON CITIZENS SUPPORT OFFICES

There has been a regular and sustained increase in the use of the services made available at the GAC offices in all 31 counties.

The 82 subcounties where Citizens Support Offices are located have a total, highly dispersed population of 78,746. It is well to mention that the subcounties of Moimenta and Lavandeira have, each, only 184 inhabitants and that the most highly populated one – Outeiro Seco – has a mere 3,436 inhabitants. **Considering all 82 subcounties, 66% (54) have less than 1,000 inhabitants** (figure 3).

Such demographical limitations severely condition the project's success. We are pleased to note that level of use of offices is fairly acceptable and steadily increasing, as shown in the following (Figure 4). A sustained average of 140 users per month and per GAC has been reached.

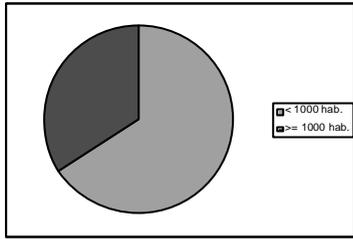


Figure 3. 66% of the sub-counties have less than 1,000 inhabitants

Between January 1st and November 30th, 2002, a total of 75,690 users were recorded (Figure 5). This number has increased, mostly because the GAC didn't all open at the same time, but also due to a steady increase in the average use of each GAC, as seen previously. We therefore believe that 2003 will register a much more significant use.

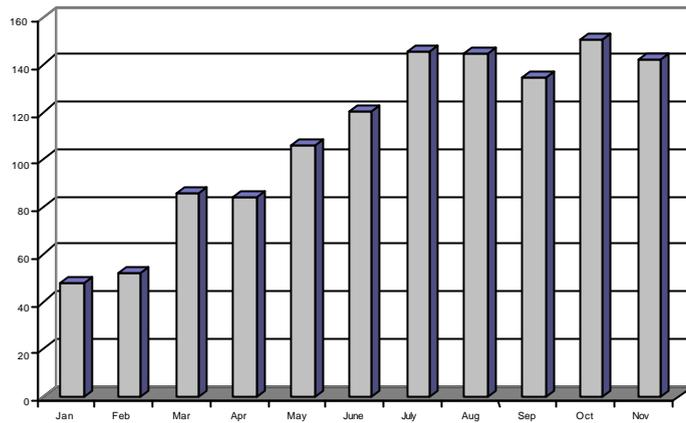


Figure 4. Average monthly users per GAC, 2002

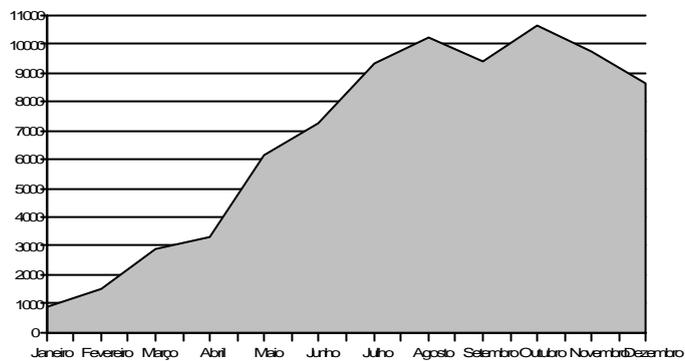


Figure 5. Overall GAC users per month, 2002

10. ASSESSMENT FRAMEWORK

SCETAD evolution and implementation are managed by an internal Centre for Management and Tracking (*Centro de Gestão e Acompanhamento*); it is also this entity that can propose new action plans. It is composed by a general coordinator and its supporting staff.

The assessment proper of the project is performed at the national level by the Portuguese government body POSI (*Programa Operacional Sociedade da Informação*, Information Society Operational Programme), which approves, oversees execution and analyses results of all Information Society projects launched originally under the “Cidades Digitais” and later under the “Portugal Digital” programmes.

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A CASE STUDY OF DEVELOPMENT AND ONLINE MARKETING OF ENGINEERING WEB APPLICATION WORLD WIDE

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ABSTRACT

Key to Steel and **Key to Metals** are the world's most comprehensive online databases of metal material properties, developed to provide technical information to professional users worldwide. This paper describes development process that resulted in one of the biggest and most valuable resources in the metal engineering and processing vertical market, as well as marketing activities that attracted 15000+ users to the Key to Steel Web site.

KEYWORDS

e-business, Web application, Web database, metals, steel

1. INTRODUCTION

In the businesses related to the metal production, fabrication and application daily turnover is several billion dollars, and global production is measured in millions of tons. Steel and metal industry is developed in virtually every country in the world, and even much more widespread is the group of industries that are consuming metal materials. In manufacturing, selection and application of metal materials, one of the most important aspects is information on their properties. However, collecting and streamlining such information is difficult since there is approximately 200.000 steel designations worldwide, and among them some 30.000 are standardized.

The basic idea of the **Key to Steel** project was to develop material properties database for all (or at least all relevant) steel alloys worldwide, which will be published on Internet and powered with all necessary tools for searching and reviewing, as well as with additional utility software and helpful content.

2. KEY TO STEEL DATABASE DEVELOPMENT CONCEPT

In such a project, the design and the content of the database are extremely important issues, as well as suitable implementation of Web technology to disseminate complex data and information. Having in mind the number of steel and metal alloys worldwide, and that the volume of technical information about one steel

is on average one page, the projected volume of the database would be approximately equivalent to library comprising of 1000 books, with 200 pages each! It is obvious that this amount of information is virtually impossible even to collect, and not to mention processing. That is the reason for limiting the scope of the database to most relevant steels, and that are – with some minor exceptions – standardized ones.

Next problem was the database design. Steel characterization is generally far from trivial, and the complexity of problem is further increased because for the same steel there are different, equally important aspects from the point of view of mechanical engineering, metallurgy, structural engineering, material testing, chemical and process engineering, etc. Therefore, in the first phase the limited set of most important material properties was included: chemical composition, mechanical properties, guidelines for application, and cross-reference tables. This way we obtained a simple database structure, analogue to the structure of data warehouse. This structure is optimised for searching and open for further including of particular properties (fatigue, heat treatment, corrosion resistance), simply by adding new tables. Disadvantage of the data warehouse structure is complex data input procedure, which requires a high competence level.

During the initial development time of 15 months before publishing on the Internet, factual (mainly numeric) data for some 10.000 steel alloys were entered to the database. In the next 3 years it has been intensively upgraded, and now it contains more than 25.000 alloys from 30 countries. Present size of the database is approximately equivalent to a library of 120 books, with 200 pages each.

3. TECHNICAL ASPECTS OF KEY TO STEEL IMPLEMENTATION

3.1 Server part of the system

The hardware platform of the system consists of relatively modest Pentium IV, exclusively dedicated to serve Web site and related services. System software is based on Microsoft technology: Windows Server 2000 is used as an operative system, Internet Information Server 5.0 for Internet services, and SQL Server 2000 is running the database.

Key to Steel database consists of 16 tables, and its structure is not complicated. Besides the Registry and Orders forms, database is aimed for data searching and reviewing, i.e. reading. Data needed for database has been collected by specialists from different sources (manuals, standards, other data bases, Internet), analysed and by appropriate software entered to production desktop databases. Production databases are implemented in Visual FoxPro, which makes them portable and easy to handle. Data is transferred to the central local data warehouse (SQL Server 2000 database) by applying asset of prepared stored procedures, and finally, after testing, it is again transferred to the Internet server.

3.2 Client part of the system

Client part is developed within Microsoft Visual InterDev 6.0 environment. Since this tool favours MS Internet Explorer as preferable Web browser, some of the options available in developing Web sites are not working on other Web browsers.

Development for the open market where choice the of the browser cannot be dictated, led us to decision to use only InterDev options which can be read by the two most common web browsers Netscape and Internet Explorer (version 3.0 or later). Our statistics show that more then 98% users are working with these browsers. This resulted in significantly longer development time, but the interface finally obtained was easy-to-use and intuitive.

4. EXPERIENCES IN ONLINE MARKETING WORLDWIDE

More than three years of developing, online marketing and selling the system **Key to Steel** worldwide, provided us sounded and interesting experiences in marketing and selling over the Internet, and in communication and cooperation with business and engineering users worldwide.

4.1 Big Three of Internet business

When the domain www.key-to-steel.com was activated for the first time, in June 1999, the database consisted of some 10.000 alloys and was approximately 20 times bigger than the next online competitor.

In the initial phase, starting e-mail campaign on more than 20.000 addresses gained very modest results. Since we knew that a need for such a product existed, initial results urged us to thoroughly review the method of marketing and selling over the Internet. Result of a serious work was discovery of the Big Three, a set of simple principles which are representing the essence of successful e-business.

We identified three elements critical for success, which are directly in our control. It is necessary to:

- 1) sell good – excellent – product
- 2) make the Web Site which efficiently sells
- 3) attract selected, targeted visitors to our site.

Focus of the further development was to attack every element of the Big Three individually.

4.2 Permanent improvement of the product

Although in the moment of launching we were sure that the product was good, it was obvious that it could be much better by enriching the database with new alloys, new aspects for particular groups of users, upgrading software, adding new content and services etc.

To maintain constant contact and dynamic interaction with potential customers, we have established regular upgrades every month, which enhanced the credibility within potential clients. This implies continuous work on product quality improvement, adding the new materials, their properties, and special aspects (properties on elevated temperatures, heat treatment, fatigue data, etc).

Besides the Web database on Internet, CD edition was developed as a new product. This product family enlargement turned out to be successful from the marketing point of view, because the demand for Web and CD editions is almost the same. Moreover, as a part of product line extension, another similar product was developed: Key to Metals, a global database of nonferrous metals www.key-to-metals.com.

4.3 Developing Web site that effectively sells

Developing of Web site which is efficient in attracting visitors and potential customers, and in converting them into customers was most probably the most critical and least known aspect of development.

Present structure of Key to Steel Web site is a result of extremely detailed analysis and research work made on specialized literature, various Web sites, targeting groups and users` feedback. Major activities on the reconstruction of Web site according to principles of successful Internet sales lasted 5 months, and it was finished at the end of November 1999. That structure is then once again improved in October 2001.

The most important principle of structuring the **Key to Steel** Web site is **Most Wanted Response** (MWR), which is actually one of the most important principles of Internet marketing in general. **Most Wanted Response** is the reaction that we want to get from potential customer during his/her visit on our Web site, and complete structure of the Web site, with all its elements, must be oriented customer-centric, in order to “deserve” MWR from a site visitor.

By implementing MWR (Order product) as always available to potential customer (“click away”) the efficiency of **Key to Steel** Web site was significantly increased. A step further is made by defining **Backup Response**, which attracts much more visitors.

4.4 Traffic increasing

Unfortunately there is no clear recipe regarding the efficiency of these methods, which in general depends on type of the Web site, type of business, vertical market, profile of potential customers and other factors.

In our case, placing links to **Key to Steel** on Web sites relevant for steel vertical market, such as steel.com proved as significant. Besides that is the most affordable way to become to attract visitors, it can contribute to site popularity in engineering world, especially in a case of good review of some institution with a high credibility (e.g. very positive review of World Institute for Iron and Steel).

Internet search engines are definitely one of the most efficient ways to increase traffic, but it takes months of work to analyse the ways of functioning of the most relevant global search engines, and to optimise keywords that are important for us. However, these activities finally lead to very good ranking on search engines, and to great increase in the number of daily visits to the Web site. Results of other ways of the Web site promotion till now have been much more modest.

4.5 Communication with visitors and potential buyers

In order to monitor visits to the Web site and to collect precious information about potential customers, getting their contact info is defined as **Backup Response**. Of course, to get this information and to create relevant contact database, it is necessary to offer something in return to a visitors. Therefore a demo version of the database was created, which can be searched in a same way as full-featured database, only the amount of data that user can access is lower. This way we gained more than 15 000 registered users in 2 years, and 10.000 subscribers to free monthly e-news, which is impressive figure for this vertical market. Users are coming from more than 100 countries.

Particularly important and delicate issue is how to build credibility among specialists and businessmen worldwide. Groups interested in such products are above average educated, very sceptical and many of them are not familiar with Internet technology. By long-lasting and constant update activities, by launching a program of high-quality technical support provided to all users (not only to customers), **Key to Steel** team earned credibility in global Internet community, and started to gain a new partners. From July 1999, when the first license was sold in to a Swedish customer, a number of customers is growing constantly. Customers come from more then 40 countries, from USA, Canada, to Europe, to Singapore, Indonesia and Tanzania. Customers list include major companies, like Ford, Hyundai, ESAB, Boeing, Algoma, BHP, Apple, Dana, Delphi, Thyssen-Krupp, ChevronTexaco and others, Universities and institutes, and standardization organizations.

5. CONCLUSION

It is forecasted that in the year 2005 between 40 and 50% of the global metal trade will be made through the Internet, with annual turnover of about 400 billions dollars. That is why the similar projects will gain value in next few years, despite the current "dot-com" meltdown and the fact that majority of e-business projects and companies in this vertical market proved to be unsuccessful.

As a result of a permanent work in quality improvement, **Key to Steel** became the world's most comprehensive database in this vertical market. Active online marketing strategy, and mastering Big Three of e-business resulted in growing online sales and customers base worldwide.

This success is, of course, related with some problems, which are slowing it down. In spite of evident progress, the quality and reliability of Internet infrastructure is still not completely supporting such kind of services all over the world. Also, definitely some time is needed for users to widely accept the idea of getting important and even critical data from the Internet. Finally, considering the competence, long-term effort and the resources invested, the number of subscribers is still modest, and therefore costs and investments to such a project have to be carefully managed.

Nevertheless, development and distribution of this kind of products, applicable for professionals in various fields of engineering, can be considered as a very good investment for the future, especially since the interest and readiness of the people for using the Internet is growing daily all over the world.

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USING ToonTalk™ IN KINDERGARTENS

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ABSTRACT

We aim to find ways, tools and/or techniques that allow children in this age span to use programming language concepts to express rules and play with them. ToonTalk, with its visual, animated environment, and program-by-example methodology, seemed a very nice tool to start with.

On this paper, we will present our experience using Portuguese ToonTalk with 7 children (5 were 4-year olds, 2 were 5-year olds), in Vila Real (Portugal) kindergartens, from May to June of 2000.

The most encouraging results, including the children's enthusiasm and the robots they managed to program, will be presented, along with some of the hurdles that require longer, broader research.

KEYWORDS

ToonTalk, concurrent programming, children programming, programming by demonstration, kindergartens

1. INTRODUCTION

Computers have a fundamental presence on our everyday lives, not only as automated elements, reacting to sensors and situations, but as tools that the important ability of being adaptable to different tasks, suiting the needs of their users. This adaptation, by which I refer to the common term “programming”, allows the same tool to do tasks with as little in common as word processing, number crunching, entertainment, etc.

Most users, however, simply use “applications”, programs made by other people. While many applications allow for customisation by the end users, these are skills that elude most of them.

This amounts to an immense wasted potential. Among the most obvious motives, we may quote David Canfield Smith and Allen Cypher (1999), referring to the gap between human communication and computer programming languages as the Grand Canyon. Norman (1986), quoted by Smith & Cypher, proposed two ways of closing this gap: moving the users closer to the system (teaching traditional programming to humans – the traditional way to do things) or moving the system closer to the user (making computer programming resemble human communication). Smith & Cypher recall that traditional computer programming education is hardly a discipline for every user: it requires effort, dedication and persistence (just like learning a foreign tongue). And conclude that computer programming should seek out ways of getting closer to human communication, making it possible for every human being to benefit from the computer tool's ability to be adjusted to different needs. This approach is mentioned in an ACM paper (Myers 1996), where end-user programming is one of the strategic research and development areas pointed.

Thus, in what ways could this skill be introduced in pre-school contexts? Modern pre-school education, rather than focusing on a curriculum, aims to give children basic skills that allow them to more easily and fully develop their personal worldview and self-learning ability. It seems to us perfect sense to give children the possibility to discover and develop programming skills, centred on learning how to state rules, how others (a computer, for instance) would follow them, and how different rules would interact with each other.

2. PRELIMINARY ISSUES

The preschoolers' limited ability to conceptualise rules and abstractions may be considered, from a broader perspective, to be the main issue at stake. However, perhaps the most obvious hurdle regarding the introduction of computer programming concepts in preschool is the absence of basic reading and writing skills. Although this is a purely technical computing hurdle, and icons or logography-based writing can be used as means of expression for the "programmer's" intentions, it seemed to us that in order to better reach to some conclusions we required a way to allow children to better express their desires.

Using drawing boards as a way to design programs (having a computer educator translate children's drawings into programming, i.e., being an "human compiler"), resorting to physical, theatre-like plays or developing graphical programming tools, suited to our research needs, all were possible starting points.

Luckily however, our initial bibliography and software review showed that we were not alone in this desire to bridge the gap between children and computers. And albeit works dealing with preschool children and programming are fairly limited (ex.: Perlman 1976), some of the methods and tools being used with older children seemed suitable enough for the initial phases of our research. Two programming tools in particular drew our attention: StageCast Creator (previously called Cocoa), and ToonTalk. Among the papers describing these systems, we may point out the ones by Smith & Cypher (1999) and Kahn (1996).

3. THE ToonTalk™ OPTION

ToonTalk is an animated programming language: the code is "animated" as in an animated cartoon, hence the name; in computer science terms, it is an implementation of a concurrent constraint programming language (Saraswat, 1993). In ToonTalk, children control an avatar moving in a city (metaphor for the entire computation). The city has houses (agents, actors, processes or objects), where robots (methods) can be programmed. The programming employs objects such as boxes (tuples, arrays, vectors or messages), scales (comparison tests), trucks (agent spawning), bombs (agent termination), notebooks (program storage), text and number pads (constants), and birds and nests (channel communication). Robots are programmed moving them with the mouse and performing the required actions (method actions), inside their thought bubbles. After training a robot the method preconditions are visible as the thought bubble of the robot.

From the very start, ToonTalk seemed to us to be the most adequate tool for the target age group (3-5): -

- it employs larger control elements, being more easily controlled by children which are still developing mouse-control skills;
- it seemed to be more easily configurable (by developing objects and behaviours within ToonTalk itself) than StageCast Creator, which could allow us to program situations and elements as required, therefore lessening the risk of having to change the programming environment to suit the research requirements;
- it requires the use of only three mouse skills: moving, clicking and dragging, against the more full array required by StageCast, which also employs click and hold, and right clicking;
- several of its functions could be reached by pressing single keyboard keys, which could allow us, if required, to employ keyboard overlays or conceptual keyboards.

In our view, StageCast Creator's main strength is the way it allows a child to devise a story and specify simple behaviour rules in a simple fashion. However, the need to devise rules for all circumstances that might arise, and the overall look of the application (which, albeit simple, we feared might prove too complicated for widespread usage by preschool children), also contributed for our option to use ToonTalk.

Finally, ToonTalk and StageCast Creator aren't completely language independent: ToonTalk, for instance employs a talking "Martian" as a help system; also, some behaviours of its controls are language-dependent (the button that makes the bike pump enlarge or shrink objects, for instance, has the letter B –big – or S – small – on it). And several elements on the StageCast Creator environment are also language-dependent. Having these language-dependent elements in English would be yet another hurdle for Portuguese-speaking children. This also tipped the scales towards ToonTalk, whose European Portuguese version was launched in May 2000.

3.1 The initial session duration assumption

In May 2000 (release of the European Portuguese ToonTalk), three Vila Real (Portugal) kindergartens wished to cooperate in our research: As Árvores (AA), S. Pedro Parque (SPP) and Araucária (AR). In each, two children were selected by the kindergarten teachers, for weekly ToonTalk sessions, until the end of June.

Based on our experience with computer activities for children of this age, we opted for 10 to 20 min. sessions. Usually children start to get fed up, when computing activities take longer. We intended to try out this assumption by having 10-min. sessions in SPP, 15-min. sessions in AR and 20-min. sessions in AA.

However, from the very first session, this assumption proved to be wrong: children loved the ToonTalk environment and didn't feel bored at all! In fact, we felt more time was required for adequately exploring the children's ideas and let them practice ToonTalk skills. Table 1 details the evolution of time occupation.

Session	Date	Start time	End time	Duration
S. PEDRO PARQUE				Average duration: 19 min.
1	May 2 nd , 2000	11h42	12h03	19 min.
2	May 23 rd , 2000	11h37	11h58	21 min.
3	June 5 th , 2000	11h43	12h00	17 min.
4	June 8 th , 2000	14h23	14h45	23 min.
5	June 12 th , 2000	11h50	12h00	10 min.
6	June 15 th , 2000	11h35	12h00	25 min.
ARAUCÁRIA				Average duration: 34 min.
1	May 30 th , 2000	11h00	11h17	17 min.
2	June 15 th , 2000	10h30	11h15	45 min.
3	June 20 th , 2000	10h45	11h25	40 min.
AS ÁRVORES				Average duration: 28 min.
1	June 9 th , 2000	15h20	15h50	30 min.
2	June 16 th , 2000	10h45	11h20	35 min.
3	June 19 th , 2000	10h30	10h50	20 min.

Table 1 – Time occupation along the several sessions

As we can see, our 10, 15 and 20-minute groups fell, almost immediately, into 20, 30 and 35 minute groups! And the 40-minute and longer sessions made us realize that actual 45 minute to 1 hour sessions were most likely viable. (This was, in fact, the base for the sessions during the following year's research.) It is worth mentioning that session 5 in S. Pedro Parque was shorter than usual due to hardware problems and session 3 in As Árvores was abbreviated, because it was end of year play rehearsal. Counting out these sessions, the average duration rises to 21 and 33 minutes.

3.2 Research Focus

Given the small number of sessions that could be performed before summer holidays ensued, we decided to focus them on two main issues: -

- ability to use ToonTalk's method for generalization, given children's limited abstraction skills;
- results yielded by a directed approach, against a coach-style approach.

The first issue was key for further experiments with ToonTalk, since the children's inability to use generalization would severely compromise any options of rule programming for generic circumstances.

The second issue was aimed at how we should proceed with the sessions on the following year: directed (i.e., proposing activities and conducting children on how they might achieve them) or coached (letting children choose what they want to do and help them achieve them).

Two different approaches on the generalization concept were used: one on S. Pedro Parque, another one on Araucária. The directed approach was used on S. Pedro Parque and Araucária, while the coached approach was used in As Árvores.

4. ACTIVITY FOR DIRECTED SESSIONS: THE EXCHANGER ROBOT

Directed sessions were based upon a simple activity: programming an “image-swapping” robot, i.e., one that takes two images and then exchanges their places.

This can be achieved by placing two boxes in the ground, so that they are combined into a two-hole box; different images are then placed on each hole (in our sessions, we used a tree and a flower). Upon giving this box to a robot, we float into its thought bubble, where we can command the robot with the mouse. The robot then is made to pick the flower and drop it outside the box. Then, it is made to pick up the tree and drop in the hole previously occupied by the flower. We conclude the robot’s programming by making it pick up the flower and place it in the hole previously occupied by the flower.

This robot can then be generalized by setting ToonTalk’s vacuum cleaner tool to “Clean” status, under which it “erases” the surface of images on its thought bubble, leaving only a generic, blank picture. However, setting the cleaner to “Vacuum” status, we can vacuum the entire images from the thought bubble, and this also generalizes the robot (the only difference being that by cleaning images the robot still requires that images are provided; vacuuming them makes the robot accept any object).

We used the vacuuming approach, since it is visually simpler, while still allowing us to evaluate the generalization issue.

5. THE CHILDREN

In order to ensure the children’s privacy, we will refer to them by their first name initials (table 2).

KINDERGARTEN	CHILDREN	AGES
S. Pedro Parque	Z (boy) and O (boy)	5 and 4
Araucária	M1 (boy) and R (boy)	4 and 5
As Árvores	J (boy), M2 (girl) and S (girl)	4, 4 and 5

Table 2 – Children identification and ages

6. INITIATION – DIRECTED SESSIONS

We went over the initial ToonTalk environment: identifying the helicopter as such, and training its controls; controlling the hand with the mouse and noticing that it made the object under its pointing finger shake; identifying robots as such and learning that the cloud near the robot’s head was a thought bubble, which contained the robot’s thoughts. Instead of exploring the tools (vacuum cleaner, bike pump and magic wand), the children were led straight into robot programming, learning skills along the way: box manipulation was practiced, but used afterwards to provide parameters to a robot, for instance. Parallel activities (getting pictures from the notepad, shrinking the tree), were conducted in front of them, and sometime by them, but not always part of the children’s activities. The robot programming for performing picture swapping was demonstrated on the first session, and on following sessions replicated by the children.

This is the full list of actions done entirely by the children, while replicating the first session’s demonstration (only action they didn’t execute: picking up the book with images from within the larger one):

- Pick up and drop a robot, then pick up and drop a box.
- Pick up another box and drop it over the border of the first one.
- Seek a tree in the images book, and pick it up.
- Set the pump on the "P" for "pequeno" (“small”) and shrink the tree.
- Place the tree in a hole, in the two-hole box.
- Seek a flower in the images book, pick it up and place it in the box.
- Hand the box to the robot.
- Inside the robot’s thoughts, perform the image swapping.

7. GENERALIZATION – APPROACH 1: EXPLANATION

In S. Pedro Parque, after programming the exchanger robot, the children tried it out, to see that it would only work with the tree and flower in the right positions. Then we explained to them that cleaning the images from the thought bubble would prevent the robot from being so fussy, and demonstrated the method.

This approach yielded no result whatsoever: the children only got confused. Therefore, we simply played around with some ToonTalk elements (trucks, bombs), to avoid pushing the concept through.

On the following session, a theatre-play approach was used for presenting the explanation, using the following physical material as stage props: two square baskets, similar in colour and size to the ToonTalk boxes; an A4/Letter sheet of paper on which we drew a thought bubble with a ToonTalk box (figure 1); two paper squares, one with a tree, another with a flower, attached to the thought bubble's box with scotch tape; two empty A5 sheets of paper (half of a A4 sheet); six markers: 2 black, 2 yellow and 2 green.



Figure 1. the A4 sheet for the robot's thoughts



Figure 2. the A5 sheets for the blue baskets.

The robot's generic behaviour was shown to the children again, which were completely puzzled over it. We then initiated the "robot" play. The children used the markers to draw a flower on the A5 sheets (figure 2), while we drew a tree. One child would play the robot, holding the A4 sheet over his head; the other would fill the baskets with pictures and hand them to the "robot". This way, the child playing the robot would have to check his "thoughts" content before proceeding, which we hoped would help clarify the robot's behaviour.

Only one issue was detected: the child presenting the baskets would have a different perspective of left/right than the robot-playing child! We overcome this problem by acting as "in-between" traders, which would turn the baskets; this would ensure they both had the same left/right perspective.

All worked fine: they would check the thought bubble sheet, and the robot would only exchange the pictures when they matched. However, when we pulled off the taped pictures from the thought-bubble sheet, leaving only the drawing of an empty box, a curious behaviour ensued: the robot-player started to exchange the images continuously, without looking at the thought bubble to check their applicability! He was mimicking the apparent robot behaviour. Clearly, the concept of "entry parameters" or conditions, while clear for concrete examples, was completely disregarded for the abstract case of generalization.

A future experiment about generalization could be done in the following way: let us suppose that the flower-tree exchange was to occur within a 3-hole box like [flower | tree | truck] and the generalized version after vacuuming was [| | truck]. Will the children check the thought bubble while playing the robot game (since they will have to check that a truck is still there even though this robot doesn't use it for anything)?

8. GENERALIZATION – APPROACH 2: USEFULNESS

At Araucária, whose sessions started after we had completed two at S. Pedro Parque, we wanted to use a different approach. After a child expressed his wish to make a robot exchange a truck with a bomb, we decided to try and have children program robots to exchange flowers and trees, and robots to exchange trucks and bombs, leveraging generalization as a time- and effort-saving technique.

The programming of robots with distinct entry parameters allowed children to more easily understand the robot-programming concept, but also allowed us to present the case of both robots being, in fact, doing the same thing, except being too picky. The vacuum method of generalization was then presented simply as a time- and effort-saver, allowing us to avoid the pickiness of the robots. We expected this to yield more success than the approach at SPP, but the success surprised us: children saw this as obvious, as a perfectly natural way to do things. Even though the experiment ground was extremely limited, due to time constraints, this nice result, with two children (a 4-year old and a 5-year old), raised our expectations regarding the possibility of larger-scale use of ToonTalk for definition of rules involving generalization.

9. INITIATION AND DEVELOPMENTS – COACHED SESSIONS

In the coached sessions, the children could decide what they wanted to do, and only sporadic suggestions were presented. A much larger focus on the interface tools occurred (the most visible elements in ToonTalk). Birds and nests were also prime attention targets, since they provide a highly animated, amusing activity.

After the initial session, which allowed them to explore these basic activities, we introduced the concept of robot programming. Their choices of programs were more or less connected with the tool manipulation activities: J wanted to make a robot to clean up the room (we directed him to program a box-cleaning robot, specialized on boxes with nests) and M2 wanted to make a tree-chopping robot! Although we could simulate this quite easily, taking advantage of small pictures to crop a larger tree picture, J had unintentionally limited access to the picture book, so M2 ended up using our unoriginal improvised suggestion of an exchanger robot. S decided that she also wanted to make a box-cleaning robot, only specialized on cleaning up bombs from boxes.

These two sessions were the only coached session we managed to fully conduct, because the last one fell on rehearsal day for the end-of-year party. However, on this last, very short session, we still discovered that S, while not being too active in the previous sessions (J and M2 more or less took over control of the mouse), enjoyed playing around with ToonTalk to the point of not leaving it to eat cakes and refreshments along with the other two children: instead, she was creating birds, moving objects around, enlarging and reducing them... Playing, plainly.

The main advantage of this coached approach, it seemed, was the greater control over ToonTalk's objects and tools, and an overall greater ease of operation. However, robot-programming experiments were very simple, and therefore inconclusive. It was encouraging for us, however, that even a quiet child like S would prefer playing with ToonTalk over cakes and refreshments, and that two more active children like J and M2 would be active while at the same time focused on ToonTalk. This coached approach seemed promising enough for further, more lengthy experiments to be conducted over the following year.

10. FURTHER DEVELOPMENTS – DIRECTED SESSIONS

On both kindergartens where directed sessions were conducted, the robot programming and generalization trials were done on the initial two or three sessions. Therefore, trying to collect further information on children's reactions to the several ToonTalk elements, we decided to introduce birds and nests, to check out the children's response. Since these children had already been introduced to robot programming, we combined bird use with robots, to achieve more dynamic (and hopefully enticing) results.

As expected, birds were a success: children loved playing with them, given the rapid response and animation.

On Araucária, where a single robot-and-bird session was conducted, M programmed a robot that would send boxes of robots, endlessly, into a bird's nest. And, most strikingly, had the intuition that by copying a nest, its bird could carry things to both copies. This was a surprising and most encouraging result.

On S. Pedro Parque, we had the opportunity to conduct three sessions with birds. On the first one, we simply went over bird-carrying: using birds to clean up the room into their nests, for instance, and also trying to give the birds different objects. For the following two sessions, only Z was available, and this allowed for more elaborate activities.

On the second session (only 10 minutes long, due to hardware problems), we introduced Z to the concept of working with nests in a robot's boxes (entry parameters). On the third session, we told Z that he could use an exchanger-like robot and combine it with birds. So he programmed a robot that would pick a flower from a box and give it to a bird in another box. This allowed us to suggest to Z that he could place the bird's nest on the box with the flower on top. And Z quickly realized, which we confirmed by questioning him, that this would allow the robot to keep juggling the flower endlessly.

Finally we suggested that he could create a second robot, which he did (copying it with the magic wand) and cross the parameters between them – therefore creating the effect of two robots sending a flower to each other. While we had to perform this last, more complicated procedure, he was following it with keen interest – not like the puzzling situation of generalization at all. This final, briefly appreciated result also encouraged us to pursue ToonTalk activities with young children, with some expectations regarding the degree of complexity they may achieve on a larger number of ToonTalk sessions, spread throughout the year.

11. CONCLUSIONS

ToonTalk is quite a success with children from the entertainment point of view; they enjoy playing with it, even if only by using the provided manipulation tools. The existent generalization techniques seem viable, if presented in a usefulness context; and we have collected nice indications regarding the amount of rule complexity it allows children to grasp, which prompted us to follow up with further, lengthier sessions and research in the following year.

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THE TUTORIAL PRACTICE IN DISTANCE LEARNING AND THE DEVELOPMENT OF CO - OPERATIVE LEARNING

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ABSTRACT

The text approaches one of the most important aspects of the Distance Learning: the tutorial. It leaves of the co-operation concept, developed by Piaget, that explains as an intellectual operation can be shared among subjects that have as objective solves some cognitive task. If they pawn in the resolution the subjects they throw hand of their intellectual abilities, of their action outlines for us to reach the solution of the enterprise and, in uncoiling of their interactive actions, they build knowledge simultaneously collective and individual. It presents the tutorial as a possibility of breaking the limit (constraint) of the virtual and to attribute the due importance: an action "competent" and co-operative tutorial can minimize one of the largest risks of the courses supplied at the distance, the students' escape.

KEYWORDS

Distance Learning ; Collaborative Learning; Piaget's Theory; Tutorial.

In the educational imaginary is present an incorrect idea: Distance Learning (EAD) needs less the teacher. This idea is unfolded in faiths as that the virtual ways of learning substitute the teacher, or that it is enough a good didactic material to construction of concepts.

To illustrate the tutorial importance in EAD, we took the placement of Armengol (1987, p. 22-24), that presents a correct characterization of this Education, under summarized:

- student population usually adult and disperses;
- pré – produced courses using texts printed, among other didactic resources, massively produced;
- courses that promote the independent and autonomous learning and stimulate the individualized study;
- use of communication resources, organized in two directions, among the students and among the students and the center that produced the course;
- communication mediated by the tutor;
- growing use of "technologies of information and communication" (TIC);
- flexibility of curricular structure;
- and decreasing costs for student, established after an elevated initial investment (derived of production and elaboration of didactic material, production of the physical atmosphere and the establishment of distribution and transmission conditions for the courses.

The author speaks about a communication with emphasis in the dialogue, although there is the physical distance between the teacher and the student, showing a deep change in the pedagogic relationship. Stays,

need of somebody that accomplishes the mediation between the student and the knowledge in an effective way.

The tutor that approximates the students with "technological content", necessary to the autonomous traffic in virtual atmospheres of learning, guaranteeing what is essential in the Education the Distance: an educational strategy found in the use of new technologies, in the incentive to the flexible and operative cognitive structures and in pedagogic methods that allow conditions as time, space, occupation and students' age, fundamentals for learning.

The emphasis in interaction learning models is due the increase of resources and processes for support of the communication between teacher and students. Parallel, it increased the importance and the value attributed to the tutorial processes.

An universal model of tutorial doesn't exist, have been varying tutorial modalities: the present, for correspondence, for telephone, for fax, by the Internet (in chats, or through messages changed by e-mail).

Negroponete (1995) indicates that this happens in a "digital world" and a time that Sancho Gil (1995) calls was "the time learning", in that better is shown capable to learn survives in better conditions.

In Distance Learning also exists a didactic triangle relationship. Is a vertex constituted by the student, other for the teacher / tutor and the third for the object of the knowledge (concepts to be built). Of this dynamic triangulation it elapses the need of strategies different from the relationship traditional teaching – learning, but that also propitiates the analysis, and the reflection.

They are several classifications, listings and "bulls" of attributions, procedures, strategies and methodologies proposed for the tutor. The fundamental objective of tutorial, as of all educational activities, is the promotion of learning. In tutorial are privileged the communicative action, the dialogue, the cooperation and the incentive to the metacognition. We took for base the tutorial interventions, proposed by Rinaudo, Chiecher & Donolo (2002).

The authors analyze six interventions of the tutor in contexts of Distance Learning:

- of organization - they aim at the handling of the time established for a course, and orient student's development;
- of "feed back" - they give feedback to the student and consist in a valor judgement of the tutor and offer new information;
- of answer to requests of the students' help - supply of information, in response to demands presented by the students;
- for change information about documents - request or offer some information about documents and materials linked to Distance Learning;
- for change of information about technical aspects - punctuate some subject of technical character, and that it affects the communication;
- "off topics" - interventions no linked to the content of the course or have Distance Learning as theme, but to several subjects – the relationship between the members of the group or comments on the general context.

The tutor has three great functions:

- to intervene systematically in the process of the student's learning, correcting deviations and explaining doubts (orientation);
- to monitor and to advise, tends in view the improvement of student's productions and of their progresses, in the construction of the knowledge (attendance);
- to evaluate the mentioned progresses, in function of criteria previously defines and awake with the group (evaluation).

We can affirm that the tutor accompanies, guides and it "encourages " the process of construction of the knowledge, individual as in group. He stimulates learning processes, inducing, supporting, monitoring and including pleased learning situations. As in all the transformation didactic action, it should center his action in the incentive to the reflection, to the critic and the constant application of the learned concepts to new contexts, promoting the construction of the *praxis*.

In this context it wins relief the co-operation concept, as it was developed by Piaget, that explains as an intellectual operation can be shared among subjects that have, as objective, to solve some cognitive task. The subjects use their intellectual abilities, for to reach the solution of the enterprise. In elapsing of their interactive actions, built the knowledge simultaneously collective and individual. As these intellectual actions don't happen in empty subjects of histories and experiences, he looked for to elucidate the different present dimensions in the human activities.

For Piaget, the knowledge is a process and, as such, it should be studied in a historical way. For this reason, his Epistemology is not satisfied with the answer to the question: how is the knowledge possible? He goes beyond, intending to study as seedling and the knowledge develops. The author defines the Genetic Epistemology as the discipline that studies the mechanisms and processes by which he happens from the states of less knowledge to the states of more advanced knowledge (Piaget, 1972, p. 16).

However, to say that the subject should be approached genetically is not enough, to know that papers carry out the subject and the object in the knowledge process. For Piaget, this process is fundamentally interactive. Like this, if the knowledge is fruit of an interaction between subject and object, it will be essentially a construction.

In other text, Piaget points us the investigations developed in Epistemology Genetics International Center that took him to conclude that the transformations possess the key of knowledge. (1995, p. 120)

Opposing to a conception, second which the Real would have a preset existence and absolutely true, independently of our action, Piaget affirms that the Real, in spite of the immense number of discoveries that enrich it unceasingly (in the child and in the sciences) is in growing intersection with the possible and the necessary, for his largest benefit.

Their investigations turned on a important problem for the Epistemology, however also for the Psychology of the intelligence and, more recently for Distance Learning: the opening of new cognitive possibilities. This is, in fact, the central problem of the Construtivist Epistemology: the construction or creation of knowledge, than it still doesn't exist, except precisely in this virtual state of the possible.

The investigations show that, with the continuity of cognitive experience, in general co - operative also with the children's growing age, it happens an increase of number of possibilities invented by the subjects, having a jump ahead in the level of the mental operations . That it takes the people to understand that, for some problems, infinite possible solutions exist and it characterizes the search of new solutions, starting from structures (traditions) previously reached.

Piaget postulates the existence of two subjects. The subject of the possibilities - differentiation of the repertoire - a free subject, since inside of their limits, it can the best and the most varied, and the subject of the need that is limited for sex, culture, development level, and that, when discovering their possibilities, will give forms to the contents and vice-versa.

He underlines that the Real don't exist as something absolutely true, as well as the own truth it is an impossible that if it turns possible for the men through the use of the languages. With the knowledge it is not different: to learn means to transform it continually in contents for us, and his existence acts as a generating limit of possibilities and needs to our thought.

The tutorial is more a tool of interactive teaching. Since the elaboration of the pedagogic project of a course in the modality EAD we are moving through the "road" of knowledge construction, and building teachers in this new virtual space. Is logical and coherent to project for the atmosphere of Education the Distance an interactivity with the students and classes, based of Piaget's concept of co-operation.

In this context, the tutorial is projected as another form of sharing mental operations with the objects of knowledge. After all, this is the co-operation sense - an intellectual partnership among subject of possibilities and of limits.

The co-operation surrounds the actions of the subjects (teaching and learning) freeing them of the immediate reality and propitiating an opening and enlargement in their repertoires of learning.

Although we are moving ourselves in the virtual atmosphere, tutors and students' co-operative actions happen in the Real, lending to the reality of the teaching and of the learning a new quality: the possibilities to mean culturally the knowledge objects.

Inside of virtual reality, and for her mediated, tutors and students have the virtual as limit. The original term for limit is "*constraint*" - recent concept, original of the idea of Vygotsky (1989) of "instrumental developments", second the which the man, being limited in his physical force, developed instruments, as the axe and the knife, to have more force. The instrument of deed as stable and more permanent message, that reduced the distance between originator and receiver message. The co-operation is imposed, opening more potent possibilities of learning. Like this, the limit (*constraint*) forces a re - elaborate the interior and external knowledge, symbolizing and giving him felt.

A lot has discussed on the teaching and about the art of teaching. We thought that were never so close to accomplishing this art with Distance Learning, for the infinity of tools that are to our disposition for be created, since the man's encounter with the virtual world is just beginning.

We take borrowed ideas and concepts of some authors, besides Piaget, because we intended to put the importance of the structural elements of culture as indispensable limits for the knowledge in Distance Learning.

In recent times, other positions were developed with regard to the relationship between development and education. Among the most captivating are Lev Vygotsky, Jerome Bruner and Clifford Geertz. They contribute for a new consideration concerning as the learning already codified by the last generations. Newer people have the opportunity to enter in dialogue with the culture, for the elaboration of *insights* obtained already. (Gardner, 1994, p. 227)

We hoped this co-operative vision of the tutorial process can introduce to the tutors and others involved in the exciting theme of EAD, in the role as effective mediators of the contents to be taught and of the "technological contents", inherent to the technologies education maids.

times due to the found difficulties and of the small familiarity with the virtual atmospheres of learning.

A "competent" and co-operative tutorial action can minimize one of the largest risks of the courses supplied at the distance: the one of the students' escape, preoccupying factor and that it takes to the emptying of extremely rich and interesting projects in EAD.

Zapata Ros (1997), in text that approaches the cooperative learning, affirms that the incorporation of technological means to the Education don't implicates in a mere adaptation of conventional models, but in the establishment of deep changes in the way of teaching - didacticism and appropriate methodologies to the digital nets - and in the use of the constructivist paradigm of learning.

The teaching process is centered in the apprentice and the means and resources integrated in a compound support system to the learning. The performance of the tutor, guaranteeing an education philosophy and that it integrates the co-operation idea, becomes indispensable.

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PI-BOOK: COLLABORATIVE LEARNING TOOL AT A MUSEUM

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ABSTRACT

Collaborative learning at museum exhibition is critical for elementary school pupil to interactively and attractively study new materials. This paper proposes Pi-book: a novel learning tool for the purpose. Pi-book is characterized by that (1) Pi-book is equipped with three kinds of portable devices: PDAs (Personal Data Assistances), CoBITs (Compact Battery-less Information Terminals), and RFID (Radio Frequency Identification) Tags as its user interface; (2) the display animation images at the PDA interactively change in a given situation; and 3) Pi-book guides the users with phonetic information. This paper describes the basic principles, the architecture, and its prototype experimental system.

KEYWORDS

Hand held devices, CoBIT, Museum Exhibition, Collaborative Learning, Animation Display

1. INTRODUCTION

So far, hand held devices such as Personal Data Assistances (PDAs) have been considered to be individual information management tools, however, they are also useful for collaborative learning for elementary school pupils. Science education in Japan in recent few years requires new curriculums to engage students by self experiments and observations outside the classroom lectures. This means that the roles of science museum will be much more important[1]. However, exhibition at most museums is unattractive and too difficult for them, thus, they fail to keep their motivation.

Based upon the background, we are conducting a joint research project to develop a novel collaborative learning tool at exhibition for science education. So far, we have developed Musex: PDA-based collaborative learning system with question-answering interfaces. The experience has suggested that such collaborative learning systems are useful for their interaction, however, static and character-based information provided by Musex are not enough to deeply understand what they really provide.

This paper reports a novel tool Pi-book to improve the defects of Musex. Pi-book attempts to provide pupils with book-like devices for the learning. To cope with the defects, Pi-book is equipped with three kinds of portable devices: PDAs (Personal Data Assistances), CoBITs (Compact Battery-less Information Terminals), and RFID (Radio Frequency Identification) Tags as its user interface; (2) the display animation images at the PDA interactively change in a given situation; therefore 3) Pi-book guides the users with

phonetic information. This paper describes the basic principles, the architecture, and its prototype experimental system.

2. SYSTEM ARCHITECTURE OF PI-BOOK

The architecture of Pi-book is shown in Figure 1.

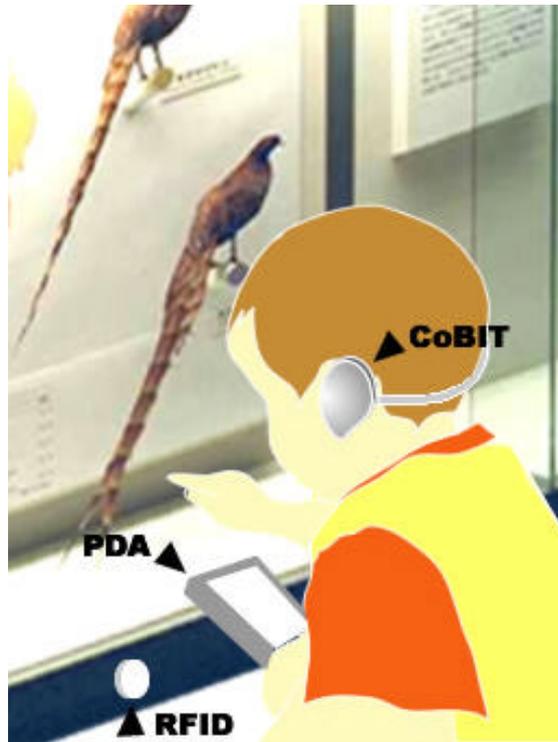


Figure 1. System Architecture of Pi-book

3. EXPLANATION OF COBIT

CoBIT, Compact Battery-less Information Terminal, can communicate with the environmental system and with the user by only the energy supply from the environment. [2] It has a solar cell and gets a modulated light from an environmental optical beam transmitter. The current from the solar cell is directly (or through passive circuit) introduced into an earphone, which generates sound for the user. The current is also used to make vibration, LED signal or electrical stimulus on the skin. The sizes of CoBITs are about 2cm in diameter, 3cm in length, which can be hung on ears conveniently. The cost of it would be only about 1 dollar if produced massively.

The CoBIT also has sheet type corner reflector, which reflect optical beam back in the direction of the light source. Therefore the environmental system can easily detect the terminal position and direction as well as some simple signs from the user by multiple cameras with infra-red LEDs. The system identifies the sign by the modulated patterns of the reflected light, which the user makes by occluding the reflector by the hand. The environmental system also recognizes other objects using other sensors and displays video information on a nearby monitor in order to realize situated support.

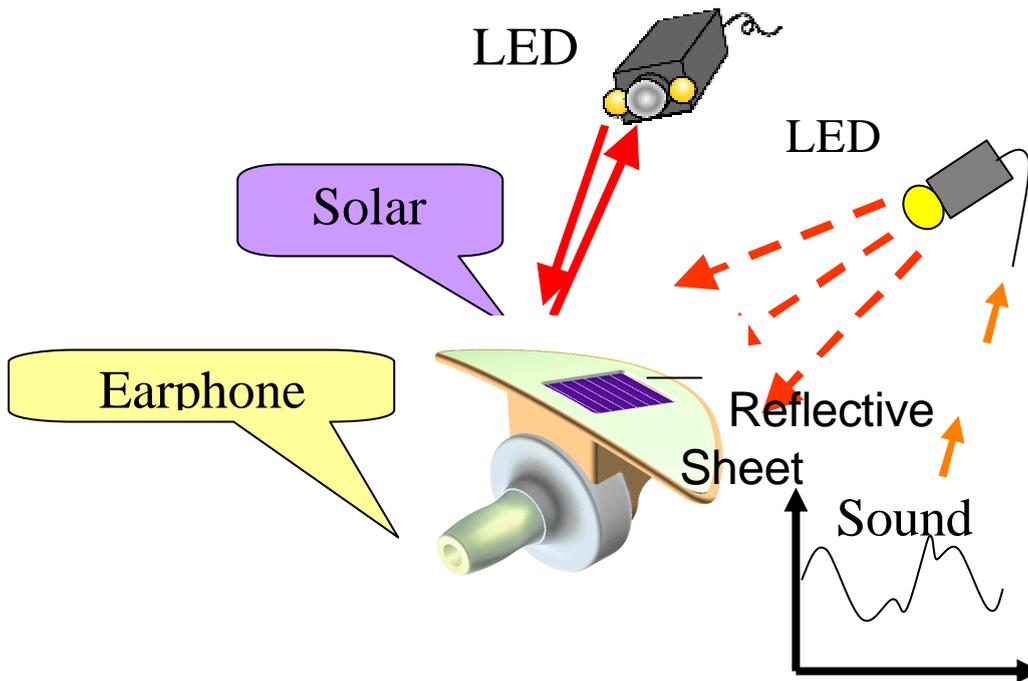


Figure 2. Configuration of CoBIT System

4. HOW PI-BOOK WORKS AT EXHIBITION

Pi-book is a hand-held tool using PDAs, RFID tags, and CoBIT. RFID tags are set to PDAs accordingly. Users or pupils will rent the devices at the registration desk of a museum and explore the exhibition. Every PDA installs Macromedia Flash Player as interactive software. Pupils handle the animation via standard web browser. Every exhibition place also has both light sensors to get CoBIT information and RFID reader/writers to get RFID information.

Pupils wear CoBIT devices shown in Figure 3 and walk around the exhibition hall. When they approach to appropriate exhibitions, they can listen to the corresponding phonetic explanation through the CoBIT device. The explanation contains the information about how to retrieve the PDAs. According to the explanation, they retrieve PDAs.

The sample PDA screens are shown in Figure 4. The left-hand side of the figure displays when pupils approach their PDA with a RFID tags toward RFID reader/writers equipped near the corresponding materials. The display shows the mimesis of hyllium pulchrifolium. Pupils will select the two materials which they consider to have closed relationships between them. The relationship is illustrated by the yellow line. After the operation, the display image is changed to the right hand side of Figure 4. The image explains 5W1H of the information of the material exhibited.

Attending these listen-select-read cycles at science museum, pupils are collaboratively learning about the exhibited materials in a very natural and simple manner. Phonetic information is a cue to find interests about the materials. RFID tags and reader/writers are used to anchor their interests to the exhibited materials. PDA animation attracts their interests to study scientific matters.



Figure 3. Wearing CoBIT Devices



Figure 4. Animation Display about the Exhibited Materials (Left: The mimesis of hyllium pulchrifolium ; Right: The behaviors of butterfly)

5. CONCLUDING REMARKS

In this paper, we have described the principles, architecture, and usage of a novel collaborative learning tool for science education at museum exhibition. Future work includes (1) to carry out intensive experiments about how effective Pi-book is for science education, and (2) to extend our architecture to the other task domain for pupil education. And We will improve many kind of interactive learning contents at museum.

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MECBRAILLE – AN ONLINE POST-OFFICE FOR BRAILLE LETTERS

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ABSTRACT

MECBraille is an experimental online service created to convert to Braille medium sized texts such as letters, print them on Braille embossers and mail it as a cecogram (free letter for the blind) to the addressee indicated by the user. In this paper we briefly present the service, analyse the results from nine months of activity, and define our future goals.

KEYWORDS

Accessibility, disability, Braille, cecogram, electronic transcription.

1. INTRODUCTION

While we live in a time where electronic mail usage and digital information becomes increasingly common, many people still have great difficulties accessing information or communicating with a remote correspondent. Among these people are many blind people, namely when they have no access to electronic information and communication systems, or when the information they need is not electronically available. In both cases they remain dependent of printed Braille.

Unfortunately, printed Braille versions of such trivial things as letters, restaurant menus, or schedules are rare in Portugal. The service we present here — MECBraille, with Portuguese acronym “MEC” standing for “Electronic Mailbox” — is the first Portuguese attempt to respond to this need. It enables people with no knowledge of Braille or people for whom it’s not economically justifiable to buy a Braille printer to convert small letters and other documents (up to 2000 characters) to the printed Braille format, with the result being delivered as a cecogram to the desired addressee. A cecogram is an open postal item containing a letter or document written in the Braille alphabet for the blind, and clearly identified as such, whose delivery is free of charge according to international postal agreements and regulations; in Portugal this service is provided by CTT, the Portuguese postal company.

This paper is a work-in-progress report, briefly presenting the system *modus operandi* (from the user’s and from the manager’s perspective), and analysing adherence (in terms of registered users and letters posted) during the first nine months of experimental activity. From the collected data, important conclusions and leads for future developments were derived, namely those related with the interest and limitations of such a service, and human resources and equipment needed.

It is a further purpose of this paper to contribute to a wider promotion of this accessibility idea and the possibilities it opens for the blind. The only similar initiative that we know of is HotBraille (www.hotbraille.com), established in the USA in 1999, from where we drew the inspiration.

MECBraille is accessible through CERTIC (www.acessibilidade.net). At the time of this writing version 2 of MECBraille is under development.

2. THE ONLINE POST-OFFICE

The MECBraille online post-office consists of two parts: the standard online user and manager interfaces (the front office), based on ASP and SQL on IIS running on a Windows NT platform, and the transcribing, handling and posting service (the back office). To avoid confusion, from here on “e-posted message” refers to a message electronically posted by the user to the MECBraille system, while “posted letter” is the Braille printed version of the former that was posted as a cecogram.

The user interface includes the registration page, the page for writing and e-posting new messages, and other informative pages. The user logs in using the password sent to the e-mail address provided during registration, fills in the addressee’s name and address (being mandatory, in this experimental phase, that it be located in Portugal), writes the desired text (limited in this phase to 2000 characters per message) and e-posts it to the system.

The manager interface includes housekeeping options, such as managing users and passwords, managing messages (Figure 1), notifying all or individual users of important occurrences (like changes in the service or returned cecograms), and statistics.



Figure 1. Listing messages for printing from the manager interface

The back office comes to action when the manager chooses a message for printing (Figure 1). The interface invokes Index Braille’s WinBraille, a driver for Braille printers (or embossers) that transcribes text documents into Braille (twenty-five different languages are supported). The text that is actually embossed includes a header explaining the addressee what MECBraille is all about and identifying the sender. The resulting sheets of Braille text are then inserted in an envelope, identified as a cecogram sent by CERTIC, and posted via CTT.

3. USERS ACTIVITY ANALYSIS

In this section we briefly analyse the results of the online post-office’s first nine months of experimental activity, from February to October 2002. The statistical data focus on the number of users and their geographic location, the number of letters posted, their origin and destination. With this we hope to give at least a sketchy idea of the impact of this ongoing, experimental project. Considerations on its usefulness and limitations, derived from the data presented here, are addressed in the conclusions.

The online post-office was set up for preliminary testing on February 2002. During this phase users could register, log in and e-post test messages, but no letters would be printed and posted to the supposed addressee. The experimental operational phase — with the messages actually being transcribed to Braille, and letters printed and posted — started the next month.

Table 1 shows the user activity during these nine months. In terms of new users, more than thirty registered each month during the first trimester, with a maximum of fifty-two in March. In the following months these values would drop and settle around an average of seven new registered users per month. This deceleration in the increase of registered users would not, however, greatly affect the average number of

letters posted per month, which lies around twenty, with a low variance during that period, if we exclude the two months traditionally reserved for vacation.

Table 1. New registered users and posted letters per month. The latter does not include test messages received during the preliminary test phase or messages whose addressee was located outside Portugal, which were not printed and posted

	Month									Totals
	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct	
New registered users	33	52	32	16	6	6	6	9	8	168
Posted letters		23	29	24	19	11	7	21	22	156

In Table 2 we can see that only forty-six percent of the registered users actually e-posted at least one message after registration, thus becoming “effective users”. That same table also shows the regional distribution of users: though present in all regions of Portugal, roughly forty-four percent of them lie in the Greater Lisbon area. This may be related with demographic and socio-economical issues — which lie outside this paper’s scope — but also with the fact that a number of users in the first two months of activity were people from the press (mostly located in Lisbon) testing the system to report on it.

Table 2. Registered and effective users grouped according to their geographic location. Users located in Portugal are further grouped according to their region: Greater Lisbon, Greater Porto, islands of Azores and Madeira, and other regions in continental Portugal. Effective users are those who actually e-posted messages during the considered period

Country	Portugal					Other European	Brazil	Totals
	Region	Gr. Lisbon	Gr. Porto	Islands	Other			
Registered users (R)	155	66	22	4	63	2	10	168
Effective users (E)	72	34	5	1	32	2	4	78
E/R ratio	0.46	0.51	0.23	0.25	0.51	1.00	0.40	0.46

In terms of users located abroad, two came from other European countries (the Netherlands and the United Kingdom), and four from Brazil. The latter resulted in no letters being posted, as the addressees were located outside Portugal.

Of the seventy-four effective users whose messages were printed and posted, about seventy percent were one-time users (refer to Table 3). This type of user, that most often experimented the system out of curiosity, was especially significant in the first months, when the media was reporting on MECBraille and disability-, accessibility- and new technologies-related discussion forums and newsgroups were discussing it. However, some of them, considering some similar addresses that occur, are effectively or probably double-registered users, either because they forgot their passwords and re-registered, or because they registered both with their individual name and the rehabilitation institute they are affiliated with. During these nine months two users were especially active, with eighteen and forty-two messages e-posted each; in most cases where multiple messages were e-posted the addressee was frequently the same, which may indicate an effective need for mail exchange.

Table 3. Users ranked by the number of messages they e-posted. Users were limited to two letters per week. Brazilian users not considered, as letters were addressed to a addressee located abroad and thus not posted

Messages posted	1	2–5	18	42
Number of users	52	20	1	1

It should be noted that during this experimental period users were limited to two letters per week, each not exceeding 2000 characters. This was not critical for most users, and only in one occasion (not considered in the data shown here) did we break these limits. It was not a case of letter exchange, rather the internal regulation of a gymnasium that needed be transcribed to Braille; due to its size, the document was not accepted by the online post-office, and the user in question contacted the administrator via e-mail.

In Table 4 we classify messages according to their size (in characters) and list the occurrences for each category category. As shown, more than one third of the messages exceeded half the maximum size allowed, with almost one fifth in the 1901–2000 characters interval. On the other extreme, nine percent of the messages were less than one hundred characters long — that’s about the size of the sentence before the dash —, which indicates that they were probably just test messages. The average size of all messages received by the system was 1089 characters (about twice the size of the previous paragraph).

Table 4. Number of letters posted for each category of message size (in characters)

Message size	1–10	11–50	51–100	101–200	201–500	501–1000	1001–1500	1501–1900	1901–2000
Number of letters posted	2	4	8	15	36	38	11	12	30

If the Greater Lisbon area is predominant in terms of registered and effective users, its weight is even more important in terms of messages e-posted by local users and letters received by local addressees: more than two thirds of the total in both cases (Table 5). It's also apparent from that same table that most letter exchanges occur within the same region, twenty-five of which with the sender also being the addressee (which indicates a user testing the efficiency of the system). It must be noted, however, that the generic "Other regions" category indeed masks some situations where the sender is, say, from Minho and the addressee from Algarve, hardly the same geographical region.

Table 5. Posted letters according to sender's and addressee's location

Sender's location	Portugal				Other European	Total received
	Gr. Lisbon	Gr. Porto	Islands	Other		
Addressee's location in Portugal	Gr. Lisbon	100	1		7	108
	Gr. Porto	1	5		2	10
	Islands	2	1	1		4
	Other regions	2			31	34
Total sent	105	7	1	40	3	156

Finally, it must be said that an average of one cecogram per month was returned by CTT, mostly due to incorrect or incomplete addressee information.

4. CONCLUSIONS AND FUTURE WORK

With this experimental project we were able to gauge the usefulness of such a service and get an idea of the frequency of user activity. It is unquestionable the need for a service thought up to serve people unable to write in Braille, that converts and delivers medium sized Braille texts (letters or other documents) to blind people. The main users we foresee will be people (blind or not) with internet access that need contact blind people with no internet access (and thus no e-mail), and all entities needing Braille printed documents for their clients, employees or other, but whose needs don't economically justify the investment on a Braille printer.

It was also possible to conclude that the limitations imposed to users — number of letter per week and number of characters per letter — were not a significant constraint, although it is desirable, in the future, to ensure the possibility of sending longer texts. It must be said that the limits to size and frequency were imposed by us and not by CTT, as the project was financed through the ordinary budget of CERTIC, no special funding being ascribed to it by any official entity or sponsor.

Once verified the usefulness of this service and identified the main characteristics of usage, we intend to optimise the user and manager interfaces. Version 2 of MECBraille (under development) will include, among other things, optimised CSS styles according to each user's registered disability profile and the possibility for the user to create his/her personal list of frequent addressees. This latter feature is very important as it is apparent that most users will most frequently send letters to a restricted set of correspondents, and avoiding the reintroduction of address information prevents address mistakes, the frequent cause for cecograms returned by CTT.

With the goal of making this service more professional and widely known, we anticipate the possibility of it being fully operated by CTT. The equipment and personnel needed and the foreseen traffic won't represent a significant economical stress, but funding from SNRIPD (the Portuguese National Secretariat for the Rehabilitation and Integration of People with Disabilities) may be in order. Further promotion within the blind community must come from ACAPO (the Portuguese Association of Blind and Visually Impaired People), especially since CTT has no online information about the existence of such a service as the cecogram.

INTELLIGENT AGENTS IN DECEPTION SYSTEMS

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ABSTRACT

HoneyPots or deception systems are new approach to intrusion detection systems. They are resources which are intended to be attacked and compromised to gain more information about the attacker and his attack techniques. The use of intelligent agent architecture in intrusion detection systems is studied in several researches but about deception systems that are new in network security we don't have any acceptable result. We propose a novel approach called HoneyAgent for mid involvement deception system using intelligent agent technology. We explore using of agents in deception system and benefits of this approach.

KEYWORDS

Deception system, Agent, Mobile agent, HoneyPot, Simulating network services.

1. INTRODUCTION

Deception system or HoneyPot is one type of intrusion detection systems that its value is in being attacked or compromised by intruders. These systems attempt to trick potential intruders into thinking they have gained access into real mission-critical system. Next they log intruders and attempt to keep them busy. This new method has some advantages. By keeping intruders in deception system, we have more time to secure our real systems, detect intruders, and learn new attacks. Added to these advantages we won't have any problem of other intrusion detection system, because all of the traffic to this system is considered intruder activity.

2. MAIN CONCEPTS

2.1 Categorization

We have three methods of deployment of deception system [B02] :

- I. High involvement : in the high involvement deception system, we have a system with real operating system in the network. Intruders interact with this system and we log their activities. This method leads to high risk. Attackers can misuse this system. For example this system can be bridge to another systems in the network.
- II. Mid involvement : in this method intruders won't interact with the real systems. Some network services such as FTP, mail, etc. are simulated and some are prepared to interact with intruders. This method has low risk but implementation and deployment of these systems are time consuming. For

this method we need to understand network services in details. BOF [B02] and DTK [C99] are samples of mid involvement deception systems

- III. Low involvement : In these systems we don't have any real operating system or simulated network service. We only log traffic of the system, however those network services that they have hand shaking operation such as SMTP won't be useful. The risk of such a system is very low.

2.2 HoneyNet

To improve the performance of deception system, the possibility of a deception system to be attacked must be much higher than the possibility of real system to be attacked. For this reason the number of deception systems must be greater than the number of real systems in the network [C99]. So we must have a network of deception systems or HoneyPots. In this network we can have one machine for one HoneyPot or one machine with some virtual HoneyPot that is called virtual HoneyNet [H02].

2.3 Agents in intrusion detection systems

A software agent is [B97]: an entity that works autonomously and continuously in a special environment. It is intelligent and flexible. It can adapt to its environment and learn from it. An agent negotiates with other agents as well as collaborates or competes with them. It can be mobile, and move from one place to another. Because of special properties of agents, they are suitable components for intrusion detection systems. Many experiments and works are based on using intelligent agents for intrusion detection systems, but none of them is complete. AAFID [Z98], IDA [A99], [H98] are examples of such systems.

3. TOWARDS AN AGENT BASED ARCHITECTURE FOR DECEPTION SYSTEM

In our proposed approach, we define a new architecture called HoneyAgent. It is based on a multi agent system architecture. It is viewed as a collection of autonomous and intelligent agents distributed dynamically and autonomously. These agents cooperate and communicate in order to perform deception tasks efficiently and achieve a better performance consequently.

3.1 Characteristics of proposed system

- 1- This system is mid involvement, so the risk is low.
- 2- This system is a network of deception systems, so possibility of being attacked is high. Added to this; the possibility of single point of failure decreases.
- 3- Distribution of this system is easy and autonomously. Management of this system is easy too.
- 4- For improvement of the performance of the system, we should use organized deceptions. So components of this system must be intelligent and collaborate with themselves.
- 5- This system gives the deception far higher quality so that it is very hard to differentiate a legitimate service from a deception. We can manage and change the deception system over time easily. Changing active simulated network services or location of deception systems in network are examples of changing deception systems.

3.2 Using agent based architecture for distributed deception system

There are five reasons for using agents in a system [M01]:

- 1-An agent-oriented approach is beneficial in situations where complex/diverse types of communication are required: More intelligent and more organized deception, is better for luring and keeping attackers in HoneyAgent. To achieve this goal, components of deception system must collaborate and cooperate.

- 2-An agent-oriented approach is beneficial when the system must perform well in situations where it is not practical/possible to specify its behavior on a case by case basis: Attacks are too various, so we can't determine a certain path for deception system.
- 3-An agent-oriented approach is beneficial in situations involving negotiation, cooperation and competition among different entities: Since HoneyAgent is distributed and many attacks use several machines to reach their target, the components of HoneyAgent can collaborate and negotiate with each other to create fake cyberspace for attackers to reach their targets.
- 4-An agent-oriented approach is beneficial when the system must act autonomously: In HoneyAgent each port and each protocol has its own listener and answerer so each component is independent and must operate autonomously.
- 5-An agent-oriented approach is beneficial when it is anticipated that the system will be expanded, modified or when the system purpose is expected to change: Since attacks' paradigms change over time, our deception methods must change over time too. Because real systems change over time, and if the deception system is static, it will fall to long-term fairly passive intelligence efforts. One way to mitigate this is by making the deception system change over time as a real system does.

4. ARCHITECTURE OF HONEYAGENT

HoneyAgent is a distributed agent system. We have an agent manager that system administrator can interact with it and setup the HoneyAgent. For each TCP protocol we have an agent for listening to port and an agent for making fake answers. Each connection has its own listener agent. HoneyAgent distributes dynamically and autonomously in the network and the locations depend on the attacker and his/her method of attack. Agents collaborate with each other to make better answers. HoneyAgent should be more intelligent to produce better lure system.

HoneyAgent currently implemented on IBM's Aglets toolkit, which is composed of a set of java-based mobile software agents, that carry out specific tasks on the network and collaborate on producing of fake answers and interact with intruders.

In figure 1 we show the diagram of system goals in MASE method.

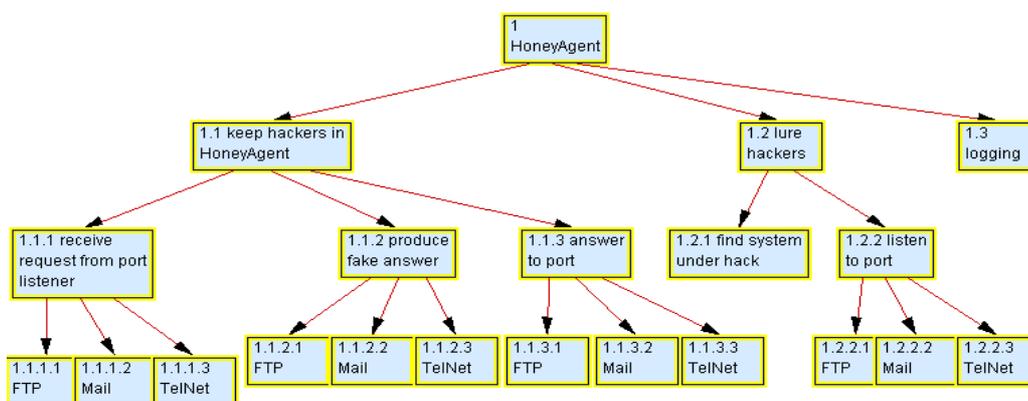


Figure 1 : Diagram of HoneyAgent system goals

Of course in that diagram we have only three services simulators – FTP, Mail, Telnet. However because HoneyAgent is based on agent architecture we can develop it easily and add more services to it.

Figure 2 shows the architecture of system in three layers.

The roles and functionalities of the different types of agents are described below.

HoneyManager : Administrator interacts with this agent through a GUI. This agent is not a mobile agent.

Logger : This agent gathers information from other agents and logs them. It can analyze logs and alert specific events to HoneyManager. HoneyManager interacts with this agent for producing reports. We can have one Logger for every deception machine.

(FTP, Mail, TelNet) Server : This agent moves to the deception machine and listens to its port. While receiving request from an intruder, it creates an agent for interacting with that intruder.

(FTP, Mail, TelNet) Fake Answerer : An agent that interacts with intruder, sends intruder requests to this agent. This agent interacts with other agents for example Logger and produces fake answers by applying reasoning and artificial intelligence methods. Finally Fake Answerer sends fake answer to interacted agent.

(FTP, Mail, TelNet) Thread : For any intruder there is an agent to interact with. This agent interacts with intruder and receives intruder request. So it sends the request to an appropriate agent and transmits the resulting fake answer to the intruder.

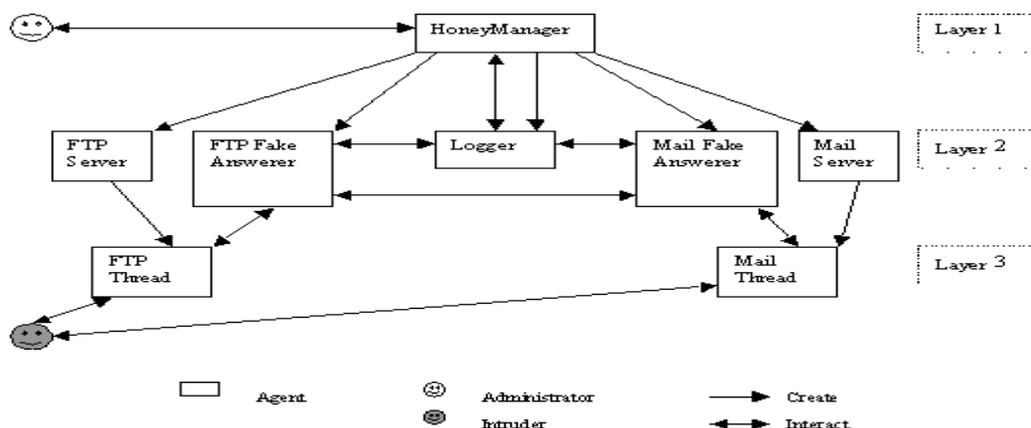


Figure 2 : Architecture of HoneyAgent and interactions among the agents

5. CONCLUSIONS

In this paper we described a deception system and its agent based architecture. Components that make a deception system must be independent and autonomous, because they listen and answer to independent ports and intruders. However for producing fake answers, components must collaborate together to make a real environment and real answers for intelligent attackers. For simulating network services, we can use agents because they are intelligent and independent. Agents can make a network of deception systems. So we have advantages of networked deception systems.

In [A99] and some other works, tracer agents are introduced. Adding tracer agents to HoneyAgent will add to its services.

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Posters

UNDERSTANDING THE ROLE OF INFORMATION SECURITY CULTURE

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ABSTRACT

In information security management, it is crucial to understand not only technical and operational issues but also human factor issues in order to ensure information assurance in organisations (Zakaria, 2002). Recently, there have been a number of reports about cyber crime and computer crime. The fact that breaches of computer and Internet security are reported with great frequency means that there is a danger that organisations will be reluctant to trust innovative technologies because of fears about security. Although there are two main potential threats: outsider and insider, the latter is apparently the most serious threat to information security in organisations. Consequently, there is a must for organisations to have a personnel security or 'people firewall' in order to prevent the issue. One possible solution is to establish an information security culture programme that covers three important aspects such as awareness, training, and education for effective people firewall. This paper gives an overview of the role of information security culture and how it can be used to increase security levels in organisations.

1. BACKGROUNDS

It is widely suggested that understanding information security and its culture is very important to information security management in organisations. The purpose of the information security culture (ISC) programme is basically to increase information security awareness and educate all crucial information security aspects among organisational staff.

2. RATIONALE OF INFORMATION SECURITY CULTURE

According to a survey in Information Security Magazine of late July and early August 2001, the number of internal security incidents is greater than the number of external security incidents (Briney, 2001). In this case, it means that there is a major security vulnerability associated with organisational personnel. According to the same survey, main obstacles to adequate security levels were because of lack of employee training, lack of end-user awareness and lack of competent information security personnel (Briney, 2001).

3. INFORMATION SECURITY CULTURE

In order to cultivate ISC in organisations, there are three major aspects to be considered: awareness, training and education. These major aspects must be all together considered when educating ISC programme, as a single aspect alone is not sufficient to ensure the information assurance objective. It is a challenge to develop an effective and efficient ISC programme in firm as it concerns human factors towards information assurance.

3.1 INFORMATION SECURITY AWARENESS (ISA)

The aim of ISA programme is to deal with Information Technology (IT) security breaches incidents resulted by improper operation of organisational staff. Awareness presentations are intended to tell individuals about standards, policies, guidelines, procedures, and encourage them to respond accordingly (McLean, 1992). Implementation of awareness

programme also can minimise the impact of social engineering attacks [Kajava and Siponen, 1997]. These programmes require participation of all employees.

3.2 INFORMATION SECURITY TRAINING (IST)

One aspect of ISC such as, awareness alone is not sufficient to create security culture. It must be accompanied with training and more advance follows by education. The aim of IST programme is to develop knowledge and skills that can assist job productivity and performance. Therefore, employee knows how to perform technical measures and procedural measures when accomplish any errands at hand (Yngstrom and Bjorck, 1999).

3.3 INFORMATION SECURITY EDUCATION (ISE)

In organisational context, ISE programme participants are IT security practitioner employees. These programmes include all integration of information security multi-disciplinary study such as computer science, information systems, criminal justice, mathematics, philosophy, psychology, sociology, accounting and management (Wright, 1998). As an IT security practitioner, it is necessary to complete basic educational requirements. The aims of these programmes are to enable IT security practitioners understand the issues and challenges inherent in IT security, and come out with a good solution. Figure 1 suggests the main programmes of information security culture in organisations.

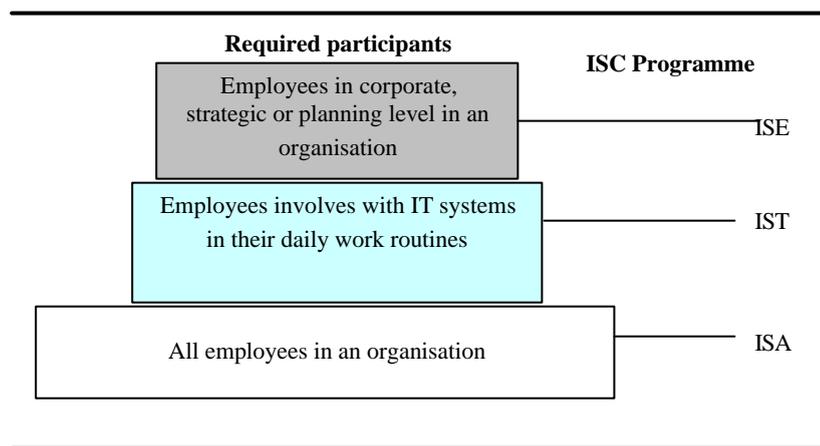


Figure 1. Main programmes of ISC development and required participants

4. CONCLUSIONS AND FUTURE WORKS

This paper has shown the necessity of information security culture programme. It is a holistic programme that involves participation of all level of organisational employees. Any single programme such as awareness or training or education is not sufficient to create organisational security culture. To ensure culture programme, a proper plan and all relevant issues must be addressed. A remarkable area for future research is to understand potential issues when developing information security culture programme. In this case, it is important to focus on the appropriateness of the programme to different types of organisations such as, public and private sectors. In future works, the author will emphasise information security culture paradigm, since we believe that the appropriate paradigm can be used as guidance for ISC development. Later, aspects of information security culture development methodologies will be focused.

USING EMS IN THE STRATEGIC MANAGEMENT PROCESS

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ABSTRACT

The need to improve management is a common problem, mainly in SME. In fact, introducing new technology is easier than improving managerial process. In this context, we propose the use of groupware technology, the adoption of concept of communication genre to facilitate the adoption of the most adequate managerial techniques.

1. A PROBLEM AND A PROPOSAL

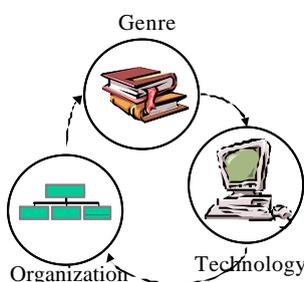


Figure 1. OGT Model

In order facilitate the introduction of new management concepts and techniques in an organization; we propose the use of a new model – the OGT model (Figure 1).

In order to solve the problem we propose the use of groupware technology. The use of experts in the managerial field is also critical. In order to match the technology and the new managerial concept we advocate the adoption of the concept of communication genre (Costa and Aparício, 2002). This concept allows the study of communication artifacts. On the other hand, genre system is a useful concept to analyze communication in organizational processes.

In order to implement the concept of genre, users may play several roles, as analysts, facilitators or participants in a meeting. The concepts of communication genre and genre system are useful in the integration of meeting results, but its implementation is possible by adopting a methodology, so we propose the following steps: (1) Insight context of the problem; (2) Obtain and analyze data, through meeting, documents and surveys; (3) Identification of main genre systems and communication genres as well as specific genre systems by decompose and specialize genre systems; (4) Identification of systems and supporting tools; (5) Adjust system to support communication genres in the context of genre system.

In order to test this approach, we used it in the implementation of a strategic management process in a SME. We used as facilitator technology the EMS. In Figure 2 a list of meeting may be shown.

2. CONCLUSION

In conclusion, our goal is facilitate the introduction of new managerial techniques. In order to match the technology and the new managerial concept we advocate the adoption of the concept of communication genre. This approach has one important implication: it requires a careful study of the community of people using the communication artifacts, to elicit the genres and genres systems they practice. This approach may thus require the observation patterns of communication for a long period of time.

Phases	Outcome
External Environment analysis	List of Opportunities List of Traits
Internal Environment analysis	List of Straits List of weaknesses
Mission Statement	Mission Statement
Define Strategy	List of Objectives, Strategies and Policies
Assess Strategy	Chosen Strategy
Programs	Action Plan for a Specific Strategy
Budgets	Budget
Procedures	List of procedures

Figure 2. List of meetings and outcomes in a strategic management process

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OFFICE INFORMATION MANAGEMENT WEB APPROACH

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ABSTRACT

This work analyses and implements a system to help office procedures from schools in the Polytechnic Institute of Castelo Branco. Our approach uses Oracle, running in a Red Hat Linux server with Apache and PHP4 Modules, providing a Web environment using https protocol.

KEYWORDS:

PHP4, HTTPS, LINUX, ORACLE, APACHE.

1. INTRODUCTION

Polytechnic Institute of Castelo Branco, has about five thousand students who attend about thirty courses, on six Schools spread all around the city. Due to the distance between schools information from each school office must be provided, often to the central offices at the main building. There is the need for a system to students, teachers and other staff that encloses all the schools academic activities, supported in a web secure environment.

This project intends to introduce the Linux operating system at the computer center of IPCB, and try to evaluate that Linux and Oracle DBMS, as a stable and solid working platform, to solve the problem.



Código	Nome	Semestros	Inscrições
1	Matemática I	1	1
21	Algebra Linear e Geometria Analítica	1	1
22	Introdução à Engenharia Informática	1	1
23	Programação de Computadores	1	1
24	Software Digital	1	1
25	Matemática II	2	1
26	Algoritmos de Programação	2	1
27	Desenho e Computação Gráfica	2	1
28	Métodos Estatísticos	2	1
29	Microssistemas	2	1
30	Electrónica Digital	1	1

Fig. 1 – Student Registration

2. PROPOSED MODEL

We propose five kinds of different users to work on the system:

Office Staff - Administrator, Chief and Employees - all the tasks related with office procedures.

Accounting Staff - Administrator, Chief and Employees - all the accounting procedures for each school.

Teaching Staff - Account Administrator, teaching Staff - all the subjects related with teaching activities, such as marks, subjects, calendar, etc.

Students - Student activities, fees, marks, registrations, etc.

Kiosk - Touch Screen portal for students and visitors.



Código	Nome	Semestros	Data
1	Matemática I	1	01/08/22
21	Algebra Linear e Geometria Analítica	1	01/08/22
22	Introdução à Engenharia Informática	1	01/08/22
23	Programação de Computadores	1	01/08/22
24	Software Digital	1	01/08/22
25	Matemática II	2	01/08/22
26	Algoritmos de Programação	2	01/08/22
27	Desenho e Computação Gráfica	2	01/08/22
28	Métodos Estatísticos	2	01/08/22
29	Microssistemas	2	01/08/22

Fig. 2 – Kiosk touch screen

3. IMPLEMENTATION

The central database system runs Oracle 8i Enterprise Edition for Linux (8.1.7). Communication infrastructures are provided by the current link communication between each school (Frame Relay 512Kbps routed by Cisco 2500 and 4500M) [1]. Communications in Intranet for each school are support based on fast/Ethernet infrastructure. Web services are implemented using Apache Web Server [2], with module for PHP4 [3]. PC's provides kiosk with touch screen display. Red Hat 6.2 operation system is used to support the proposed system.

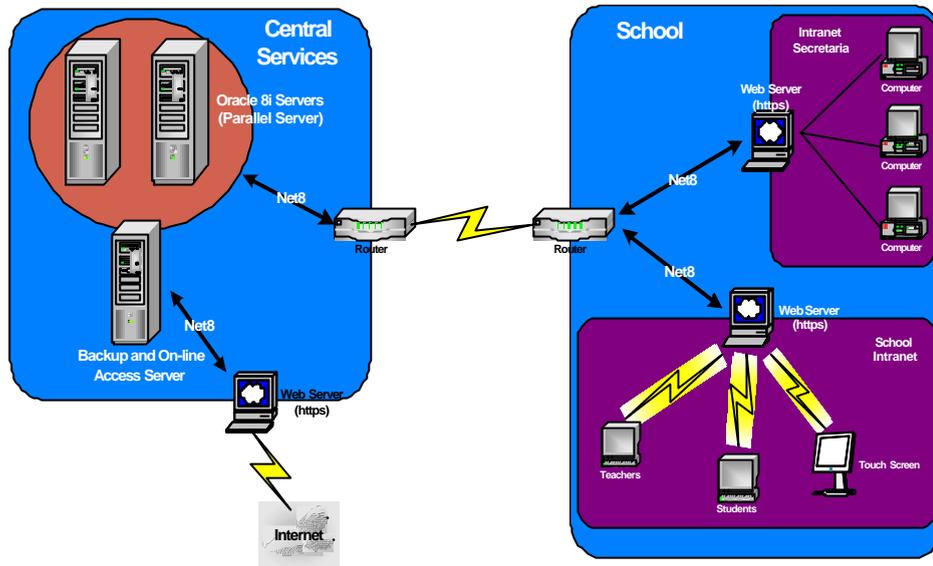


Fig. 3 – Overall view of the system

4. CONCLUSION AND FUTURE WORK

In this work we analyze and we have implemented a new approach office information management to help office procedures from schools in the Polytechnic Institute of Castelo Branco.

Web approach supported by Oracle, Red Hat and Apache prove to be a consistent platform. Approach with the touch screen kiosk also proves to be a good interface for students to communicate.

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THE ERA OF VIRTUAL MULTICASTING NETWORKS

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ABSTRACT

The paper presents crucial information on the possibilities of applying multicasting networks to information exchange between corporations.

KEYWORDS

multicasting, MBONE, network

The present situation in multicasting routing is still far away from the one in which multicasting packets would be easily sent in the whole Internet. Presently, there are the so called "multicasting islands" isolated from each other and consisting of one or numerous local networks of computers with multicasting implemented and connected by *mrouted* (a multicasting routing programme, operating on Unix servers or standard PCs) or routers "understanding" the *multicast* packets.

The *mrouted* programme enables the establishment of the so called "tunnels", transmitting multicasting packets between "islands" via networks that do not support multicasting. Multicasting packets are "wrapped" in standard TCP/IP packets and sent to the address of the second computer with the use of *mrouted* and with the *mrouted* programme implemented in order to unwrap them and send again as *multicast* in the network in question (Kieltyka, 2002).

Multicasting "islands" connected by *mrouted* tunnels form a global, virtual network in the Internet. This network runs at the top of the physical Internet layer and enables multicasting transmissions, so called **MBONE** (Multicast Backbone).

In order to transmit multicasting packets more efficiently, numerous techniques and solutions have been elaborated. Due to the potentially large number of multicasting session users there is no need for the transmission source to "know" all destination addresses. Instead, multicasting routers must somehow "translate" multicasting addresses into the addresses of the computers receiving the transmission. The main principle of multicasting packet routing is that multicasting routers communicate with each other in order to exchange information concerning neighbouring routers.

In order to avoid unnecessary doubling of functions, a single router is chosen (by the IGM P protocol) as the *Designated Router* appointed for each subnetwork (Networked Multimedia Overview; <http://www.cisco.com/warp/public/614/19.html>).

In order to provide efficient transmission, *Designated Routers* construct the so called **logical spanning trees (multicasting trees)** which connect all members of the particular multicasting group.

The multicasting packet stream of each pair (sources, destination groups) is sent from the source to the receivers via logical spanning trees connecting all computers in the particular group. Different multicasting routing protocols apply different techniques for creating multicasting logical spanning trees (multicasting trees); since the moment of creating a tree, all packets are transmitted by it (Networked Multimedia Overview; <http://www.cisco.com/warp/public/614/19.html>).

Presently, the MBONE network is commonly utilised by scientists conducting their research and engineers who need an efficient communication infrastructure that facilitates team work for example by the possibility of sharing applications or data exchange (Networked Multimedia Overview; <http://www.cisco.com/warp/public/614/19.html>).

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Networked Multimedia Overview, <http://www.cisco.com/warp/public/614/19.html>

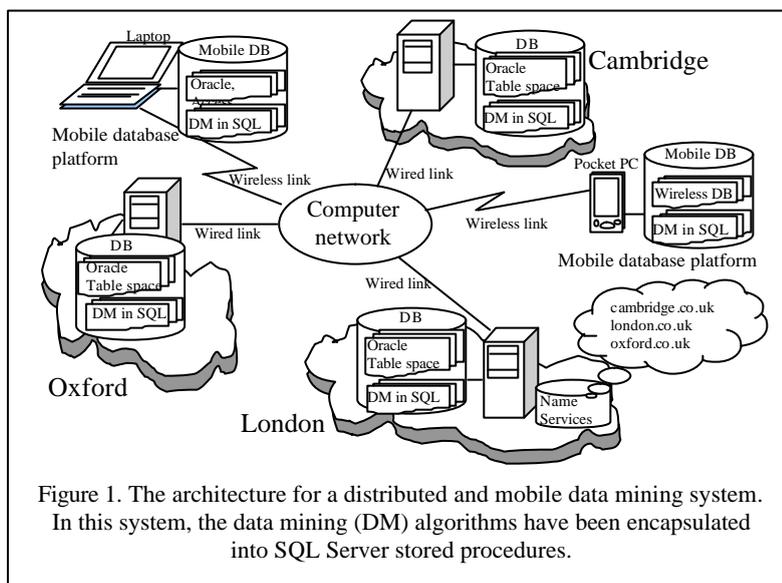
AN MOBILE DATA MINING SYSTEM BASED ON DISTRIBUTED ALGORITHM

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Most of the popular data mining algorithms are designed to work for centralized data and they often do not pay attention to the resource constraints of distributed and mobile environments. In support of the third generation of data mining systems on distributed and massive data, we proposed an efficient distributed and mobile algorithm for global association rule mining, which does not need to ship all of data to one site thereby not causing excessive network communication cost.



Our preliminary results indicate that our PL/SQL implementation of our distributed ScanOnce algorithm is much faster than Apriori mining [Agrawal 1993]. As shown in Figure 1, three desktop computers, one laptop computer and one pocket computer were used in the experiments. The desktop computers were Intel Pentium machine with Windows 2000 Advanced Server operating system and Oracle9i enterprise edition. The desktop computers were connected by the 10 Mbps MAN Network. The laptop computer and pocket computer roaming across the North Campus

and City Campus of the London Metropolitan University, were used as mobile database platforms. Both of these computers were equipped with Wireless LAN cards (11 Mbps). The laptop (1.1 MHz CPU, 512MB RAM) was loaded with Oracle9i enterprise edition and Microsoft Access XP whereas the pocket computer (Compaq iPAQ Pocket PC H3970, Windows CE 2.0, 400 MHz CPU, 64 MB RAM, 288MB Flash ROM) was loaded with Wireless Database 4.0 (KelBran Software). Wireless Database supports a subset of the standard database SQL language. This feature allows us to access large databases (up to 1GB data) remotely and create our own query for distributed data mining with the SQL query wizard, as illustrated in Figure 2. The experiments show that this Distributed ScanOnce algorithm in PL/SQL beats classic Apriori algorithm, which requires repeated scans of the databases thereby shipping all of the data to one site and consequently causing excessive network communication overhead, for large problem sizes, by factors ranging from 2 to more than 20.

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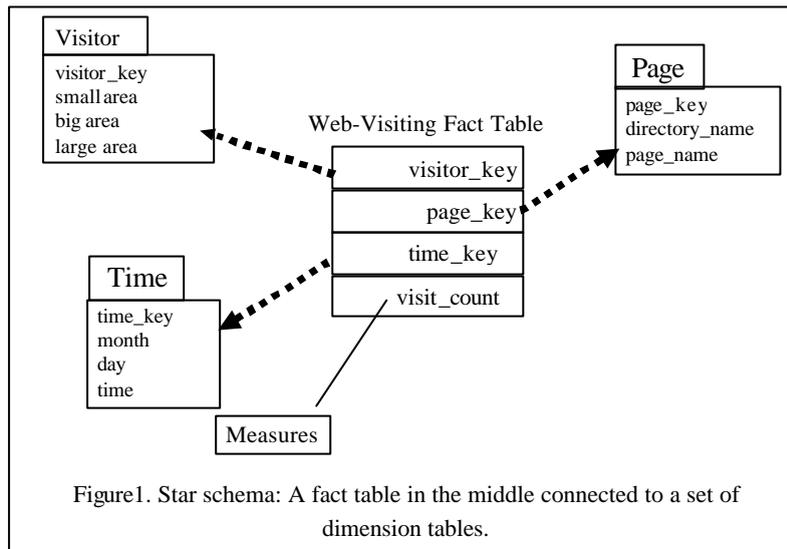
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Figure 2. The roaming pocket computer was used as mobile database platform.

WEB LOG MINING TO FACILITATE THE DAILY MANAGEMENT OF A PUBLIC WEB SITE

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Web click stream data can be easily obtained. Many internet websites usually collect hundreds of megabytes of click-stream data everyday and want to analyse these data efficiently [Kim 2002]. But because of a tremendous amount of user click stream data, enterprises and communities are labouring to answer even basic questions, such as “which page is the most popular” [Zaiane 1998]. In this report, we will prototype our department’s website that integrates interactive web log mining operations.

We built a star schema of three dimensions: a fact table in the middle connected to a set of dimension tables, as shown in Figure 1. Dimensions are the visitor, the page and the time. And a measure is visiting count. Hierarchies are hidden in each dimension. The test data are imported in MS SQL Server 2000 analysis service. And then the system creates and processes manually cubes using its cube creation wizard. In SQL Server 2000 analysis, the benchmark program accesses the cube through ADO MD (ActiveX Data Object Multi-dimensional) API. And the performance of the system is evaluated by query execution time. In general, main objectives of web log mining are to understand the needs and preference of users in order to attract new visitors and retain existing visitors. So we set up the following queries:

Show top 100 visitors that visit most frequently the front page, which delivers the navigation to teaching, staff, and administration, etc.

Show top 100 visitors that visit most frequently in January

Show top 100 visitors that visit most frequently the front page in January

The plan behind this article is to explore a semi-automated data mining system that can be used to create and maintain web based content through interactive mining operations in a hierarchical arrangement. In this system, the data mining algorithms have been encapsulated into Microsoft SQL Server stored procedures. What we have achieved through this project is to utilise the techniques that go behind web log mining for specific purpose. We have developed a bare bones version of this system integrating web log mining. This project provides a good start in the direction of integrating data mining into the daily management of a public web site.

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COGNITIVE LOAD AND ADAPTIVE INSTRUCTIONAL DESIGNS FOR COMPUTER-BASED LEARNING

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ABSTRACT

Current research investigating the use of biosensors, for the real-time assessment of cognitive load is described. This ongoing work can be foundational to the development of adaptive computer-based environments that respond to users' cognitive load.

KEYWORDS

E-Learning, Adaptive Learning, Assessment, Cognitive Load

1. INTRODUCTION

How do instructional designers know that computer-based learning environments are effective? For many, extensive multimedia aspects and increased interactivity are assumed to be associated with increased learning. However, in some learning environments, these factors are distracting and detrimental to learning (Iding, 2000), resulting in increased cognitive load (amount of cognitive resources allocated to a specific task). In addition to instructional designs affecting cognitive load, users' individual cognitive states can contribute to cognitive load.

2. MEASURING COGNITIVE LOAD

Physiological data can be used to infer cognitive states, including cognitive load. We are working with a suite of physiological sensors to assess the users' cognitive load in real-time. An eye tracker system monitors fixations, blinks, saccades, and pupil dilation. Other sensors assess blood flow, temperature, hand/finger pressure on a computer mouse, and heart rate. Experiments using combinations of these measures have confirmed that physiological data corresponds to cognitive load (Crosby, Auernheimer, Aschwanden and Ikehara, 2001).

We have just embarked on other basic research in devising models that combine sensor's data to produce measures of cognitive load. For instance, we interpret how fast the user depresses and releases the

mouse as an indication of the perceptual and cognitive complexity load and use a combination of heart beat and galvanic skin response as a measure of stress. In one experimental setup, we employ a moving

fraction game in which the user must determine whether the values of various moving targets exceed a given value.

Furthermore, the AMI Lab has developed a flexible software framework that supports data collection, real-time data analysis and output of data to various devices (Aschwanden & Stelovsky, 2003). The data input can originate from a variety of hardware sources, such as serial and parallel ports, local area network or Internet sockets, local and remote files as well as peripheral input devices attached directly to the local computer, such as keyboard and mouse. The framework can accept numerous data formats, such as event objects, XML and several proprietary formats as specified by the sensors' manufacturers. All these input sources are internally converted to a common format - a stream of events. In addition to events that originate in hardware devices, the software that the user operates can send its own events to record the changes in its state. The event streams from all input sources are merged according to their timestamps.

Similarly, the framework can output event data to various target devices, such as local area network or Internet sockets and local and remote files as well as various data visualizations, such as graphs and gauges. Several formats of events are supported - XML, event objects and formats readily accepted by commercial statistical packages. The modular design of the framework makes it easy to incorporate new input and output devices and additional data formats - the software developer needs to construct one Java class that conforms to a predefined software interface. The framework supports standard processing techniques, such as filtering as well as more sophisticated data analysis based on mathematical transformations. Filtering can be used, for instance, to eliminate noise or to de-multiplex events based on their types. To determine cognitive load, events are processed using mathematical functions that accept an n-tupel of event values and return a value that corresponds to the current load. Again, it is relatively easy to define and incorporate new filters and transformations.

This software framework will make it possible to construct adaptive interfaces that adjust presentation of topics to users' cognitive loads. While current online courseware assesses students' knowledge with quizzes and exams, instructors must typically develop learning materials as web pages and similar static multimedia presentations. We plan to enhance presentations with dynamic "augmented lecture notes". Such notes will be short segments. The student's cognitive load during the most recent segment will determine which supplementary material - if any - should be suggested for further study. For instance, if cognitive overload is detected, presentation software will suggest that the student view versions that are rephrased or in a different presentation modes. Similarly, if increased cognitive load indicates that the student may have difficulty understanding further information, the software can suggest that the student view a short review of necessary prior information.

3. CONCLUSION

We believe that research such as this can be foundational to the creation of adaptive learning interfaces or instructional designs that can be tailored to individual learner's levels of cognitive load associated with particular tasks.

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EDI: THIRD-PARTY VENDOR TRAFFIC STILL RISING

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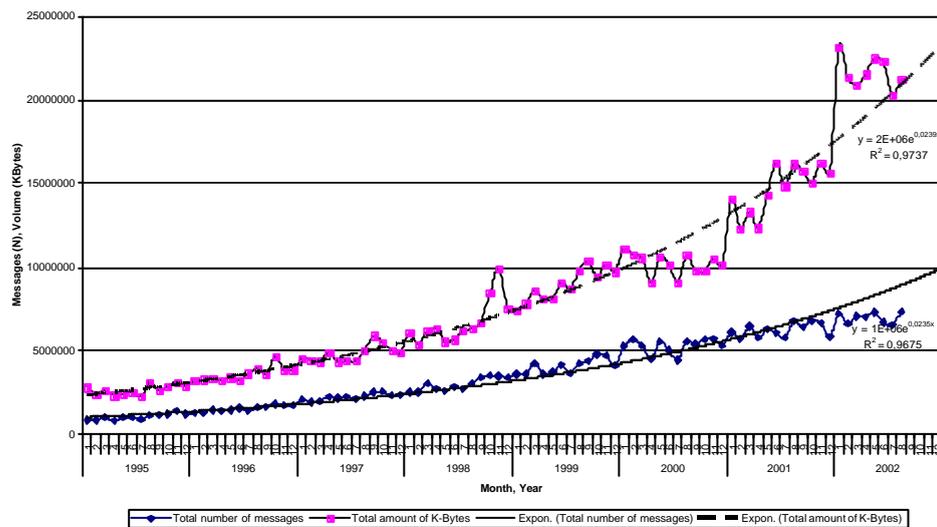
EXTENDED ABSTRACT

Although EDI, e.g. EDIFACT and ANSI X.12, is considered superseded by various XML dialects by many people, industry is still using it a lot. Similarly, value-added network service providers (VANS) were expected to be defeated by the Internet by the end of the 20th century. We have surveyed VANS-based EDI traffic in Denmark since 1995 and found that traffic is increasing with average yearly increase-rates of 30% even into the 21st century.

During the late 1990s, we have surveyed EDI-uptake and pointed to outstanding growth-rates of VANS-based EDI. Even during the assumed dot-com high area 1998-2000, a general high level of EDI application usage has been found. Based on an update of our analysis, we can now demonstrate that third-party against all odds is doing well and continues to outperform the Internet-based exchange of EDI-messages. The growth in the Danish EDI traffic is remarkable in the light of the business structure where there is few multi-national companies present and no major up-stream powerful companies.

Our analysis include all major VANS-operators in Denmark where we have collected all outbound traffic month by month for the time span from 1995 till 2002. We have data for both the amount of K-bytes and the number of messages transmitted. The increase in bytes is at a more exponential level than the growth in messages.

The analysis of our data has also found that the companies that use EDI exchange still more messages with still more partners, but do not exchange more different types of messages. Also, there is no indicator that the integration of the EDI-messages is at a substantial higher level since the most prevalent message types exchanges is orders and invoices. One exception is the health sector, which has been the major reason for the growth in EDI traffic.



GEOESPIGUEIRO – PUBLISHING GEOGRAPHIC INFORMATION OF TRÁS-OS-MONTES E ALTO DOURO ON THE WEB

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ABSTRACT

A website for publishing geographic information on the Web is presented. The integration of geographic information regarding the region of Trás-os-Montes e Alto Douro lead to the development of a Geographic Information System (GIS). By accessing the GIS database, the website, called Geoespigueiro, publishes this information in a format that can be accessed by any computer connected to the Internet and displayed to the user on a webbrowser.

KEYWORDS

Geographic Information Systems, Web publishing.

1. INTRODUCTION

Trás-os-Montes e Alto Douro, an inner region of Portugal, has a sparse population connected by a degraded road network. To provide the emergence of the Information Society in the region and become an instrument of development, the Universidade de Trás -os-Montes e Alto Douro created the project “Serviço Cooperativo de Extensão em Trás-os-Montes e Alto Douro - Trás-os-Montes Digital” (SCETAD-TMD).

Considering geographic information as an important asset for the implementation of digital regions by providing the link between the people and the land, this project supported the creation of a website, called Geoespigueiro, for displaying geographic information for the region of Trás-os-Montes e Alto Douro.

In order to accomplish this goal we have developed a GIS integrating geographic information of the region and a website for displaying and providing interaction with the geographic information.

2. GEOGRAPHIC INFORMATION SYSTEM

The information available in the GIS database is divided in several themes according to the socio-cultural background of the region addressed by this project. The GIS cartographic base includes the administrative regions and the road network. These themes allow the user to easily locate the geographic region of interest.

The other themes in the database address institutions devoted to education, healthcare, cultural heritage, exhibitions, tourist accommodation and amusement, as well as industrial parks.

The GIS database is not static but in constant change, either updating the existing information or adding new information as it becomes available.

3. GEOESPIGUEIRO WEBSITE

Geoespigueiro was implemented like an ordinary website, and can be accessed using a webbrowser on a computer connected to the Internet. The system is based on a client-server architecture, where the Internet

Information Server provides information as webpages in HTML format. HTML code generation is controlled by using Active Server Pages (Jones, A., 2000).

To access the GIS and produce the different maps selected by the user, we used Geomedia Webmap 4.0 (Intergraph Corporation, 2002). This software produces maps in ActiveCGM format that are included in the webpages and thus can be displayed by any webbrowser, required only that an additional plugin (ActiveCGM by Corel Corporation) be installed.

This solution was chosen in order to be accessible to a wide range of the population, characterized by a low level of computer literacy, and scarce access to computers and connection to the Internet. A lot of effort has been devoted to reduce the amount of data transmitted for each map, in order to address the lack of wide band internet connection in the region.

A graphical interface was developed to present maps containing geographic information that can be easily selected and searched for. A navigation bar was also developed to allow interactive navigation on the map. There is also an area displaying attribute information relating to the geographic elements selected on the map.

4. ONGOING AND FUTURE WORK

Although extensive, the information available to the user is being expanded, either completing the number of administrative regions for which information is accessible, or by adding more classes of information to the themes. As institutions supply geographic information for publication, the GIS is updated.

One of the main advantages of GIS is the graphic display of analysis on the information contained in the database. We are developing new functionalities to display thematic maps with the information available.

We are also implementing the possibility for the user to change the properties of an institution stored in the database, by providing a login and password to the ones responsible for those institutions.

Another functionality that we want to develop is the optimal route selection over the road network. Although the most common selection criteria is the minimization of travel time, we intend to add others like maximizing the cultural or touristic interest.

Another of the projects that we are currently working on is the development of a visualization area dynamically generated 3D models in VRML (ISO/IEC 14772-1:1997).

We also intend to develop a server to provide location based mobile services to devices like handheld computers or mobile phones, delivering geographic information according to the user's location.

5. CONCLUSION

Geoespigueiro demonstrated how to provide a geographic virtual space for searching and visualizing information regarding the region of Trás-os-Montes e Alto Douro. Information available in databases can be associated to geographic features and displayed together in a virtual 2D space (a map).

Trás-os-Montes e Alto Douro is a remote region with vast problems of accessibility, and Geoespigueiro can break that gap. By representing features, both in main cities and remote villages, with the same graphic representation, physical distance and isolation can be overcome.

By displaying thematic maps, citizens can detect asymmetries between distinct sub-regions, and become aware of the need to intervene to decrease the differences.

Geoespigueiro can also be used for consulting public utility information, like searching the nearest pharmacy available.

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SCORING ALGORITHMS FOR EVALUATION TESTS IN ADVANCED E-LEARNING SYSTEMS

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ABSTRACT

The proposal of this paper is to show ideas around the automatic correction of machine-generated tests in the context of e-learning systems. We show works realized around IMS norms in its QTI box. These works, which are orientated to implement the rules in a real system and its use to get a measure of its possibilities, have led to the necessity to bear in mind more complex scenarios than the scenarios posed by IMS and the need to develop adapted algorithms to these scenarios. The last scenario studied, includes the realization of proofs in several stages where the questions will have associated a level and they could only be seleccionated for the same or higher level of that stage. A student will access to higher level questions only if he has reached a certain degree in the previous stage.

The last version of our system includes a new evaluation algorithm which extends QTI standard following its specification. In this version we storage questions using XML like the own QTI structure. The new algorithm was developed to get the maximum similarity to the behaviour of the teacher evaluating a test. The reason of developing this new algorithm is to look for a higher precision in pupils' knowlegment evaluation.

We must take care of several items which will be able to give us the start in the development of the new learning evaluation algorithms. These items are: the exams have to contain the essential containts of the subject, the questions of all the exams must be clear without ambiguity, and also it must be known by the system users the evaluation criteria or the algorithm, and at last the quality of the test exam.

With all this, we developed an algorithm which has 5 steps in the test generating phase. Each step contains four questions and depends directly on the previous step and the student's answer to those questions. This behaviour makes the tests extremely flexible and variable, and needs an adapted method for evaluating the results of the test. Also, it is very important the exams preparation phase, in which, the teachers, create the questions for the test and evaluate the importance and difficulty of each question.

The development of standards for components of e-learning systems are very important. Even more important, is to work next to the borders of these standards because it confirms the work done with them. The shown scenario and the applied scoring algorithm, work in this zone of knowlegment to open new ways for the development of actual standards. The results we have got till now and the shown ideas appear clearly like a way to be followed by the new versions of the standards and by our own systems.

THE NUCLEUS OF PRODUCTION IN DIGITAL LIBRARIES

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1. RESUME

A digital library can be understood as a collection of information managed through associated services, where the information is stored in digital formats and accessible via computer net ways. The information format and the methods used to manage and disseminate the information are influenced by available technologies. This process promotes changes that stimulate new creations, storages, uses and disseminations of the information. Two groups are strongly involved with the development of new politics to incorporate these innovations: the information professionals and the computation workers. The growing necessity of the knowledge reconstruction, for the efficient dissemination of the most distinct information, has stimulated these professionals to innovate on which the information services are useful to particular groups.

The Brazilian public university has been worried, in the last years, with the fixation of objectives to improve the possible applications of the Information and Communication Technologies (ICT). This fact indicates the urgency to stimulate the production of digital contents in important areas such as education, history and culture besides others. Other aspect that must be considered is a larger investment in the permanent formation of people capable to manipulate new ICT and to generate models and methodologies that improve the technological knowledge.

Recently, digital libraries have been consolidated as an efficient tool to spread information across the world. So, it is important to obtain know-how in the construction of this tool and to prepare the information professionals to get all of its benefits. The Nucleus of Production in Multimedia Digital Contents is operating with this proposal.

We classify the results as achieved results and estimated results. First of all, it will be detailed some achieved results involving social, technical and scientific gains reached with digital libraries:

- Development of institutional fluency in the application of ICT
- Upgrade of interdisciplinary laboratories
- Dissemination of public web services with major and rare historical, cultural and educational contents
- Greater integration between university and Non-Governmental Organization
- Development of a systematical to capture and to edit audiovisual documents
- Know-how to measure Internet performance

Some estimated results are:

- Creation of a model to index digital audio and video content
- Reduction of the costs to construct digital libraries maximizing the use of open software

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COLLABORATIVE E-LEARNING FOR EDUCATION IN SOFTWARE TECHNOLOGY

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ABSTRACT

The important system requirements, development results and practical evaluations of a collaborative e-Learning system to complete the traditional education of Software Technology as well as the individual responsible learning are presented.

KEYWORDS

e-Learning, collaborative learning, CSCL, software architecture, software technology, adaptive system

1. SYSTEM REQUIREMENTS, RESULTS AND EVALUATION

The integration of an appropriate e-Learning system to traditional lectures of software technology will be supported a more individual and effective learning process. Experiences in education of the special fields of software architecture as well as software analysis and design have shown, that an e-Learning system is a suitable addition for the students, if there are the following aspects considered:

- evaluation of different learning scenarios to systematic and effectively usage of the system
- scalable model for knowledge representation and structuring including meta modeling
- definition of higher concepts for learning (constructivistic instead of behavioristical learning)
- simple way for the user to try collaborative work and CSCL mechanisms
- transparent user modeling for learner specific and adaptive information structuring, linking, searching, presentation, annotation, navigation, communication and help
- integration of different types, roles and strategies to enable individual learning effects
- supporting of open and closed information space approaches including cooperative authoring

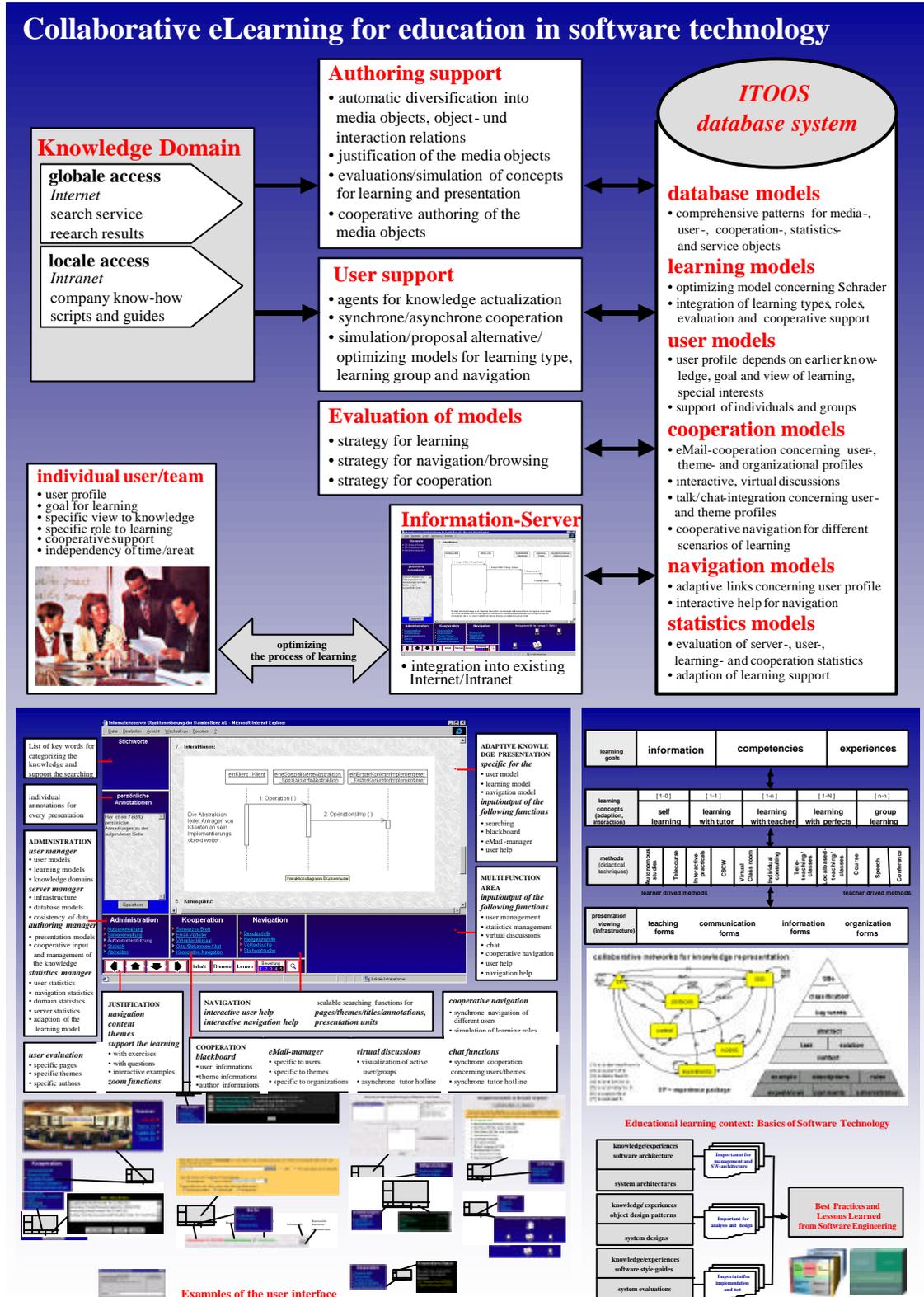
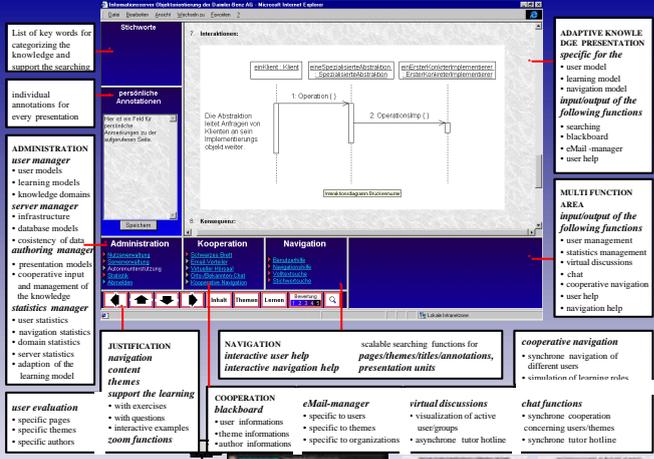
The most important parts of the developed e-Learning system are shown on the poster, especially:

- the infrastructure and architecture including the data-, administration-, CSCW-, learning-, statistical- and the adaption models as well as the knowledge representation based on collaborative networks,
- the user interface with the content presentation, different tools for virtual classrooms, synchronous and asynchronous communication and single or guided navigation by teacher and student,
- the educational context of software technology.

The eLearning system was evaluated in the most of the identified learning scenarios to complete the traditional student education with background information, common experiments and discussions and alternative problem solutions as well as the individual responsible learning with software programming simulations and coding tests concerning the recommended style guides for software technology.

The testing of the subjective and objective student learning effects caused by the e-Learning system was done with the help of questionnaires, interviews, usability engineering techniques and assessments by students and teachers to evaluate the most suitable usage and support of the system.

2. POSTER

Examples of the user interface

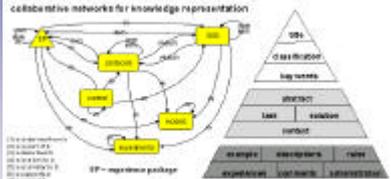
learning goals | **information** | **competencies** | **experiences**

	[1-0]	[1-1]	[1-2]	[1-3]	[1-4]	[1-5]
learning concepts (adaptation, interaction)	self learning	learning with tutor	learning with teacher	learning with peers	group learning	

methods (didactical techniques)	Information	Telecourse	Interactive	Practical	Case	Virtual Classroom	Individual consulting	Self-study	Self-organized learning	Course	Conference
	learner driven methods						teacher driven methods				

presentation (viewing infrastructure) | teaching forms | communication forms | information forms | organization forms

collaborative networks for knowledge representation



Educational learning context: Basics of Software Technology

knowledge/experiences software architecture	Important for management and SW-architecture	Best Practices and Lessons Learned from Software Engineering
system architectures		
knowledge/experiences object design patterns	Important for analysis and design	
system designs		
knowledge/experiences software style guides	Important for implementation and test	
system evaluations		

INTERPRETATION OF THE STATUTORY LAW AS A COMPUTERIZED DECISION MODEL

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ABSTRACT

This poster session presents parts of a web-based learning module in the field of German intellectual property law. The module addresses IT students who take part in an interdisciplinary, virtual seminar of Computer & Law (C&L), but are not familiar with the interpretation of statutory law. Therefore an interdisciplinary didactics was needed that relates to the specific learning culture and thinking structures of IT-students.

KEYWORDS

Computers and Law, E-Learning, Knowledge Transfer, Cognitive Flexibility, Constructivism

1. INTRODUCTION

The RION Project Freiburg is engaged in creating a web-based introductory course in German intellectual property law for IT students. This course is part of a didactical concept aimed to intensify the interdisciplinary teaching of "Computer and Law". For IT-students, accustomed to a model-oriented thinking, the way, how law in general and the German IP code in particular employ conceptual hierarchies and networks is not easily comprehended.

2. INTERDISCIPLINARY LEARNING: LAW AS COMPUTERIZED DECISION MODEL

Interdisciplinary structure of C&L might be intensified if learning modules take regard of the specific learning culture of IT students. Therefore, the course design has to tie with the methods and thinking structures of computer scientists. The manner of representation of the unknown discipline (statutory law) should enable the IT students to transfer and apply their existing knowledge (model oriented thinking structure) to this new matter. Thus, we tried to represent the interpretation of copyright law that determines an object ("something") as a copyright protected work ("Literary, scientific or artistic work") in a graphical model (Fig. 1). The fundamental idea was that the process, which creates a definite legal matter (printed in green) out of indefinite circumstances (printed in yellow), can be understood as a test algorithm. Thus, the relation between legal concepts being a network can be visualized in a computerized decision model. The here presented didactics follows the idea of knowledge transfer as it is outlined by the constructivist cognitive theory of flexibility (Spiro 1992, Graddy 2001). The poster session will largely focus on the other models represented in the course.

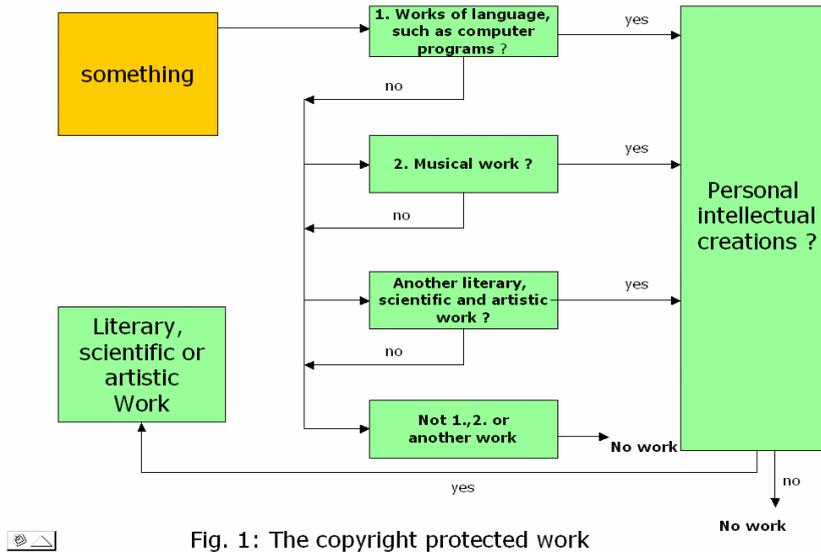


Fig. 1: The copyright protected work

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MAMMOGRID AND EDIAMOND: GRID APPLICATIONS IN MAMMOGRAM ANALYSIS

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ABSTRACT

Breast cancer as a medical condition, and mammograms as images, are extremely complex with many dimensions of variability across the population. The way diagnostic systems are used and maintained by clinicians varies between imaging centres and breast screening programmes, and in consequence so does the appearance of the mammograms generated. A geographically distributed database that reflects the spread of pathologies across the population is an invaluable tool for the epidemiologist and the understanding of the variation in image acquisition protocols is essential to the end-user who runs a screening programme. The aim of the recently EU-funded MammoGrid [1] and UK-funded eDiamond [2] projects is, in the light of emerging Grid technology, to develop a European-wide database of mammograms that will be used to investigate a set of important healthcare applications as well as the potential of this Grid to support effective co-working between healthcare professionals throughout the EU. This poster reports on the motivation for, and the initial stages in the planning of, the MammoGrid and eDiamond projects.

KEYWORDS

Medical imaging, e-Health, Grids computing, collaborative healthcare, tele-diagnosis

Patient management in breast cancer (diagnosis, treatment, continuing care, post-treatment assessment) is rarely straightforward, but there are a number of factors that make patient management based on medical images particularly difficult. First, image-based diagnosis has to take into account the particularities of the individual patient: patient age, diet, lifestyle, incidence among relatives, clinical history etc. Second, in practice, often very large quantities of data, with complex structure, are involved (3-D images, time sequences, multiple imaging protocols). In many cases, no single imaging modality suffices. Although clinically significant signs are subtle, there are many parameters that affect the appearance of an image, including image acquisition parameters and anatomical and physiological variations. In the case of mammography, show marked variation across the population throughout the menstrual cycle and throughout the course of a woman's life.

Between them, MammoGrid and eDiamond aim to provide clinicians with direct access to massive volumes of clinical and medical image data to perform epidemiological studies, advanced image processing, radiographic education and, ultimately, tele-diagnosis over communities of medical 'virtual organisations' [4] i.e. geographically disparate groups co-working through the shared resources of the Grid. This is achieved through

the use of Grid-compliant services for managing (versions of) massively distributed files of mammograms, for handling the distributed execution of mammogram analysis software, for the development of Grid-aware algorithms and for the sharing of resources between multiple collaborating medical centres. All this is delivered via a novel software and hardware information infrastructure that, in addition, caters for the confidentiality of patient data and that guarantees the integrity and security of all data.

There are several technologies underlying the MammoGrid and eDiamond projects. An important one, SMF, is described in [2]. The MammoGrid project seeks to establish the Standard Mammogram Form (SMF [3]) as a common standard for mammogram analysis and storage across Europe and will develop SMF to cater for different acquisition protocols across Europe. MammoGrid will set the basis for a common database of mammography information comparable to other proposed systems in the US and the UK. The project members will build on the success of MammoGrid to ensure that all manufacturers of digital mammography equipment output images in terms of SMF and not in their own proprietary formats with their own ranges of intensity and contrast. The success and publicity generated will ensure that all the major corporations are aware of SMF and should ensure their acceptance of a new standard in mammography. The project will also demonstrate how much easier and accurate it is to compare images once they have been transformed to a standard. This will lead to a worldwide demand for SMF images especially for those images that are currently stored on film.

SMF is not only the basis for standardisation of mammography, but it is also the key to quantitative assessment of breast images. MammoGrid will be exploiting this attribute in the quality control and epidemiological studies. Users will be seeking to use SMF for not only further epidemiological and quality control issues but also for teaching and more accurate diagnosis such as “by how much has that tumour grown over the last year?” This also has significant implications in the pharmaceutical business where companies invest heavily to try to assess drug impact in qualitative time-consuming ways. SMF may lead to very quick and accurate assessment of drug impact.

Two other mature technologies that have already proven their efficacy in delivering solutions for scalable database architectures at CERN (the European Centre for Nuclear Research, Geneva) in its Large Hadron Collider experiments (LHC) are AliEn and CRISTAL. AliEn (Alice Environment [5]) is a Grid framework developed to satisfy the needs of the ALICE experiment. CRISTAL, a distributed scientific database system, was designed for use in the construction and operation phases of a large experiment. It makes use of a description-driven approach, using meta-data modelling techniques, to manage the evolving data needs of a large community of scientists and in handling distributed data volumes of the order of terabytes. By combining these two technologies MammoGrid researchers will provide fresh insight into the mediation of queries across a widely distributed database, will generate new approaches into the management of virtual organisations and will inform the development of the next generation of Grid-resident information systems.

ACKNOWLEDGEMENT

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THE MECHANICS OF A DEEP NET METASEARCH ENGINE

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ABSTRACT

The Deep Net refers to the thousands of topic-specific search engines on the Internet, including those that are inaccessible to traditional crawler-based search engines. Commercial metasearch engines have been slow to provide a simple, universal interface to these smaller topic-specific search engines. Turbo10 has developed a commercial metasearch engine that connects to these resources en masse (<http://turbo10.com>). Turbo10 automates the process of creating and maintaining software adapters that connect to, search, and extract results from a multitude of search engines. This poster outlines the functional mechanics of how Turbo10 searches the Deep Net.

KEYWORDS

Metasearch Engine, Deep Net, Information Retrieval

1. INTRODUCTION

Recent research has highlighted a large number of topic-specific search engines that are inaccessible to crawler-based search engines [1, 3, 4]. These engines have been variously grouped under the umbrella terms: invisible web [3], deep web [1], and hidden web [4]. The research has found that crawler-based engines cannot access the information stored in some of these engines, hence the monikers: invisible and hidden. Turbo10, however, prefers to use the term 'Deep Net' because some of these information sources are not web-based (e.g., peer to peer networks) and the contents of these databases are not hidden or invisible to metasearch engines. The challenges for a commercial metasearch engine are, first, to connect to these Deep Net sources, second, to select the most relevant, and third, to return relevant results as fast as possible.

2. ENGINE MECHANICS

To meet these challenges Turbo10's search engine is divided into three major subsystems: the Adapter Manager, Trawler Server and Browser (see Figure 1). The functional design of Turbo10 is different to other web-based search engines. In the interests of speed, the computational cost of information retrieval is mainly borne by the client web browser, not the server. Most metasearch engines do relevance ranking and results merging on the server-side. The problem is the server must wait for all the target engines to reply (or timeout) before sending the result to the browser. Waiting for the slowest target engine can hobble the response time of a metasearch engine.

Turbo10 performs relevance ranking, topic clustering and result merging in the client web browser, not the server. Rather than waiting for the slowest engine to respond, Turbo10 returns a result the moment the fastest engine responds. To achieve this, the server sends asynchronous messages to the browser and a client-side program caches all the results in memory. Because all the results are loaded at one time, displaying topic clusters and result pages does not require repeat trips to the server which makes browsing the results faster.

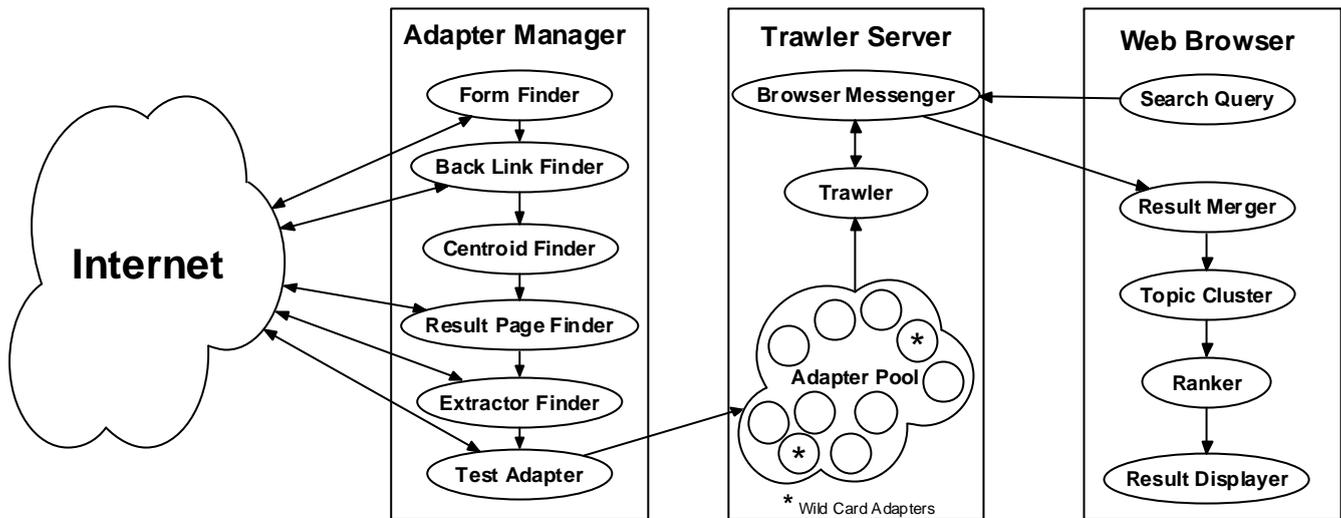


Figure 1. Three major subsystems: Adapter Manager, Trawler Server and Browser.

On the server-side a bespoke web server, the Trawler Server, contacts target engines concurrently. As soon as the fastest engine responds the search results are sent to the browser. The results are also compressed to maximise the transmission speed. The Trawler Server holds a pool of adapters for connecting to search engines. Adapters encapsulate all the information required to connect to, query and parse the results of a target search engine. The adapters are automatically created and maintained by the Adapter Manager. Turbo10 initially created adapters using a manual process. A programmer would analyse the target search engine by inspecting the search form variables and craft a regular expression to extract details from the search results pages. However this process was found to be time consuming, error prone and difficult to maintain. To meet the challenge of creating and maintaining connections to thousands of engines in the Deep Net, Turbo10 required a fully automated process. The Adapter Manager fulfils this objective.

The Adapter Manager runs once a day and is responsible for testing existing adapters and connecting new ones. If an adapter is found to be broken the Adapter Manager will automatically attempt to fix it. The only information required to adapt a search engine is the URL of the web page that contains the search box. All other information is gathered automatically. Turbo10 has been accepting submissions for inclusion in its database of Deep Net engines since late 2001 and now has a large list. The Adapter Manager passes URLs from this list to the Form Finder component. The Form Finder locates the search form and identifies the parameters required to drive the underlying search engine including the query parameters, form submission method, cookie settings and the search URL. Once a valid form is found, a test query term is required to retrieve results from the engine. The test query term is drawn from the terms used in the pages that 'link back' to the search form.

The Back Link Finder retrieves the top 50 web pages that point to a target engine's search form. The context of each back link is extracted using structural cues found in the text of each back link page. The contexts from all the back links are then combined and passed to the Centroid component. The centroid is the top 100 most distinctive terms that describe the engine used in back linked pages. Distinctiveness is measured by using the pre-computed Inverse Document Frequency (IDF) values from an inverted index of the Open Directory Project database (<http://www.dmoz.org>). This outer centroid is calculated by multiplying the term weight by the number of occurrences in back link pages, then sorting the terms in order of decreasing weight, and taking the top 100 terms. A test query term is taken from the outer centroid and used to search the target engine. If the test query succeeds, the Result Page Finder verifies that a valid result page is returned. The next step is to find an extractor definition to retrieve the search results from the page.

The Extractor Finder is the most complex component in the system. It locates semantic and structural information in the results page that match the search result list. Once the list has been identified, individual results can be selected as candidate links. From the candidate links a pattern emerges and it is this pattern that

forms the basis of the extractor. These details are then encapsulated in an Extractor object. The extractor definition is accurate but at the same time flexible enough to match different result pages from the same engine. Many heuristics were tested during development until a balance was found. If the extractor test succeeds, the adapter is completed and moved into the pool of adapters used by the Trawler Server.

Turbo10 searchers can include a number of wild card adapters in the collection of engines they choose to search. The Wild Card Adapter attempts to match a search query to the best engine on which to conduct the search. Turbo10 initially tackled this problem by using a taxonomy-based approach but this required manually categorising engines. To search the Deep Net en masse Turbo10 needed a fully automated system. Turbo10's taxonomy-based source selection algorithm has been replaced by a system that maps search query terms to adapter centroids.

The Wild Card Adapter performs this function. It is spawned in parallel like the other adapters and searches a pre-defined traditional crawler-based engine (e.g., <http://altavista.com>). The results page is analysed for sub-topic clusters in a process similar to Lin et al. [3]. For example, searching on 'crime' may yield the sub-topics, 'government' and 'police'. These sub-topic clusters are combined with the search terms and matched against the adapter centroids. Whenever an adapter's centroid matches, the weight of the term (found in the centroid) is added to the score for that adapter. At the end of the process the adapters with the highest scores are selected as Wild Card Adapters. Turbo10 plans to improve the matching algorithm by probing target engines for an inner centroid.

3. CONCLUSION

A metasearch engine that connects to thousands of target source engines is an ambitious endeavour. Turbo10 found that it was not feasible to tackle the problem with manual processes. As a result Turbo10 automated the process of creating and testing adapters that connect to, search and extract results from the Deep Net. This fully automated system enables Turbo10 to connect to the Deep Net en masse.

ACKNOWLEDGMENT

I'd like to thank everyone at Turbo10 HQ, especially my sister and business partner, Megan Hamilton for her tireless support and encouragement. Thanks also to my academic colleagues and mentors: Dr Ron Ben-Hador, Chris Johnson, Jim Underwood, Assoc. Professor David Wilson and Professor Jenny Edwards at the Faculty of Information Technology, University of Technology, Sydney, and Professor Ron Weber at the Business School, University of Queensland.

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NOSOCOMIAL INFECTIONS AS A SUITABLE CASE FOR THE GRID

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ABSTRACT

On the detection, identification and notification of antibiotic-resistant strains as a Grid problem

1. NOSOCOMIAL INFECTION AND ANTIBIOTIC RESISTANCE

A pattern familiar in the United States is repeating itself in Europe. In the US, after AIDS and food-borne illnesses, nosocomial infections are already the third most costly and deadly infectious diseases. The growth in these has continued unabated for nearly two decades, despite many measures – such as shorter hospital stays – which can reasonably be expected to have had an attenuating effect.

A major reason for this growth has been the emergence of antibiotic resistant bacteria. Pioneers of antibiosis were already aware that antibiotics provide a window of defence against pathogens, but the intensity of use through the latter half of the twentieth century has resulted in far more catastrophic outcomes than could have been foreseen. There are now bacterial strains which are resistant to all but one known antibiotic. It is widely argued that the only sustainable defence against this danger is greater vigilance, public education and a significant reduction in ‘antibiotic pressure’ in the community.

Greater vigilance and preparedness are also the only possible defences against two other modern plagues: bioterrorism and various economically catastrophic animal diseases – in the United Kingdom, BSE and FMD being cases in point. Some of the ideas in this proposal intersect with proposals for dealing with these otherwise unrelated dangers.

2. MONITORING THROUGH AN INFORMATION SYSTEM

There are many projects in Europe and elsewhere aimed at surveillance. In Europe, these range from the large scale EU-funded projects, such as the European Antimicrobial Resistance Surveillance System (EARSS) and the European Resistance Intervention Study (EURIS) [EUR99], to smaller partnerships between universities and commercial organizations [Lam01]. From the larger projects, attention is drawn especially to the 2000 EARSS report [EAR00] which documents activities in the participating states; from the EURIS project, see [Sol03].

In Canada, an expert conference in May 1997 recommended the creation of the Canadian Coordinating Committee on Antimicrobial Resistance (CCCAR). In the US, the American Academy of Microbiology has issued a report [AAM00] which treats antimicrobial resistance as an ecological problem. In 1999 the National Nosocomial Infections System, which has been in existence since 1970, had to scale down its scope since the too high resource demanded by the project was resulting in inaccurate and inadequate information in some areas. In the same year, the Public Health Action Plan to Combat Antimicrobial Resistance [CDC99] was launched with the aim to support and improve surveillance, prevention and control, research and product development. The executive summary of this report, a series of promissory notes, provides a convenient list of actions to be taken in combating antibiotic resistance.

3. A ROLE FOR THE GRID?

There are several scientific and technical challenges in the design of a grid-based epidemiological information system (GEIST). The typing, i.e. the identification, of bacterial strains is a problem for several reasons, among which the multiplicity of typing methods and the difficulty in communication in the absence of a universal coding system are significant. Projects to define a common language often rely on one particular method (for a European example, see [GEN00]), but there is a need to continue to accommodate new techniques which promise greater discrimination. It is argued that typing of bacterial strains, with the need to search for and reconcile fuzzy information across a large number of reference locations, is in itself a suitable grid problem.

However, the problem of infection is wider than the identification challenge. Any strategy to combat antibiotic resistance based on epidemiological insights will have to take account of the impact of such factors as levels of antibiotic prescription [Ekd02] and of what is known about patterns of disease evolution. In both these areas, provided information is gathered – e.g. about the volume of pharmacy-dispensed antibiotic prescriptions – the evidence base, on which to determine best practice, would itself continue to evolve and improve.

A grid collaboration in the epidemiological control of antibiotic resistant pathogens would require at least the following:

- (a) partnership and integration of knowledge from projects such as EURIS and EARSS;
- (b) a plausible solution to strain identification as an information problem;
- (c) coordination of biomathematics efforts to identify and predict patterns of disease propagation.

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MULTIMEDIA OBJECTS IN WEB SITE USABILITY PROBLEMATIC

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ABSTRACT

The addition of multimedia objects in a web site is nowadays necessary, both to attract the attention of the users, both to provide them a best service. Since multimedia comes with a high price-tag in terms of bandwidth, it should be used sparingly and with care. The goal is to provide a pleasant product, without compromise its usability.

The usability test is the best way to verify the effectiveness and efficiency of a web site, both for e-learning and informative sites. In order to optimize time and budget, it would be better to base the whole web site project on the achievement of established usability parameters. This experiment aims to design and implement a simple web site, conforming to the most reliable heuristics for producing a usable web site, with the addition of two particular multimedia sections, that make critical the web sites usability. Then a usability test has been designed and executed on this site and on two other web sites similar in purpose and contents, in order to compare the outcome.

The results which emerge from the usability test, compared with the other two web sites, reflect our expectations. Designing a web site, keeping in mind just a few basic principles, produces a better result with a lower maintenance cost, following these standards ensure that users can understand the individual interface elements in the product and that they know where to look for what features. It does not ensure that users will know how to combine the interface features or that the system will have the features users need [Nielsen, 1999]. So it's always essential a specific usability test, at the end of implementation step. The web site we produced turned out to be more user-friendly than the other contemporary web sites tested. We are now studying further special features and test items that could be added in a usability test when dealing specifically with distance learning in University level courses.

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INTERNET IN THE ELEMENTARY SCHOOLS OF “TRÁS-OS-MONTES E ALTO DOURO” REGION – PART TWO: THE METHOD¹

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ABSTRACT

In this paper we describe a visit—working session—visit method that can be used to help teachers with Internet usage as a learning tool. By doing so, we work simultaneously with teachers and students at the school. The first school visit has primordial importance, making possible a direct contact with the teachers, and noticed that in the schools where we have directly contacted the teachers the participation ratio was higher. A web site to help teachers, students, and parents, with pedagogical strategies and activities is also described, from which we point out a group of dynamic on-line exercises. We think that this site may help increment Internet’s use as a learning tool.

The method described is unique in the “Trás-os-Montes e Alto Douro” region, and is being extended to other Portuguese regions.

KEYWORDS

Elementary school, Internet, learning tool, methods

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Doctoral Consortium

PhD PROJECT ON KNOWLEDGE MANAGEMENT AND INTELLECTUAL CAPITAL

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1. KNOWLEDGE MANAGEMENT AND INTELLECTUAL CAPITAL

Bontis et al. (2002) suggest that intellectual capital represents the “stock” of knowledge that exists in an organization. Managing this stock of knowledge in the firm is the domain of knowledge management (Choo and Bontis, 2002). There are different dimensions of intellectual, and flows between them. There must be made a fundamental distinction between stocks and flows of knowledge (Dierickx and Cool, 1989), (Roos and Roos, 1997), (Bontis et al., 1999). Knowledge is a puzzling concept, tough to measure (Spender, 2002).

Value is created when stocks of knowledge are employed and degrades when they remain unused (Pike et al., 2002). Knowledge assets are not consumed when they are applied to solving organizations problems, on the contrary, a knowledge asset’s value is generally maintained and often enlarged by its application, while conventional assets must be depreciated or replaced (Spender, 2002). Thus, knowledge management is a strategic issue (Nonaka and Konno, 1998), (Alvarez and Barney, 2001), (Bontis and Nikitopoulos, 2001).

Knowledge-based approach opens up new questions about the interaction of the explicit and tacit (Polanyi, 1962) knowledge assets (Spender, 2002). This new organizational reality challenges the traditional planning, organizing, leadership, controlling, accounting and other organizational practices (Sveiby, 1999), (Guthrie, 2001), (Mouritsen et al., 2001). Firms need to redefine their strategies and functions to compete in the knowledge era. The “knowledge intensive firms” represent the new kind of organizations that employ large proportion of highly qualified staff (the “knowledge workers”) (Blackler, 2002) The knowledge-based competitive advantage (Nonaka, 1991), (McEvily and Chakravarthy, 2002) is sustainable because the more a firm already knows, the more it can learn (Cohen and Leventhal, 1990). Literature presents a distinction between two main knowledge management strategies: Exploration and Exploitation (March, 1991), (Lovas and Ghoshal, 2000), (SubbaNarasimha, 2001), (Choo and Bontis, 2002), (Zack, 2002), (Bierly and Daly, 2002), (Knott, 2002), (Ichijo, 2002), these will be the ones considered in the study.

The Intellectual capital concept emerged from the differences found between market and book values (Sveiby, 1999), (Brooking, 1997), (Bontis, 1998), (Edvinsson, 2000), (Joia, 2000), (Bontis, 2002a), (Bontis, 2002b), (Pike et al., 2002), and it represents the wealth of ideas and ability to innovate that will determine the future of the organization (Bontis, 2002a). The intellectual capital of the firm is such a powerful resource (Barney, 1991), (Alvarez and Busenitz, 2001), (Cohen and Prusak 2001), (SubbaNarasimha, 2001), (Bontis, 2002c), (Nahapiet and Ghoshal, 2002) that it is often recognized as the most valuable (Stewart, 1999), (Cohen and Prusak, 2001), (Nahapiet and Ghoshal, 2002), it is the most important asset in the organization (Wiig, 1997). Intellectual capital is an intangible asset (Sveiby, 1999), (Canibano et al., 1999), (Stewart, 1999), (Sánchez et al., 2000), (Caddy et al., 2001), (Sveiby, 2001), (Winter and Szulanski, 2002) and it can be seen as the base of competitive advantage (Birchall and Tovstiga, 1999) (Davenport and Prusak, 2000). The intellectual capital’s typology adopted is the one considering the dimensions: human capital, structural capital and relational capital (Petrasch, 1996), (Saint-Onge, 1996), (Bontis, 1998), (Lynn, 1998), (Sánchez et al., 2000), (Bart, 2001), (Bontis et al, 2002), (McElroy, 2002), (Wexler, 2002).

2. LEVEL OF ANALYSIS

According to Barney (2001) and Rouse and Daellenbach (2002) the resource based view perspective should adopt the organization as its unit of analysis. I'll approach the research question at the organizational level within a single industry as advised (Dess et al., 1990), (Rouse and Daellenbach, 1999), (Hitt et al, 2001) and adopted by many authors (Bontis, 1998), (Bontis and Fitz-enz, 2002), (Stovel and Bontis, 2002), (O'Regan et al., 2002), (Hitt et al., 2001), (Rouse and Daellenbach, 1999), (Bontis et al., 2002), (McEvily and Chakravarthy, 2002), presenting the possibility of generalization (Bontis, 1998), (Bontis et al., 2000), (St Leon, 2002).

3. RESEARCH MODEL AND METHODOLOGY

I'll have to clearly define constructs and draw my measurement model with the constructs and its items. I'll use constructs and items already applied on previous research. The items for identifying the knowledge management strategies and the intellectual capital dimensions are supported by literature review (Bontis, 1998), (Crossan et al., 1999), (Bontis and Girardi, 2000), (Bontis et al., 2000), (Bontis et al., 2002), (Crossan and Hulland 2002). I consider the option of introducing some items to better identify the constructs and adapt them to the portuguese reality and the industry chosen.

In this process I must pay attention to: content validity (through literature review and expert's analysis); reliability (internal consistency, split halves, test-retest, alternative forms or inter-rater reliability) (Boudreau et al, 2001), and construct validity (discriminant and convergent - using exploratory factor analysis and confirmatory factor analysis). I'll have to establish relationships among my constructs - underlying the hypothesis - and come out with my structural model to test them. This will be my conceptual framework.

After gathering secondary data, I'm going to use a survey as the instrument to do my data collection (Bontis, 1998), (Bontis et al., 2000), (Bontis and Girardi, 2000), (Bart, 2001), (Bart et al., 2001), (Hitt et al., 2001), (Bontis et al., 2002), (St Leon, 2002). Following some authors (Song and Zahedi, 2001), (Bontis et al., 2002), I'll run pre-tests and pilot tests to convenient samples to identify possible errors or problems related to items and constructs. To make my study most robust I'll develop semi-structured interviews at the firms (O'Regan et al., 2002), (Stovel and Bontis, 2002), (Bontis and Fitz-enz, 2002).

I'll have to determine my sampling method and sample size based on literature review and the industry chosen. The information I'll collect will then have to be statistically analysed. I'll use structural equation modelling as my estimation model (Cortina, 1997), (DeShon, 1997), (Aguinis and Pierce, 1999), (Edwards, 2000). Structural equation models are sets of linear equations used to specify phenomena in terms of cause-and-effect variables. The models allow for variables that are not measured directly, and they are particularly helpful in the social and behavioural sciences. The goal of structuring equation analysis is to provide plausible explanations of observed correlations by constructing models of cause-and-effect relations among variables. Significant correlation coefficient does not imply causal relationship, yet convincing arguments for causality can be constructed from statistical inference, together with postulated relationships developed from knowledge of subject, or common sense (Johnson and Wichern, 1992).

My research hypotheses at this point are: **H1** - Human Capital is positively associated to Structural Capital; **H2** - Human Capital is positively associated to Knowledge Management Strategies; **H3** - Knowledge Management Strategies have a positive impact on Structural Capital.

Hopefully I'll be able to gather evidence in support of the relationships I've established.

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TOWARDS PRIVACY PROTECTING MOBILE BUSINESS APPLICATIONS

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ABSTRACT

The development and wide spread of Information and Communication Technology (ICT) has given birth to innovations in the way business is being dealt with and provided to end-users. Currently and in the near future, due to the rapid development of mobile technology, organizations are extending their access channels and services to the mobile channels. However, a lot of challenges exist that are delaying the spread of mobile business applications. One of those challenges is incorporated into privacy threats. Regulatory frameworks may have organized and issued protective ways of dealing with personal information, but technically enforcing these rules is still in its infancy. In this paper, we propose to develop an ICT architectural framework that supports privacy protection in mobile information services such that it can resolve the conflict, of managing personal information, existing between personal information owners (users) and information collectors (service providers).

KEYWORDS

Mobile business applications, Context Awareness, Privacy

1. INTRODUCTION

In the last decade, a big movement has been noticed towards the Internet. Many enterprises put their business onto the Internet to make it available for their customers electronically in what is known as business-to-consumer (B2C) and Business-to-business (B2B) applications. The rapid development in mobile communication technology and the widespread of mobile devices have paved the way for a new computing paradigm known as anytime and anywhere, *ubiquitous*, computing together with a new market domain known as mobile commerce [Samulowitz, 2000]. Efforts are being exerted to extend and develop e-business applications and models for mobile business channels. This attention towards mobile business is due to its expected benefits compared to electronic business or simply e-commerce, such as increase in revenues and trust relationships.

However, a lot of research efforts are still required before this comes to reality. The current limitations of mobile communication networks and devices and the heterogeneous contextual information of mobile users such as different devices capabilities, network resources, users preferences and interests, motivate service providers to adapt services content and information to the users context.

We enunciate that context awareness adds new challenges to privacy not previously considered by existing regulatory frameworks due to the passive collection of users personal information through sensors available anywhere and at any time [Ackerman et al., 2001]. In fact, more threats do exist in such mobile applications due to the ubiquitous linkage between individual identities and their context.

We aim to develop an ICT architecture that resolves the conflict existing between personal information owners (individuals) and information collectors (service providers) regarding privacy control. This conflict is caused by the confrontation between service providers, aiming to collect more information about users in order to provide personalized services, and users requirements of controlling their privacy aspects.

In sections 2 we give a review of privacy supporting technologies. Section 3 presents the research objective, questions, and strategy respectively while section 4 concludes the paper.

2. PRIVACY SUPPORTING TECHNOLOGIES

The privacy concept has been dealt with for a long time. Due to its importance, legal frameworks have been addressing privacy. One of the most effective privacy legislation was that attained by the US Privacy Act 1974, as it defined new privacy principles such as fair information practices and affected the successor privacy policies all over the world [Langheinrich, 2001]. Europe has been addressing privacy legislation via implementing the so-called Directives within the European council and also establishing cooperation with other countries privacy regulations [Casal, 2001]. Increasingly, privacy policies have been submitted to organize and maintain users privacy issues, and to ensure privacy protection.

Privacy-enhancing technologies represent a means of enforcement of privacy regulations and policies. Privacy-enhancing technologies are believed to help reducing privacy threats, however, they are still neither effectively implemented [Huizenga et al., 2002] or legally and socially accepted and a lot of research efforts are still required.

As privacy threats emerge as a result of the linkage between identities and context, thus it can be deduced that there are two options to solve this privacy problem; whether to control users identities, by deterring identity capturing, or to control contextual information perception.

Deterring identities capturing is not an acceptable option to most service providers, or organizations. Organizations always collect users identities before issuing their services, as a means of controlling their business. However, efforts have been exerted on developing credential systems that support anonymous transactions in electronic commerce applications [Chaum, 1985; Camenisch and Herreweghen, 2002].

With *anonymity*, users identification information can be hidden or not included while collecting user information, thus it is not important to get users consent when transferring or dealing with. However, anonymity is not commercially wide accepted due to the complexity of implementations and the cost retained and also because it is not relevant for activities where identification is required such as payments. In addition, anonymity, in principle, is not suitable for personalization of services or information. Increasingly, Rao and Rohatgi [2000] argue that anonymity cannot guarantee full privacy, due to possibilities of leakage of some information that can be collected in subtle ways using traffic analyzers and therefore leading to identification of information sources.

However, for applications where identification is required, users identities can be replaced with dummy identities through what is known as *pseudonymization* [Lysyanskaya and Rivest, 1999]. Hence, service providers can personalize their services and adapt to users preferences but at the same time users identities are kept confidential. A user can have different pseudonyms for different service providers. However, multi virtual ID's or pseudonyms is still annoying users privacy, since a third party might be able to link all these VID's and to reach the original identity of the users [Hauser, and Kabatnik, 2001; Hauser, 2002].

The second option in preserving privacy, controlling contextual information perception means controlling parties abilities to collect users sensitive information. *Reducing* the amount of sensed contextual information represents the easiest way for that purpose. However, this option cannot be feasible in a limited environment such as the mobile networks, with limited bandwidth, reliability, and devices capabilities, where context adaptation is required. Hence, contextual information collection is not likely to be reduced, and indeed, difficult to be controlled.

Controlling contextual information perception can be achieved via *access control* of users information objects; or by *data randomization* using hash functions before it is submitted and then collecting it back at the target. A third way of controlling personal information while stored in databases, is via *database randomly partitioning* into unlinked encrypted partitions located on different sites that cannot release data separately, such that data is useless unless collected together at one server and decrypted via its owner [Clifton et al., 2002].

Cryptographic algorithms such as public key and symmetric algorithms have been introduced to support data encryption transmission on traditional networks. However, with the high complexity of such algorithms based on arithmetic computations, it is relatively not well suited to be applied to restricted computation devices such as mobile terminals [Lamparter and Westhoff, 2002].

Agrawal et al. [2002] introduce a new class of databases, known as *Hippocratic Databases* for protecting personal data privacy. They develop a *strawman* design approach that concerns applying privacy policies and encryption mechanisms in protecting privacy. Increasingly, Agrawal and Kiernan [2002] propose a watermarking algorithm to mark the sensitive attributes in relational databases such that the data owners through private keying control access to this sensitive information. However, this represents a real challenge because data owners are normally users (can be other organizations) who do not have access to the hosting organization resources.

Moreover, a possible way of protecting users critical information unobtrusiveness is to prevent the accessibility to the information from outside a certain physical area. This concept is known as *data proximity* [Langheinrich, 2001]. On the other hand, *Smart cards* can be developed to save users information. However, privacy and security threats still do exist, since information transfer of sensitive information needs to be secure. In addition, how will the other party deal with the received information is a privacy matter.

3. RESEARCH APPROACH

As discussed above, privacy control in context aware mobile applications (services) is still in its infancy. To the best of the authors' knowledge, little research effort has been exerted so far. New mechanisms are required that support explicit consent of the users, and provide them with the capabilities to have full control of their contextual information.

Thus, this work aim is to support privacy protection of context aware mobile applications (services). We propose to develop an ICT architectural framework. This architecture should be aware of users privacy requirements and legal issues, up-to-date by always reflecting users recent privacy preferences, provide users with technical means to know when privacy agreement to be changed to reflect a new demand by the collector, to allow users to access their data at anytime, performing full control of their own data such as update, error correction, delete operations, and assigning access permissions. Increasingly, this framework is required to be flexible, and extendable such that more functionality can be added according to the changes in the business requirements.

The main research question is

“How can privacy be protected in context aware mobile applications (services) such that the conflict of both users privacy requirements and organizations collection of contextual information is resolved?”

In order to answer this question, a number of sub questions need to be answered: -

- What are the privacy threats and functional requirements specifically added by context aware mobile applications?
- How to design an architectural framework of building blocks that support privacy protection in context aware mobile applications?

The choice of the research approach mainly depends on both the research problem and the status of the theory development in the research area [Vreede, 1995]. Research development starts with theory building, then theory testing and finally theory expanding. The research approach can be summarized as follows: based on privacy problems, and threats in context aware mobile applications, perceived from literature or empirical studies (case studies), functional requirements of privacy control are defined and represented. Then abstracted into descriptive conceptual models of building blocks that are used to design the conceptual architecture. Then the developed architecture should be tested and validated. Testing and validating is carried out through a number of case studies and a prototype. Finally, based on the obtained results, an evaluation is carried out.

4. CONCLUSION

In this paper, we gave an overview of current privacy protection mechanisms and possible solutions to overcome privacy threats. However, new approaches are still required to support privacy in mobile and context aware information systems due to its limitations and the new requirements and functionalities.

We propose to address privacy protection in this domain. We aim to propose an ICT architecture that resolves the conflict existing between information owners (individuals) and information collectors and users

(service providers) regarding privacy protection. This conflict exists because individual personal information is controlled with different actors, and when protecting privacy by giving individuals full control of their personal information, service providers managing and processing capabilities might be affected.

Currently, we investigate the possible privacy threats existing in mobile information systems together with the requirements and functionalities that are needed to design a privacy protective mobile information system. Then, based on these specifications, we will be working on developing a new model that supports privacy and helps in resolving the mentioned conflict. We still need to investigate which privacy mechanism will effectively solve this problem. Increasingly, experiments will be conducted on some mobile applications, using a UMTS test bed, to help shaping the specifications and testing the designed model.

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AN APPROACH FOR DEVELOPING DECISION SUPPORT SYSTEMS FOR MODELING OPERATIONAL PROCESSES OF BUSINESS NETWORKS

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ABSTRACT

In the Industrial era, an era in which the concept “self-sufficiency” is considered as a trend for survival, organizations model their operational business processes to find & analyze bottlenecks, and analyze alternative solutions. Models are simulated in order to identify bottlenecks in the operational processes and to experiment different alternative solutions. In the current era, an era in which the concept “services and business networks” is considered as a major trend for survival, organizations have to model not only their own operational business process but also the business networks they are involved in. In this era, organizations provide a full service to customers by creating networks with other organizations. Each organization focuses on its core competences and outsources the rest in order to meet customer’s increasing and changing demands. In doing so, each organization need to have models that give insight into the operational processes of the would-be or existing partners, i.e. business network, in order to assess and evaluate the overall operational processes. However, creating operational level models of a business network is not easy for an organization inside the network, as the operational processes of other organizations do not appear transparent. It seems crucial to support decision makers in organizations with models of operational processes of business networks. It is the aim of this research to develop an approach for supporting decision making in business networks through operational processes modeling. In addition, the aim is to assess the usefulness and relevance of the models for improving operational processes of business networks. It focuses on a decision maker in an organization who needs operational process models of external organizations in a business network.

KEYWORDS

Models, business networks, operational processes, decision-making

1. INTRODUCTION

Just as in evolution theory, where the fittest organisms are those that are the most adaptable, organizations that are capable of adapting quickly to the rapidly changing environment are the most likely to survive and thrive. In the Industrial era, organizations were trying to control and own upstream activities and processes as a means to survive and adapt. Ford car manufacturing is an example (Bowersox, D.J et al., 1996). The company set out to implement its “self-sufficiency” plan in order to outperform its competitors. Not wanting to be dependent on other companies that supply ingredients for car making, Ford’s decision makers invested in a number of spare part factories, companies, and even lands for planting tire-making rubber trees.

In the current era, organizations are using inter organizational relationships as a means of adapting and increasing performance level (Sol, H.G., et al, 2001). This is because the current era is characterized by high competition, high information flow, high demand for timeliness and accurateness of information, change of business needs, and change of customer needs. According to Sol et al (2001) trends such as deregulation of markets, increase use of information and communication technology (ICT), outsourcing, and globalization, indicate this fact. Therefore, in order to survive in the current era, organizations create alliances and business networks (Bowersox, D.J et al., 1996) (A business network consists of set of organizations that are

conducting business by creating relationships among them, e.g. supply chain partners). By using these business networks, organizations bring together their core competencies to create “best of all” products or services.

Because of the above characteristics of current era, interactions within business networks are complex and dynamic which creates difficulty in assessing operational processes of the network. In the industrial era, organizations assess their operational processes in order to increase performance level. However, in the current era, organizations have to have insight into the operational processes of the business network, in addition to their own, because there is so much dependency on the network. We think that, to make appropriate assessments and evaluation of operational processes of business networks, decision makers needs representative models of the different operational processes. However, getting or creating such models is challenging given the fact that organizations in the business network are not transparent and the overall business network is unstable. *It is the aim of this research to develop an approach to support decision-making in business networks through operational processes modeling.* Focus is given to a decision maker in an organization who needs operational process models of external organizations in a business network.

2. THEORIES AND CONCEPTS

Some of the important concepts and theories that will be used in the research are the following.

2.1 Decision making

The decision problems in which decision makers are involved can be well structured, unstructured, or semi structured depending on how familiar the decision maker is with the existing state, desired state, and the transformation necessary to go from one state to another one. The type of solutions envisaged to these decision problems can be maximum (outcome of the decision is clear and alternatives are well established), “satisficing” (decision made in a situation of uncertainty), or incremental (decision making in small steps away from the existing state towards a desired state). Decision support systems (DSS) are designed to support semi structured and unstructured decisions in situation where information is incomplete and where “satisficing” is a goal. In addition, DSS are used in all phases of decision-making processes.

Simon (1960) states that decision-making processes consist of four parts: intelligence (seeking problem that needs decision), design (identification of possible alternative directions), choice (selection of a direction), and review (evaluation of choice). According to him, decision makers show rationality only within the limits imposed by the information provided to them.

2.2 Business networks

There are different definitions and ways to look upon organizations. The way organizations are described depends on the on the communicator’s context. Organizational phenomena are being described lately using the concept of networks. According to Nohria (1992), there are three reasons for increase use of network concept: New Competition, technological development, and maturing of network analysis as an academic discipline. In the New Competition, organization face more global competition, deregulated markets, increase customer selectivity on price, quality and services. In response to these factors, companies restructure their organizations to become flexible and dynamic (Hammer, M. et al, 1993). The resulting new forms often involve inter and intra organization collaboration and interactions. According to Nohria, Network is the model of organization in the New Competition whereas large hierarchical firm was the old model. According to Baker (1992), network organizations are organizations integrated across formal groups, created by vertical, horizontal, and spatial differentiation for any type of relation. An organization’s environment is properly seen as a network of other organizations.

2.3 Modeling and simulation

Zeigler et al (2000) established a framework for modeling and simulation consisting of four entities: source system (real or artificial source of data), experimental frame (specify the conditions under which system is observed or experimented with), model (system specification that contains instructions for generating data), and simulator (computational device for generating behavior of the model).

In System theory, two types of models of a system is considered: structure (internal constitution of a system) and behavior (its outer manifestation).

3. RESEARCH APPROACH

According to Vreede (1995) a *research approach* maybe defined as following a certain *research strategy*, in which a set of *research instruments* are employed to collect and analyze data on the phenomenon studied, guided by a certain *research philosophy*. Since the outcome of the research is to propose an approach to support decision-making in business networks through operational process modeling, the research philosophy followed is interpretivism, which states that reality can only be understood by subjectively interpreting observations of reality. The research strategy, which outlines the steps to be taken in a scientific inquiry to meet the research objective, is inductive-hypothetical model cycle (Sol, 1982) that is based on Singerian strategy. In inductive-hypothetical model cycle, knowledge about the problem and feasible solutions are obtained by endless adaptation through induction and multidisciplinary view of new observations. Different research instruments (the way the research steps are carried) are used during the research: literature review (to study previous researches done in the same direction), experiment & prototyping (to understand the problem incrementally as well as realize concepts), and action research (to test concept and theory in reality and assess the outcome).

In the initial stage, a case on US Department of Defense (DOD) supply chain management was used to inductively discover and understand interorganizational issues. The case involved numerous organizations interacting with each other, which gave insight into the problem that organizations do face difficulty in understanding their environment (business network) and that there is a need to understand the business network. In addition to the case study, literature review was used in the initiation stage to understand the problem from other researchers perspective and the efforts done so far to alleviate the problem. The analysis of the problem revealed that developing an approach to support decision-making in business networks through operational processes modeling seems necessary.

As mentioned earlier, the outcome of the research is to provide an approach to support decision-making in business networks through operational processes modeling. Sol proposed a framework for presenting approaches using *way of thinking*, *way of working*, *way of modeling*, *way of controlling*, and *way of supporting* (Sol and Van Hee, 1991; Sol and Crosslin, 1992). The way of thinking refers to the philosophy that is used in the approach. The way of working specifies the steps that are to be taken in order to realize the approach. The way of controlling specifies the guidelines and set of directives (e.g. management of time, means and quality aspects) that are to be followed while using the approach. The way of modeling defines the modeling concepts that are used in order to use the approach. Finally, the way of supporting refers to the support tools that are used in order to solve a problem using the approach.

4. PRELIMINARY RESEARCH

As mentioned in the introduction section, the problem at hand is that organizations are increasingly facing difficulty in understanding the operational level processes of the business network they are involved in. This difficulty hinders decision makers, within each of the organizations, from evaluating and assessing their operational processes (e.g. assessing resource utilization, processing delays, and inventory control). To investigate the problem and to evaluate different alternative approaches to solve it, we assume that *operational level models can improve understanding of the operational processes of organizations and decision makers in organizations can make informed decisions if they have insight into the operational processes of the organizations they interact with.*

Since the problem context is not new, there are already some generic approaches proposed to support decision-making in business networks, even though they do not focus on operational processes modeling. Vreede(1995), for instance, proposed Group Support System (GSS) to assist decision makers in business networks to build operational processes models jointly. Babeliowsky et al (1994) used group support system in order to build inter organizational logistic model by involving all the stakeholders. Even though this approach is advantageous in a sense it facilitates coordination between stakeholders, it assume that all organizations in the business network are fully transparent and stakeholders are willing to compromise their interest.

In the fields of competitive intelligence, business intelligence and process intelligence there are numerous approaches developed in order to model external organizations in a business network. There are tools and technologies already available (e.g. data mining, expert systems, neural networks, fuzzy logic, genetic algorithms, rough sets, approximate reasoning, intelligent agents and hybrid systems) for decision makers to model business network i.e. other organizations in the network. However, the previous approaches used in modeling business networks assume that all the organizations in the network are collaborating fully and therefore are fully transparent i.e. internal data and processes are transparent. In addition, most of these technologies are mainly used in modeling strategies, financial health, shifting demographics, lifestyle trends, opening of new markets, government policies, and in other high level issues. Focus was not given in operational processes.

In this research, we take the assumption that organizations appear as a gray box (depending on the relationship and business network) within a business network and operational processes are not fully transparent. Currently, experiments are being conducted to evaluate different ways for modeling operational processes of organizations in a business network by using a case study that consists of two supply chain partners in interaction.

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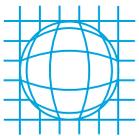
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