University of Applied Sciences Northwestern Switzerland
School of Business

sponsored by
Ecademy CH

CollECTeR Europe 2006

Proceedings edited by
Petra Schubert and Daniel Risch

Published June 2006

basel, switzerland, june 9-10
CollECTeR europe 2006
collaborative electronic commerce technology and research

Proceedings

University of Applied Sciences Northwestern Switzerland
School of Business
Competence Center E-Business Basel

Peter Merian Strasse 86
4002 Basel

www.e-business.fhbb.ch

Imprint

Printed by University of Applied Sciences Northwestern Switzerland FHNW

June 2006

Petra Schubert and Daniel Risch (eds.)

ISBN: 3-9810394-1-6

Collaborative Electronic Commerce Technology and Research Background of CollECTeR Europe 2006 in Basel, Switzerland

The CollECTeR series of conferences (http://www.collecter.org/) was established to link research centres at universities to form a basis for collaborative research in Electronic Commerce.

Conference Topic 2006: Collaborative Business

The "networked economy" challenges organizations to consider the use of Collaborative Business, namely the combined deployment of groupware and e-business infrastructures. Mobile computing technology and collaboration support have reached a level that makes a seamless integration of communications and data processing economically feasible. This constitutes our notion of Collaborative Business: the timely bundling of communication, coordination, and collaboration activities.

The focus of CollECTeR Europe 2006 is on new forms of Customer Relationship Management (CRM) – including mobile CRM – that cover the whole value chain and use new working modes. This concerns questions related to the optimisation of channels, the improvement of customer acquisition and retention, and after-sales contacts and services.

Aim

CollECTeR Europe 2006 is a forum for researchers to present and discuss their current and ongoing work. In order to stimulate a lively discussion the number of participants is limited to approx. 30 people. The aim of the event is to bring together researchers and practitioners to discuss foundations and industry potentials of Collaborative Business. This includes the exploration of the effective deployment of novel technologies and services.

Contributions are grouped into sessions covering the following topics:

- Digital archiving, privacy and property rights
- Personalization
- Markets and business processes
- Mobile and ambient business
- Communities and Work Group Collaboration
- Social systems
- Security devices and secure communication

All paper submissions to CollECTeR Europe 2006 represent the original work of the authors. There were no rigid guidelines regarding paper size for the final research papers. We asked to submit between 6 and 8 pages.

The social event, the conference dinner, lunches and breaks were sponsored by Ecademy, the National Network of Excellence of the Swiss Universities of Applied Sciences for E-Business and E-Government.

Basel, June 2006 Petra Schubert and Daniel Risch

Table of Contents

Digital archiving, knowledge management and the persistence of digital data: managing access to digital resources as technologies change: A Discussion Paper.

Carole Alcock,[1] Joan Cooper[2] and Lois Burgess[3]

[1] University of South Australia
carole.alcock@unisa.edu.au

[2] Flinders University
Joan.Cooper@flinders.edu.au

[3] University of Wollongong
lburgess@uow.edu.au

Abstract

As electronic resources displace independent media such as paper, digitally stored information becomes vulnerable in ways that may defy solution. Indeed, these resources are vulnerable to the very changes embodied in the new technologies. This discussion paper suggests that if new standards are not established for the storage and maintenance of resource collections, the advantages of electronic delivery will be lost. However, focus on storage alone is not sufficient. It is essential that the issue of long term access be addressed at the point of creation of the digital resource. Changing technologies, hardware and software will continue to present problems for long term access unless appropriate procedures are put in place to ensure that essential digital resources are preserved and continued access assured. The methods suggested to date: archiving the technology, migration of data, and emulation, all present problems of cost, practicality and loss of data. Today, our ability to store information is unparalleled. The wealth these stores contain is essential to our economic and social wellbeing. This wealth is of little use, however, if we lose the key.

1 Introduction

Assuring the longevity of essential digital resources is a critical element in effective knowledge management systems. While emerging technologies promise greater access to information, there is an obverse side to this prospect. As electronic resources displace independent media such as paper, digitally stored information becomes vulnerable in ways that may defy solution. Indeed, these resources are vulnerable to the very changes embodied in the new technologies. This discussion paper suggests that if new standards are not established for the storage and maintenance of resource collec-

tions, the advantages of electronic delivery will be lost. While the initial debate has come from government public records agencies and libraries, this problem is not unique to those sectors. It is one which must be addressed by all sectors: government, business and industry.

2 The problem

Changes in technologies, which affect delivery and the ease with which records can be copied and changed, mean that, for some records, permanence can no longer be guaranteed. However, this is not the main reason for concern. Changes in software and hardware are occurring so rapidly that some records may not make the transition from one system to the next. While, for the more ephemeral records this may not be important, there are many areas, in business, industry and research, where it will be essential to retain access to electronic resources stored on media only accessible through older systems. Access might depend not only on retaining the records themselves, in whatever storage media, but also multiple versions of software and even hardware. If standards are not in place for the migration of records, the advantage of electronic storage will be lost.

In his discussion of approaches to information management, Bentley [1998] emphasised the importance of completeness and correctness of information, the prevention of deterioration and avoidance of accidental loss and corruption. One of the advantages of today's technology is that we expect that digital copies will not be degraded, that they will be the exact same as the original. While this may be so initially, with the passage of time, changes in software, hardware, and systems, degeneration may occur in digital copies, too. Bentley also pointed to the risk of dependency on Information Systems. Witness the panic over the Y2K problem. This demonstrated society’s dependence and the interdependencies of organisations on computer systems. One of the positive aspects of this crisis was that it forced businesses to undertake inventories of critical systems [Manion & Evan: 379] and to recognise the importance of IT systems and resources to strategic decision-making. If access to resources is lost or corrupted, business will suffer.

The Y2K experience also made businesses aware of their interdependencies both within and outside organisations and across national borders. Ohmae emphasises this importance of the flow of information among countries and the change that has occurred. Information once monopolised by governments is now accessible to individual citizens [Ohmae: 18-19]. He speaks of global citizens who have their own sources of information and are no longer dependent on government sources. While dependency may have shifted away from governments, access to information itself will remain essential to well functioning businesses and societies. Indeed, without the guarantee of protection and safeguards that governments can provide it is even more important to ensure the longevity of those resources essential to continuing development.

One of the most significant issues is that of technological obsolescence. This issue is one which should be of great concern. An example, which illustrates this point is that of the 1960 US census which was stored on magnetic tape [Parkes:362]. By 1976, the equipment needed to read this tape was no longer available at the Census Bureau, and only two such machines survived: one in Japan and another in a US museum [Parkes:362]. The information the tapes contained was of significant historical value to the National Archives. Fortunately, a copy was able to be made which did allow long term preservation [Parkes:362]. This is just one example but it illustrates the problem.

While much focus has been on the physical storage media itself, the problem of technological obsolescence should be of far greater concern. This view is strongly emphasised by researchers in this area [Parkes:363].

3 Who is affected? (Business, Archives, Libraries)

Efficient record storage and retrieval is essential to business success. To meet commercial and statutory requirements, information has traditionally been stored in hard-copy media such as paper or microform. To maximise the benefits accruing from the exponential growth forecast in electronic trading, organisations will become increasingly dependent on electronic forms of transaction records. Archiving of these records in a manner that ensures access for the future thus becomes a matter of serious concern.

The external resources that business use have been affected. Denison's and Stewart's *Electronic sources of information for business in Australia and New Zealand*: (3rd ed: 1998-1999), presented a comprehensive list of electronic sources for business including a mix of 'stand alone' media like CDROMs as well as web and traditional online database resources [Denison and Stewart]. This is a rapidly changing field with many of the traditional electronic resource providers experiencing considerable pressure to keep up with the demand from business to provide more flexible, accessible and affordable electronic resources in line with the heightened expectations that Internet access has produced. Many of these services existed in some form before Web access was generally available and have had to adapt to the new technologies in order to maintain their business market.

Most people are familiar with some aspect of these problems of archiving, if only on a small scale. System software upgrades, hardware changes, moves to a different e-mail system, all can cause problems where access to files are concerned. In the business sector, such changes may cause problems which have legal and financial ramifications for the company.

The difficulty of access to large collections of information resources is not new. Negotiating today's web of digital information has been compared with the labyrinthine stacks of the monastic library described in Umberto Eco's *Name of the Rose* [Alexander: 23]. Access was not the only concern of that period. Previous to the advent of the printed book, the degeneration of content, both text and pictorial, of hand-copied manuscripts was a common problem to the extent that classical authors warned against relying completely on their content [Eisentstein: 194-195]. Errors were inevitable. One of the perceived advantages of today's technology is the expectation that digital copies will not be degraded, that they will be the exact same as the original. While this may be so initially, with the passage of time, changes in software, hardware, and systems, degeneration may occur in digital copies, too.

4 What is being done?

Governments are moving towards greater dependence on electronic data storage and hence are already engaged in digital archiving projects. While their requirements may differ from those of the business sector, there are still benefits to be gained from a study of current digital archiving projects to establish where there is overlap and to establish the extent to which these projects have dealt with the problem of changing technologies and changing format requirements.

Some research into digital archiving is well established in the field of government and in libraries. The Victorian Government in Australia, for example, embarked on a whole of government approach to electronic records keeping. The Victorian Electronic Records Strategy (VERS) Project was aimed at enabling Victorian Government agencies to implement satisfactory electronic archiving systems and strategies which would facilitate long term accessibility. Other studies have been conducted. For example, the US National Historical Publications and Records Office funded a project at the University of Pittsburgh in 1995. Another study, *Preserving Digital Information* was conducted by the US Commission on Preservation and Access and the Research Libraries Group (1996).

A project of interest at the UK Public Records Office at Kew was EROS: Electronic Records in Office Systems (UK: Cabinet Office. Central Information Technology Unit's Government Directive Initiative: Digital Records. August 1998). The role of the Public Records Office (PRO) includes the electronic preservation of government records. The EROS Web site [see bibliography] gives information on this project. Some examples of the records kept on this system included:

(i) Committee proceedings, notes and attendees; and, (ii) Drafts of a Green Paper. The latter was presented in pdf format. Dates allowed movement back and forward to various versions of document (dates indicated changes made).

Large scale data storage functions have been undertaken by Oxford University Computing Service which Archives electronic assets of University of Oxford [Feeney: 34-35]. The University of London Computing Centre provided a databank for a variety of depositors including the Public Records Office. Work was undertaken on a contract basis, with management of data at the bit stream, on a 'cost for quantity' economic model. The Computing Centre's core service was as a ‘Safety Deposit Box’ [Feeney: 37-38]. Clearly, for governments and the library sector this could be matter of serious concern. For the business sector, where access to records is a matter of financial survival, tackling this problem is essential.

Businesses are attempting new ways of dealing with the expanding need for digital storage. One example is the Media Asset Management (MAM) systems which aim to provide faster retrieval of digital assets (graphics, illustrations, page layouts, and compound documents which may include movies and sound, etc.) and create metadata characterising the particular asset [Anon.: 1998]. In order to get the most out of these systems it is recommended that digital assets first be organised in folders or binders in much the same way as for paper documents like letters and faxes. It is suggested that not doing anything about media asset management isn't an option as the problem will only get worse [Anon.: 1998]. While this is an example of the concern over digital assets which focuses on access, the need for organisation of resources and for appropriate metadata, the compounding problem of changing software will still need to be addressed.

Storage is another area where changes are occurring. Annual growth rates for storage provision have been reported to be more than 60%. Storage management costs were rising by 25% p.a. Hence the growth in outsourcing to Storage Service Providers (SSPs). These could be viewed as information utilities allowing faster rollouts of new applications, improved security, backup and data archiving[Moore:1,24].

Enterprise Storage connects to, stores and retrieves data from all major computing platforms in both mainframe and open systems environments. It also allows connection

to networks, file servers, Web servers and management interfaces. Consolidation of data is facilitated and managers are able to leverage information from throughout the enterprise. Enterprise Storage Network (ESN) [Rich, 2000] provides a single infrastructure which exploits the power of information. It is independent of location, cost effective, flexible and provides easy scalability (up or down). Other aspects include: cross-platform connectivity, transparent and non-intrusive data migration and data-centric storage architectures. ESN presents particular advantages in merging organisations [Rich, 2000].

It is clear from the above examples that there is some overlap in the concerns of the public and private sector organisations in their focus on data migration and data storage. Indeed, some have pointed to the idea of the web as a distribution system for content and suggested the prospect of its developing into a distributed system to enable migration of content [Evans: 1999]. While approaches may differ, there are surely benefits to be gained from both contributions.

5 Proposed solutions (Migration, archiving the technology, emulation, standards)

Proposed solutions to ensure access include: archiving the technology, migrating content as systems and software change, saving data at the bit stream and using emulation software as required [Rothenberg, 1995: 24-29]. Archiving the technology is unrealistic although it is conceivable that there may be a role for this to some degree. In the summary provided in Parkes, solutions focus was around three areas: migration of data; emulation; and standardisation.

Migration involves not only transferring the data to the new media but ensuring that the necessary modifications have been undertaken to maintain compatibility with the new technology [Parkes: 369]. Exact copies can not be guaranteed, however and the task may involve some complexity [Parkes: 369]. Most regular users of word processing and presentation softwares would be familiar with the problems involved in migrating basic documents as software packages are upgraded! Indeed, the US Task Force on Archiving Digital Information (1996) noted that migration is 'time consuming, costly and much more complex than simply refreshing' and did not favour this method [Parkes: 370].

Emulation: Rothenberg's proposal to provide software which emulates the original hardware and software environment is discussed [Parkes: 370]. While this method has received some favourable reviews, it is suggested that many of the same problems are evident here as for migration, among them the economic feasibility of continually producing emulation software given the speed of technological change.

Standardisation: Again, Rothenberg's work is referred to [Parkes: 371]. While preservation in a computer system independent format may be suitable for some content, problems arise if structure is an important element [Parkes: 371]. This may be one reason why pdf format documents have been favoured by some digital preservation projects.

Victorian Electronic Records Strategy (VERS) was a joint project of the Public Records Office of Victoria and the CSIRO [PROV:1998]. Its aim was to provide good record keeping for government business with a focus on long term storage requirements. A successful prototype was developed with potential financial benefits. All government departments would be involved. Electronic records would be produced in long term format, captured at point of production. Information is preserved within metadata and includes data formats and descriptions of content [Waugh,2000]. Standards estab-

lished included: Use of XML; PDF; digital signatures to ensure integrity; standardised metadata [PROV: 1998]. Interest had been expressed from the business sector.

From discussions with researchers involved in some of the projects listed above and in others in the UK and Australia, it might be concluded that none of the solutions offered a final answer. More recent proposals such as Genomic storage, while interesting, seem impractical at present [Wong, 2003]. Problems with all of these proposals include: practicality, costliness and loss of information.

6 Standards (XML, PDF, etc.)

In his discussion of the importance of XML, Berners-Lee [p.173] points out that it 'stems the tide of information loss' because it allows anyone to create their own tags as they deem necessary. Hence, 'An XML document is typically richer: the information it contains is more well defined.'[Berners-Lee: 173]. XML is favoured for these reasons by influential groups internationally (W3C) and has gained widespread acceptance.

Other potential standards have been indicated above, among them pdf, digital signatures and standards in metadata. The usefulness of pdf was noted in 4 above: Drafts of a Green Paper were presented in pdf format. Dates allowed movement back and forward to various versions of document (dates indicated changes made). Although pdf relies on proprietary software, its broad availability and popularity and the popularity of XML certainly hold some promise for their being adopted as standards in the short term. The VERS project above included these among the favoured list of standards.

7 Recommendations (Procedures, the process)

While discussion of standards tends to consider the global context, local needs must also be considered. Joseph Stiglitz - Chief Economist with the World Bank, when discussing to the Global Development Network emphasised the importance of locally based research institutions which possess a knowledge of local conditions and needs. For this reason, global 'technological fixes' may never be adequate to meet the digital archiving needs of individual businesses. To some degree, the focus will need to be on procedures and processes which take into account local conditions.

For most organisations, the integrity and accessibility of electronic records is essential to the success of their enterprise. As has been suggested, the rapid changes to technology, changes in hardware and software for example, present difficulties where long term preservation is concerned. How to ensure the migration to a new system, of all records essential to the conduct of their business, is a perennial concern with no quick solution. What is needed along side the technical solutions is a set of policies and procedures which will guarantee that all essential records are indeed retained and are accessible and secure.

It will be important to develop a standard approach to dealing with record storage and retrieval within an environment of continuing technological change - for both software and hardware. One step should be the design of a process methodology which defines a uniform set of standards for adoption by the organisation, to enable the storage and retrieval of strategically important information.

The organisation will be well aware of the importance of guaranteeing that client records are not lost as records migrate for one system to the next and of the need to ensure efficient and effective access over the long term. A preliminary study of specific

needs which covers areas such as commercial transactions, client information, financial record keeping, legal requirements and focuses also on the enabling technologies will aid identification of the essential procedural elements.

International standards are being developed as regards the use of metadata in providing access links between electronic media. It is important that these standards, especially as they relate to the specific needs of the organisation concerned, be considered when establishing procedures.

8 The Future (merging software, Data mining, Data warehousing, Knowledge Management Tools, Digital Archiving)

"… after only a few generations of computer hardware, software and Web content, there is little in the way of an enduring cultural heritage to build upon." (Bergeron, 2002:258)

Bergeron has suggested that Cyberspace culture is based on a loss of data: programs, operating systems, databases, application specific files, all are disappearing. What is preserved is a matter of choice. What is remembered or revived depends on the priorities and values of a given group at a given time. Indeed, what has come down to us as classics from past centuries, as O'Donnell suggests, have been influenced by artificial imperatives. He illustrates this by pointing to the revival of the reading and copying of Latin classics at the time when Christianity became the official religion of the Roman state [O'Donnell: 109-110]. Undoubtedly, this selectivity was continued during the periods where expensive and time consuming manuscript copies were made in medieval libraries, usually in monasteries. Today, too, choices will be made as to what is to be preserved. The likelihood that much will be lost that, perhaps should have been preserved is real. Clearly, the changing technologies make that inevitable unless some simpler means for the digital preservation of resources is found.

Established technologies such as data warehousing and data mining present a reactive approach often dealing with legacy systems. Newer Knowledge Management (KM) Technologies focus on current business needs. Much of the discussion around digital storage and digital archiving on the other hand, tends to be proactive and concerned with both current and future access. This is important. Descriptions of current developments in all of these, suggests a merging of technologies to a degree. A more radical approach may appear: Internet scale operating system, storage and applications could provide a partial answer (Anderson and Kubiatowicz,2002). However, assuring long term access to content through global agreements on standards may continue to be difficult to achieve.

9 Conclusion

Efficient storage of digital resources is an urgent concern for both private and public sector organisations. However, focus on storage alone is not sufficient. It is essential that the issue of long term access be addressed at the point of creation of the digital resource. Changing technologies, hardware and software will continue to present problems for long term access unless appropriate procedures are put in place to ensure that essential digital resources are preserved and continued access assured. The methods suggested to date: archiving the technology, migration of data, and emulation, all present problems of cost, practicality and loss of data. Today, our ability to store in-

formation is unparalleled. The wealth these stores contain is essential to our economic and social well being. This wealth is of little use, however, if we lose the key.

References

ALEXANDER, Michael and PRESCOTT, Andrew. (1998) The Initiatives for Access programme: an overview. In: Leona Carpenter, Simon Shaw and Andrew Prescott (eds.). *Towards the digital library: the British libraries Initiatives for Access programme.* London: The British Library, 1998 : 15-27.

ANDERSON, David P. and KUBIATOWICZ, John. (2000) *The worldwide computer: an operating system spanning the Internet would power many of the world's Internet connected PCs to everyone's fingertips.* In: Scientific American.V.286(3):40-47.

ANON. (1998) Assets management applies to all media. In: *Graphic Arts Monthly.* Sept. 1998: V. 70(9):98-99.

ANON. (1999) New digital archiving and custom publishing solution introduced. In: *Information Today.* V.16(1):30

BENTLEY, Trevor J. (1998) *Managing information: avoiding overload.* London: Chartered Institute of Management Accounts, 1998.

BERGERON, Bryan. (2002) Dark Ages II: when digital data die. Upper Saddle River, NJ: Prentice Hall.

BERNERS-LEE, Tim with FISCHETTI, Mark. (1999) *Weaving the Web: the past, present and future of the World Wide Web by its inventor.* London: Orion Business Books.

CARPENTER, Leona; SHAW, Simon and PRESCOTT, Andrew (eds.). (1998) *Towards the digital library: the British libraries 'Initiatives for Access' programme.* London: The British Library.

DENISON, Tom; STEWART, Janet M. (1988) *Electronic sources of information for business in Australia and New Zealand: 3rd ed: 1998-1999.* Melbourne: RMIT Publishing.

ELECTRONIC RECORDS IN OFFICE SYSTEMS (EROS)
http://www.pro.gov.uk/records management/eros : now see:
http://www.nationalarchives.gov.uk/electronicrecords/advice/pdf/principles.pdf

EISENSTEIN, Elizabeth. (1993) *The printing revolution in early modern Europe.* Cambridge, UK: Cambridge University Press.

EVANS, M.P. et al. (1999) Strategies for content migration on the World Wide Web. In: *Internet Research: Electronic Network Applications and Policy.* V.9(1): 25-34.

FEENEY, Mary (ed.) (1999) *Digital Culture: maximising the nation's investment: a synthesis of JISC/NPO studies on the preservation of electronic materials.* London: National Preservation Office; British Library.

KESSLER, Jack. (1996) *Internet digital libraries: the international dimension.* Boston: Artech House.

MANION, Mark; EVAN, William M. (2000) The Y2K problem and professional responsibility: a retrospective analysis. In: *Technology in Society.* No.22: 361-387.

MOORE, Fred. (2000) First ISP, then ASP, now SSP. In: Computer Technology Review. May 2000: 1,24.

O'DONNELL, James J. (1998) *Avatars of the word: from papyrus to cyberspace.* Cambridge, Mass.: Harvard University Press, 1998.

OHMAE, Kenichi. (1999) *The borderless world: power and strategy in the interlinked economy.* Rev. ed. New York: HarperBusiness.

PARKES, Mitchell. (1999) A review of the preservation issues associated with digital documents. In: *Australian Library Journal.* Nov. 1999: V.48(4):358-377.

PETROSKI, Henry. (1999) *The book on the bookshelf.* New York: Vintage Books, 1999.

PUBLIC RECORDS OFFICE VICTORIA (AUSTRALIA*)* (1998) *Victorian Electronic Records Strategy Final Report.* [Melbourne]: Public Records Office Victoria.

RICH, Stewart et al. (2000) Storing up for the future. In: *America's Network.* V.104(9):85-90.

ROTHENBERG, Jeff. (1995) Ensuring the longevity of digital documents. In: *Scientific American.* Jan. 1995: V.272(1): 24-29.

ROTHENBERG, J. (1999) "An Experiment in Using Emulation to Preserve Digital Publications" *The Koninklijke Bibliotheek & RAND-Europe*, April, 1999.

ROWLEY, Jennifer. (1998) *The electronic library.* London: Library Association Publishing.

STIGLITZ, Joseph. (1999) Scan globally, reinvent locally: knowledge infrastructure and the localization of knowledge. Keynote Address*. First Global Development Conference.* Bonn, Germany: Dec. 1999

WAUGH, A., Wilkinson, R., Hills, B. and Dell'oro, J. (2000) "Preserving Digital Information Forever" *Proceedings of the 5th ACM Conference on Digital Libraries*, June, 2000, San Antonio, TX, pp.175-182.

WONG, P.-C., Wong, K.-K. and Foote, H. (2003) "Organic Data Memory Using the DNA Approach" *Communications ACM*, 46(1) (2003): 95-98.

Privacy Negotiations enhance Data Collection for CRM

Sören Preibusch

German Institute for Economic Research
spreibusch@diw.de

Abstract

The application of Privacy Negotiation Techniques alleviates the Privacy-Personalization trade-off by reconciling consumers' quest for Privacy with the service providers' personalization efforts. The kind and amount of personal data to be disclosed is individually settled. By applying the mechanisms of privacy negotiations to data collection for customer relationship management purposes, drop out rates can be reduced. The service provider strategically designs the negotiation settings and includes external sources in the data acquisition process. This paper describes the service provider's tasks when designing a successful negotiation scheme and provides two examples of use in telecommunication industry.

1 Introduction

Consumers are facing a large and increasingly complex range of web based services. Recent applications include online retailing, where product information and personalised product recommendations are made available to the shopper. Retail stores are constantly expanding their assortments in width, depth and quality levels. As a result, consumers are confronted with a number of product alternatives that makes an exhaustive comparison impossible [Gross 1994]. Therefore, customers appreciate being offered effective guidance through automated recommender systems [Personalization Consortium, 2000].

On the supply side, service providers face stiff price competition due to the commoditization of digital services. Successful customer value extraction requires attracting and binding customers by new means. Personalized services, individually tailored for a single consumer, create lock-in effects. In addition, enterprises need to identify potential high-value customers to successfully focus their marketing endeavours. A recent survey concluded that knowledge from, for and about customers is a mission-critical factor [Salomann et al. 2005].

Yet Customer Relationship Management (CRM) typically relies on large amounts of data to be collected and kept over time. For new customers, credit assessment or service eligibility evaluation requires the potential user to divulge personal data for at least a one-time use. Careless data collection activities and data misuse are nowadays discussed in mass media and remember customers to care about their Privacy.

The depicted situation is known as the Privacy-Personalization trade-off. A common way for websites to communicate their data-handling practices is to post “privacy policies” on their website. Though, this approach is too inflexible and impractical. Privacy Negotiation Techniques (PRINT) can overcome current drawbacks of static privacy policies, and reconcile privacy and personalization.

Our contribution is to depict how privacy negotiations can be used to enhance the data collection activities for CRM. It will be shown that individually negotiable revelation schemes lower drop-out rates due to customers aborting transactions when too much personal data is asked for [IFAK 2002]. Well-crafted negotiation strategies and data combination from multiple sources allow enterprises to gain access to previously private information.

The remainder of this paper is organized as follows: Section 2 will briefly explain the mechanisms and advantages of privacy negotiations. Section 3 focuses on the strategic design of privacy negotiations and describes the service provider’s tasks. Before concluding with a summary and outlook, a detailed application scenario in telecommunications is provided in section 4.

2 Advantages of Privacy Negotiations

Thompson defines negotiations as an “interpersonal decision-making process necessary whenever we cannot achieve our objectives single-handedly” [Thompson 2005]. Distributive negotiations are carried out in case the amount to be distributed is fixed and the stakeholders only discuss how to allocate it. Due to the scarcity of goods, distributive negotiations lead to win-lose situations. Multi-attribute negotiations, however, offer the opportunity to find an integrative solution which is beneficial for all parties involved. Such mutually beneficial bargains increase welfare and unleash additional economic potential [Ströbel 2000]. When applied to privacy levels, integrative negotiations between a service provider and a user can overcome two major shortcomings of existing online privacy handling mechanisms:

- The first shortcoming is the “take-it-or-leave-it” principle. The user can only accept or refuse the provider’s privacy policy proposal as a whole.
- The second shortcoming is the “one-size-fits-all” principle. Once the service provider has designed his privacy policy, it will be proposed to all potential customers – regardless what their individual preferences are. There may be users who would have accepted offers with less privacy protection and would have agreed to the provider’s proposal even if more personal data would have been asked.

Due to the limned shortcomings, the provider fails to tap the users’ full potential. It has been demonstrated that the drawbacks of static privacy policies persist even if the service providers offers several of them. Similarly, a market-driven specialization of competing service providers, each of them focussing on a user group with given privacy preferences will not succeed [Preibusch 2006a].

Privacy negotiations can be implemented in Web applications by extending the Platform for Privacy Preferences (P3P) developed by the W3C [W3C 2006]. P3P enables service providers to express their data collection practices in standardized machine-readable policies. Via P3P’s built-in extension mechanism, multiple negotiation options can be coded smoothly and displayed to the user at his choice [Preibusch 2006b].

3 Strategic Design of Privacy Negotiations

As observed in the previous section, the economic benefits and the ease of implementation plead for service providers to migrate to dynamic, i.e. negotiable privacy policies. When putting privacy negotiations into practice, service providers have to perform several consecutive tasks, each of them being portrayed in the following sub-sections.

3.1 Service Provider's Tasks

3.1.1 Choosing the Negotiable Privacy Dimensions

Apparently, it is not feasible to negotiate entire privacy policies. Typically, a privacy policy is composed of parts that can be subject to negotiations and parts that are fixed and not suitable for individual agreements. As an example, consider the meta-information contained in a privacy policy, stating expiry dates, issuer data, and contact information. These parts are unchanging.

Hence, one important aspect is to identify relevant and negotiable privacy dimensions. We define a *privacy dimension* as one facet of the multi-dimensional concept 'user privacy'. For each dimension, different discrete revelation levels exist, monotonously associated with the user's willingness to reveal the data. Privacy dimensions can be identified at different degrees of granularity [Preibusch 2006a].

The four top-level privacy dimensions are the recipient of the data, the purpose for which the data are collected, the time they will be stored, and the kind of data. These four dimensions (recipient, purpose, retention time, and data) are in accordance with European privacy legislation [European Parliament 2002a, 2002b].

The importance of each of the four dimensions as perceived by the user as well as her respective willingness to provide information depends on the thematic domain of the service. Yet, it is common to focus on the amount and kind of data to be revealed. Hence, the service provider has to choose a subset of the privacy dimensions spanning the data space. Examples for second-level privacy dimensions under the data dimension are: the user's name, her birth date, postal address, and telecommunication details.

When examining traditional data collection practices, one notices that the data requested from the user coincides with the data to be used in the subsequent business processes. However, when enhancing data collection with privacy negotiations, this identification no longer stands: the service provider faces different types of users having different revelation preferences for each of the privacy dimensions in concern [Preibusch 2006a]. By taking advantage of complementarities between personal data, the service provider may offer alternative privacy dimensions from which the user can choose. Data complementarities are largely based on inference rules. For instance, the user's home country (privacy dimension: postal address) can be inferred from her international telephone code (telecommunication details). The case study in section 4 will further stress on this issue.

3.1.2 Choosing the privacy Revelation Levels

After having decided the negotiable privacy dimensions, the service provider fixes different discrete revelation levels and a revelation threshold for each of the privacy dimensions. The revelation levels correspond to increasing detailedness. For instance,

the dimension ‘birth date’ may have the revelation levels ‘none’, ‘year’, ‘year and month’, ‘year, month and date’, and ‘year, month, date and hour’. Obviously, the service provider will not include irrelevant facts like the hour of birth – thus, he imposes an *upper limit* for the revelation levels.

The thresholds indicate the minimum detail level to be revealed and are usually openly communicated. They correspond to the *lower limit* for the revelation levels. In implementations, hints like ‘required field’, ‘required information’ or form fields marked by an asterisk are common practice. The obligation to reveal those data can be deduced from the nature of the transaction: It is obvious that an online bookstore cannot achieve postal delivery if the user refuses to provide her shipping address.

The different degrees of detail corresponding to the revelation levels are usually easily deducible from the data type. Users can be guided to a given revelation level by a wisely chosen rebate structure (cf. next section). Thus, setting the thresholds is the major scope for designing the negotiation environment.

3.1.3 Designing the rebate structure

Private information being of value to both the information holder and the information seeker, the customer expects to get compensation when revealing personal data. The user’s benefits can be divided into non-monetary personalization benefits and monetary benefits. Latter are well assessable and can thus be subject to planning; the service provider develops a discount scheme, indicating the rebate on the purchase price granted to the customer when revealing a given combination of private information. The rebate structures maps every possible privacy negotiation outcome to a percentage. (Note: Coupons of a fixed amount are often used in practice. They are equivalent to a percentage discount worth at most the ratio of the minimum purchase price.)

The design of the rebate structure constitutes the service provider’s major possibility to make customers prefer one negotiation alternative over another. Yet, the setting has to fulfil the constraints of incentive-compatibility as described in the next section.

3.2 Incentive-Compatible Rebate Structures

The service provider faces different types of users with diverging privacy preferences [Preibusch 2006a]. Though he knows that different types exist, such like identity concerned or marginally concerned customers [Spiekermann 2001], the service provider is unable to tell a user’s type at the time when revealing her the rebate structure. It can be acknowledged that every user prefers higher discounts over lower discounts and less detailed revelation over more detailed revelation; yet the concrete preference subtleties are unknown to the service provider. Thus, the final rebate structure has to incentivise *all* users so that they opt for negotiation outcome beneficial to the service provider *regardless their type*.

Incentive compatibility has to be fulfilled at the time when the customer makes his decision about which data to reveal. Yet, CRM efforts are targeted to long-term relationships and participants’ attitudes may vary over time: a participant may be initially very open in terms of providing personal information for a CRM system, but later decide to draw back information. We consider it to be hard for participants to take these changes in attitudes into account. Privacy preference transformations are often triggered by external events like misuse of data or other bad experience, unforeseeable by the user.

The correct discounting of uncertain future utility values is a challenging if not unattainable cognitive task. Still, these multi-period aspects are consistent with our model when interpreting the user's utility values as present values.[1]

Consider the following example where the service provider faces a marginally concerned consumer (index 1) and an identity concerned user (index 2). The parties negotiate about the customer revealing her birth date and her email / name as an identifier. For the dimension 'birth date', the revelation levels 'none' (0), 'year of birth' (Y), and 'year, month, and day of birth' (YMD) exist; for the dimension 'name', the revelation levels 'none' (0), 'email' (E), and 'email, first name, and last name' (EFN) exist, with the revelation threshold being to divulge at least the 'email' address. The following figure (Fig. 1) depicts the global rebate (R) and the disutility values U_{DD} for both user types: this negative utility value must be compensated at least by an appropriate discount, before the consumer is willing to disclose the respective information [Preibusch 2006b].

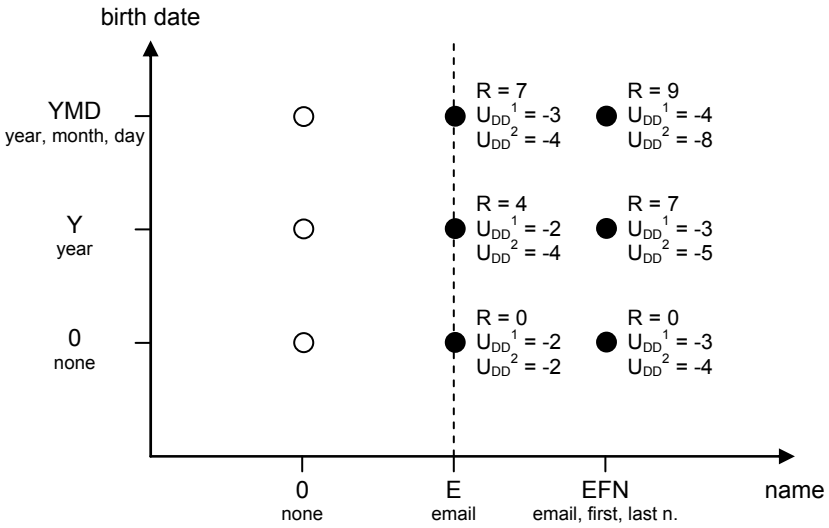


Fig. 1: Rebates (R) and disutility values (UDD) for two types of users. Negotiation outcomes not fulfilling the revelation thresholds are excluded from further analysis.

Each user chooses the negotiation option that yields to the maximum positive total utility $U = U_{DD} + R$.

Based on the current rebate structure, both users would disclose their full birth date, but only the marginally concerned user (1) would also reveal her full name details. The identity concerned user (2) would only disclose her email address (cf. Fig. 2). Though, in multiple settings (cf. section 4 for an example from telecommunications), the service provider valuates access to a user's name details higher than to the birth date details: For customer segmentation based on ages, only the year of birth is necessary, as is for majority checks. In addition, as shown in the next section, the first name can be used to impute a user's age and validate her statements concerning her age.

[1] Privacy-friendly systems may respond to changing user preferences by setting relatively short data retention times, allowing for renegotiation after a given period.

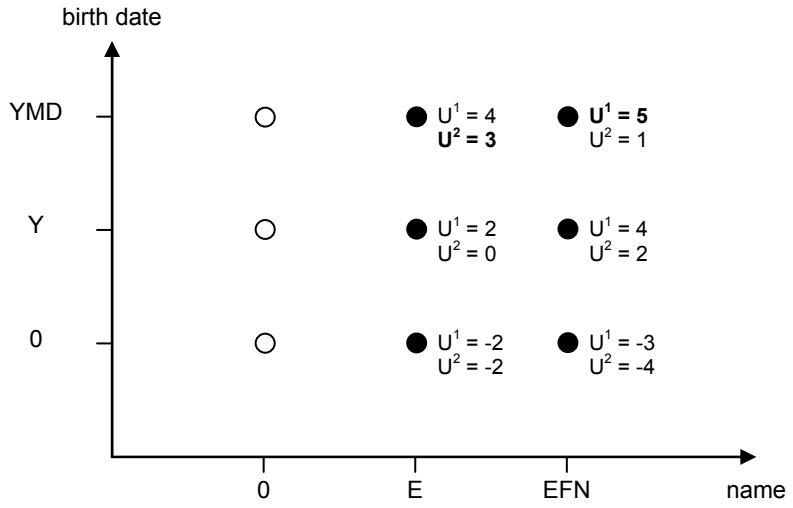


Fig. 2: User 1 would choose the negotiation option (EFN, YMD) and user 2 the option (E, YMD).

The service provider thus has to revise its negotiation design so that all users reveal their name details. The first alternative is to increase the threshold on the 'name' dimension. This, however, would result in a rather rigid setting, more comparable to static privacy policies than to privacy negotiations. The second alternative is to change the discounts. The service provider can either (a) increase the rebates for desired outcomes, or (b) reduce the rebates for unwelcome outcomes.

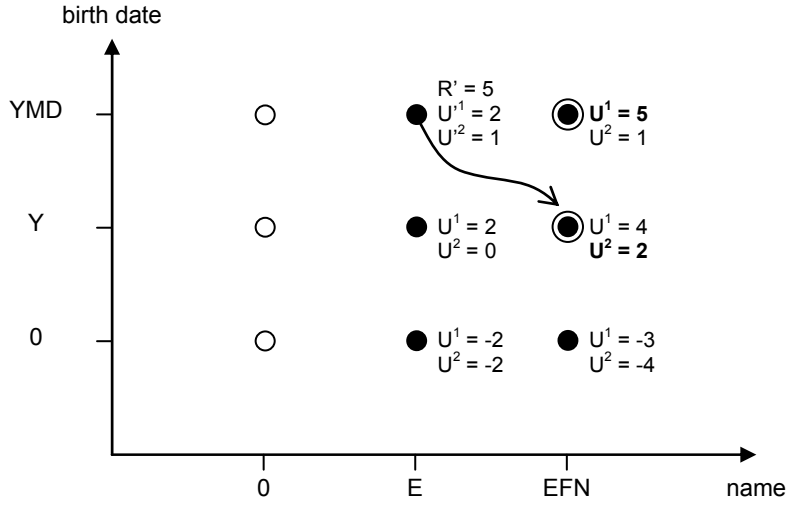


Fig. 3: Revised rebate structure: Both users choose negotiation options where they reveal full name details.

(a) The service provider may increase R(EFN, Y) by 2. However, the user 1 would then switch to (EFN, Y) which is an undesirable result. The service provider may also increase R(EFN, YMD) by 3. Yet, this would result in R(EFN, YMD) being 12 – an unjustifiable high value.

(b) The service provider may decrease R(E, YMD) by 2. User 1 would stay with the option (EFN, YMD) and user 2 would switch (EFN, Y). Consequently, both users would reveal full name details.

3.3 Strategic Alignment of Privacy Negotiations

The service provider's overall strategy aims at exploiting competitive advantages. Hence, all sub-strategies need to be targeted at acquiring new customers, at retaining existing relationships, and at performing in customer value extraction.

Accordingly, the service provider's privacy negotiation strategy has to be embedded in and needs to be aligned with its corporate strategy. As accentuated in the *customer profile life cycle* [Schubert/Koch 2002], data collection must be governed by a collection strategy. This also holds for privacy negotiations: As depicted in the previous section, the rebate structure as a core element of the negotiation environment requires revision if need be: the existing discount scheme was adapted as it formerly gave the wrong incentives. The following section illustrates the process of implementing such a goal-supporting privacy negotiations strategy based on a real-world case-study.

4 Case Study: Implications for CRM in Telecommunications

Having shown that strategically well-crafted privacy negotiations support data collection for CRM, we will now provide evidence from telecommunication industry for the successful application of these methods. Considering the case of Deutsche Telekom, we show that determining the age of potential customers is crucial and how imputation mechanisms for customer ages can be used. Second, considering the case of Vodafone, we will demonstrate how these findings can be integrated in existing data collection scenarios.[2] In addition to the results of section 3.2, we will highlight the importance of revelation thresholds in simplified privacy negotiations.

4.1 Deutsche Telekom: Determining the age of potential customers is crucial

In summer 2005, Germany's leading telecommunication provider for landline network, T-Com, planned the introduction of a new family rate [microm 2005]. T-Com is a division of Deutsche Telekom AG and operates primarily in the German market, with representations in Hungary, Macedonia, Montenegro (through Magyar Telekom), Croatia (through T-Hrvatski Telekom), and Slovakia. With about 41.7 million narrowband connections and 7.7 million broadband connections, T-Com is one of the biggest fixed network suppliers in Europe [Deutsche Telekom AG 2006].

The analysis of data from the billing system, the customer relationship management system, and the contract management helped identifying the customers *not* susceptible to adopt the new rate. However, identifying the right customers remained a challenge. The age of the customers, beside their turnovers, was recognized to be the key indicator for targeting the customer group. The existing data about turnovers and provided birth date were not sufficient for a satisfying identification of families [microm 2005]. Mainly the analysis of the customers' first names helped to close the gaps in the age-related data. The third party analysis provider "microm Micromarketing-Systeme und Consult GmbH" supplied the necessary matching between first name and age.

[2] The cases are based on publicly available information from the mentioned companies.

The age of a customer, beside her purchasing power and her marital status, is one of the most important variables in customer targeting. Several products only come into question for a narrow age-group. If age data is missing for all or for some entries in a customer database, first name analysis can help to induce the missings. Yet, the imputation of a customer's age is not trivial as remarkable regional differences in the naming behaviours can be observed. For instance, a typical "Johannes" is 65 years old when living in the East of Germany, but only 46 years when living in the South of Germany [microm 2006]. [Huschka, Gerhards, Wagner 2005] provide additional background information on the naming differences in divided Germany based on the data of the German Socio-Economic Panel Study (SOEP), supporting the thesis of naming patterns differing across regions.

Still, in an online transaction context, the availability of additional information can drastically improve the accuracy: When one knows whether the potential consumer lives in Erfurt or in Essen, the regional naming differences can be used for precise imputations. By combining automatically collectible data from the user's explicit profile (like the IP-address) with implicit profiles (e.g. the mapping from IP-addresses to regions), the data inference algorithms can be notably improved [Schubert 1999]. Services like IP2Location™ [IP2Location.com 2005] or GeoIP® [MaxMind 2006] identify visitors' geographical location i.e. country, region, city, latitude, longitude, ZIP code, ISP and domain name using a proprietary IP address lookup database, partly free of charge.

4.2 Vodafone: Consequences for Web-based data collection

According to the findings of the previous section, the general contact form on the German Vodafone Web site has been designed: First name and last name are collected for each inquiry even though only the email address would be necessary to answer the requests.

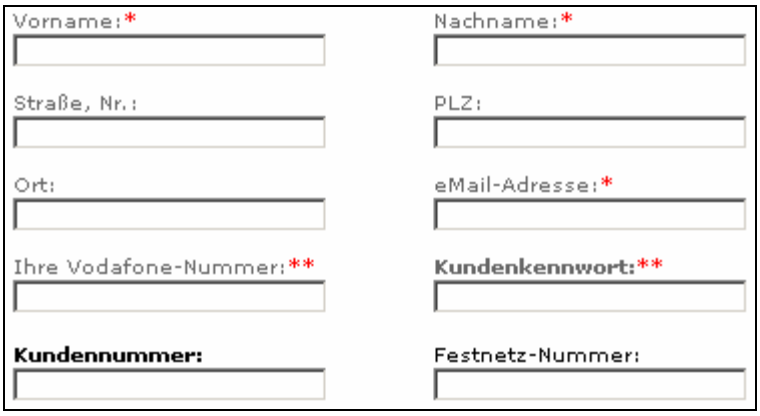


Fig. 4: Contact form on the German Vodafone Web site [Vodafone 2006]

Unlike the adaptation of the rebate structure in section 3.2, the service provider assures relevant data to be collected by setting restrictive revelation thresholds. This procedure is facilitated as there is a *social norm* for supplying the own full name when initiating a communication. Hence the visitor will probably not be surprised to be asked for her name – as it would be when asked for her birth date.

Implementing a contact form allowing for a negotiable data revelation scheme would alleviate the restrictiveness and provide customers with enhanced privacy, fulfilling the

principle of sparing data collection. As demonstrated in section 3.2, the service provider may still get the desired information as by offering the participant an enhanced CRM experience in return.

5 Conclusion and Further Research

Privacy negotiations can reconcile the personalization efforts of service providers with the privacy worries of its customers. The static privacy policies of traditional approaches are replaced by an individually negotiated revelation scheme. The service provider does not ask for every data item finally necessary; instead, data revelation alternatives are offered. The information seeker's task is to strategically shape a negotiation setting that sets the right incentives. The service provider chooses the negotiable privacy dimensions, fixes data revelation levels and thresholds, and maps out a rebate structure. By combining multiple possible input data with implicit profiles, missing data can be imputed and supplied data can be validated or checked for plausibility. The ratio of users to be lost due to excessive gathering of personal data will be reduced, as the users themselves can choose their revelation option. By the cases of Deutsche Telekom and Vodafone, we illustrated that these mechanisms are on the way to be implemented in large scale CRM.

The alignment of privacy negotiations with an overall customer data management strategy is of primordial importance. The top-down deduction of the right settings for privacy negotiations is subject of ongoing research. Implementation of an incentive-compatible rebate structure that is suited for different types of users is far from being trivial. The examples of industrial applications encourage us in our assumption that the framework of privacy negotiations will enhance data collection in customer relationship management.

Acknowledgements

The author would like to thank Michael Klafft at Humboldt-Universität zu Berlin for his helpful comments during the setup of this paper.

References

Deutsche Telekom AG (2006): Telekom - - Deutsche Telekom, http://www.telekom3.de/en-p/home/cc-startseite.html

European Parliament, Council of the European Union (2002a): Directive 2002/58/EC on privacy and electronic communications, in: Official Journal of the European Communities, 31.7.2002, L 201, pp. 37-47

European Parliament, Council of the European Union (2002b): Regulation (EC) No 45/2001 of the European Parliament and of the Council of 18 December 2000, in: Official Journal of the European Communities, 12.1.2002, L 8, pp. 1-22

Gross, P. (1994): The multi options society (original title: „Die Multioptionsgesellschaft"), Suhrkamp, Frankfurt am Main, 1994

Huschka, D.; Gerhards, J.; Wagner, G. G. (2005): Naming Differences in Divided Germany, in: Deutsches Institut für Wirtschaftsforschung, Research Notes 8, 2005

IFAK GmbH & Co (2002): Nur begrenztes Vertrauen der Verbraucher beim Einkaufen im Internet. Research study. Taunusstein. Jan. 18, 2002

IP2Location.com (2005): IP2Location™ Overview, http://www.ip2location.com/ip2location.pdf

MaxMind (2006): MaxMind - GeoIP, http://www.maxmind.com/app/ip_locate

microm Micromarketing-Systeme und Consult GmbH (2005): Krisenbewältigung im Data Mining - Der nutzenorientierte Einsatz microgeographischer Daten bei T-Com, http://www.microm-online.de/de/mcstddtl.htm?id=1199

microm Micromarketing-Systeme und Consult GmbH (2006): Vornamensanalyse, http://www.microm-online.de/de/mcstdlist.htm?cid=230

Personalization Consortium (2000): Personalization & Privacy Survey, 2000

Preibusch, S. (2006a): Implementing Privacy Negotiations in E-Commerce, in: Frontiers of WWW Research and Development - APWeb 2006: 8th Asia-Pacific Web Conference (APWeb 2006), Harbin, China. LNCS 3841, 2006, pp. 604-615

Preibusch, S. (2006b): Personalized Services with Negotiable Privacy Policies, in: Proc. of the CHI 2006 Workshop on Privacy-Enhanced Personalization (PEP 2006), Montréal, Canada, 2006

Salomann, H.; Dous, M.; Kolbe, L.; Brenner, W. (2005): Customer Relationship Management Survey, Status Quo and Further Challanges, University of St.Gallen, 2005

Schubert, P. (1999): Virtual Communities of Transaction in Electronic Commerce: Management, Marketing and Social Environment (original title: „Virtuelle Transaktionsgemeinschaften im Electronic Commerce: Management, Marketing und Soziale Umwelt"), Lohmar - Köln: Josef Eul Verlag, 1999

Schubert, P.; Koch, M. (2002): The Power of Personalization: Customer Collaboration and Virtual Communities, in: Proceedings of the Eighth Americas Conference on Information Systems, (AMCIS), 2002

Spiekermann, S. (2001): Online Information Search with Electronic Agents: Drivers, Impediments, and Privacy Issues, 2001

Ströbel, M. (2000): On Auctions as the Negotiation Paradigm of Electronic Markets Success Factors, Limitations and Research Directions, in: EM Journal of Electronic Markets, Vol. 10, No. 1, 2000, pp. 39-44

Thompson, L.L. (2005): The Mind and Heart of the Negotiator. 3rd edn. Upper Saddle River, New Jersey: Pearson Prentice Hall, 2005

Vodafone D2 GmbH (2006): Vodafone - Kontaktseite, http://www.vodafone.de/vodafonestars/17076.html

W3C (2006): The Platform for Privacy Preferences 1.1 (P3P1.1) Specification, W3C Working Draft 10 February 2006, http://www.w3.org/TR/P3P11/

Digital Rights Management for Vehicle Services

Albert Held[1], Achim P. Karduck[2] and Michael Schäfer[1]

[1] DaimlerChrysler AG, Research Vehicle IT and Services,
{Albert.Held|Michael.F.Schaefer}@DaimlerChrysler.com

[2] Furtwangen University, Faculty of Computer Science
karduck@hs-furtwangen.de

Abstract

In the content and media industry, establishing rights and licensing policies for the digital assets which are produced, acquired, managed, reproduced and distributed is of essential importance. This comprises also questions about usability and customer acceptance. The management of rights and licensing is an Intellectual Property challenge in the context of Intellectual Asset Management. XML-based Rights Expression Languages - such as XrML and ODRL - are emerging for the specification of licenses. They form the basis for sophisticated licensing-infrastructures. This paper describes our project aimed at applying concepts and technologies from DRM to vehicular service environments and scenarios. This includes the identification of the technical prerequisites for the introduction of DRM-technologies into vehicles, the development of a RightsManager, and the necessary infrastructures for a wide-scale adoption of DRM for automotive services. Our project is put into context with the EU-project "Global System for Telematics" to illustrate the expected business potential from an open, DRM-enhanced infrastructure for vehicular services.

1 Introduction

In the last years, *Digital Rights Management* (DRM) has gained momentum in the content industry, although the concepts, technologies and adoption strategies are still discussed rather controversially.

In contrast, systems and services outside the content industry are still in the pre-DRM-era, where common *role-based access control* (RBAC) systems are predominantly used to manage and enforce access rights and permissions for data and service. Often these systems and services are of closed and proprietary nature. In order to enable an open systems paradigm for complex multi-tier business architectures, methods and technologies from DRM-systems derived from the content/publishing industry, should be considered to be adopted.

Our research evaluates and demonstrates the possibilities for using DRM-technologies for services and functions in vehicular environments. Our preliminary results indicate,

that key DRM concepts and technologies can be adopted for vehicular scenarios. One key issue within DRM-systems is the description and interpretation of permissions and constraints. Licenses have to be human- and at the same time machine-readable. Therefore, they have to be based on an open standard which enables interoperability between different systems [Rosenblatt 2003] and must be easily extendable for different scenarios and use cases. *Rights Expression Languages* (REL) are used in DRM-systems to bundle metadata of digital assets into licenses, like permissions, constraints, obligations, owner and user identification. The main part of our research focuses on the usefulness of such *Rights Expression Languages* in a vehicular service environment and how a versatile, user friendly editor for REL-based licenses can be developed.

The paper is organized as follows: First a generic reference model for DRM-systems and an introduction into RELs is presented. Then, vehicle services and the application of DRM-technologies to these services are introduced. Subsequently, the adoption of DRM in vehicular infrastructures is explained by two sample scenarios. The scenarios show the potential DRM might have for creating new kinds of service markets in the car industry. Then, the need for a RightsManager with corresponding editor tool is explained. The paper concludes with related research projects and an outlook into future activities.

2 Reference model and Rights Expresssion Languages for DRM-systems

In traditional access-control systems, digital assets like content or access services are kept inside a protected, secure container, such as a fileserver. When an identified user proves that he has the proper credentials to access data, this data is then transferred outside the secure storage to the user. Afterwards the data is unprotected and can be copied, modified or transferred to third parties by the user. Traditional access-control systems for services also require that the user profiles must be known to the system beforehand and the necessary credentials have to be specified.

2.1 Reference model

In contrast to traditional access-control systems, a DRM-system is able to control and enforce the rights and restrictions of digital assets also after the asset is transferred to the user. The digital asset is stored in a secure format or container, which can only be accessed with a proper license. This is often achieved through cryptographic methods. To access the digital asset, there has to be either a generic security policy (general access control), allowing the specified kind of access, or the user has to possess a license which grants the access. While a traditional access control system can only allow certain operations at one point in time (like transferring a file), DRM-systems allow the definition of dynamic rights and constraints. The license may express a static right (like playing a digital music file), contain restrictions (like playing two times) or may be dynamic (for every playing there has to be a extra billing). The DRM-system protects the digital asset after it was transferred to the user. The following basic functions of a DRM-system can be identified.

- Authentification/identification: The participating entities, like the user, data owner or service provider, have to be identified and authenticated.

- Authenticity and Integrity of the data or service and corresponding metadata: The systems must be able to verify that the controlled data or services are the ones specified in the corresponding metadata and that data and services are not modified.
- Protection/authorization: The digital assets must be protected against unauthorized access or use, the usage is limited to the model specified in the corresponding license.
- Description: The rights and permissions for the digital assets must be described by metadata, if possible machine- and human-readable and in an interoperable format.

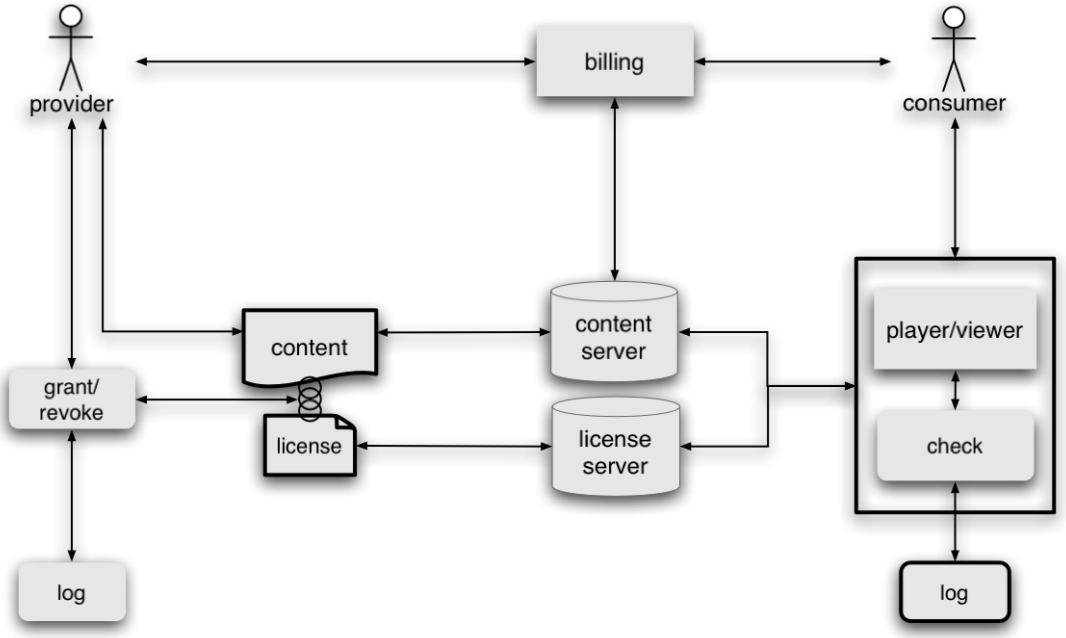


Fig. 1: DRM Reference Model

Fig. 1 shows a generic reference model for a content DRM-system. There are two main actors in the system. The **provider** of digital content (lefthand side), which is the owner, reseller or distributor of digital content and wants to define permissions and constraints for the usage of the content by the licensed or unlicensed **consumer** (righthand side). The rights and constraints for a digital asset are **granted or revoked** by the provider and expressed through a **license**. The **content** and the license are digitally secured and linked to each other. This linkage can be achieved by bundling content and license together in one secure container or by securing both independently and link them via metadata information within the license. License and content are stored in corresponding systems. The consumers acquire license and content by performing a payment (**billing**). He/She can also independently acquire licenses for content already present on his/her systems. The **player/viewer** for the digital content contains a **check**-component that verifies license and content, and identifies provider and consumer. It uses the license to open the secure content container and allows the consumer to perform the operations granted in the license.

For a DRM-system to be open, interoperable and accessable to third-party providers, superdistributors and various devices, it´s licenses have to be based on a common description standard.

2.2 Rights Expression Languages

A REL is used to express a license in a standardized way, containing permissions, constraints and corresponding obligations for a digital asset [ContentGuard 2001]. A REL allows these licenses to be described in a machine and human-readable, interoperable format (like XML), based on a common ontology for a specific DRM scenario. The two major RELs today are XrML and ODRL.

XrML stands for *eXtensible Rights Markup Language* and is owned by the company ContentGuard [ContentGuard 2006] (a joint venture of Xerox and Microsoft). XrML is an XML-based rights expression language that is extensible for different application domains and has evolved from Xerox PARCs *Digital Property Rights Language* (DPRL). XrML has been adopted by Microsoft, and is the REL of the MPEG-21 standard and specified by ISO in ISO/IEC 21000-5:2004. XrML is protected by patents and can only be used if licensed from ContentGuard [Rosenblatt 2001].

ODRL stands for *Open Digital Rights Language* and is as well an XML-based rights expression language. It features an extensible language and vocabulary (data dictionary) for the expression of terms and conditions about a content. ODRL includes permissions, constraints, requirements, conditions and offers or agreements with rights holders. The language is created and controlled by the Open Digital Rights Language Initiative [ODRL 2006a]. Supporters include for example the mobile phone company NOKIA. ODRL has been officially adopted by the Open Mobile Alliance (OMA) as the rights expression language for mobile content/devices. The ODRL specification is published as a W3C-Note [ODRL 2006b]. The next version of ODRL, version 2.0, is about to be specified and will contain major improvements and additions to the language. For our project in the vehicular infrastructure context, we selected ODRL as rights expression language, since it is an open, well-specified and already adopted by several companies and the OMA.

Fig. 2 shows the basic model of ODRL which is centered around three core elements: Assets, Rights and Parties. Parties identify entities like the right holder (provider). Assets uniquely identify the digital content or service. Usage rights describe the application domain specific permissions. These permissions are limited by constraints, requirements and conditions. A constraint for the permission "play" may for example limit the number of times a digital content could be played. A requirement could be a fee which has to be payed before playing is allowed, and conditions describe the context in which the right can be exercised (analog output only for example). An offer is a proposal by a right’s holder for a specific right, which then can be part of an agreement between two or more parties. Offers and agreements can also be revoked.

ODRL defines the grammar itself and a basic data dictionary. Domain specific elements (like rights, constraints, etc.) are defined in data dictionaries and can then be included in the ODRL-language.

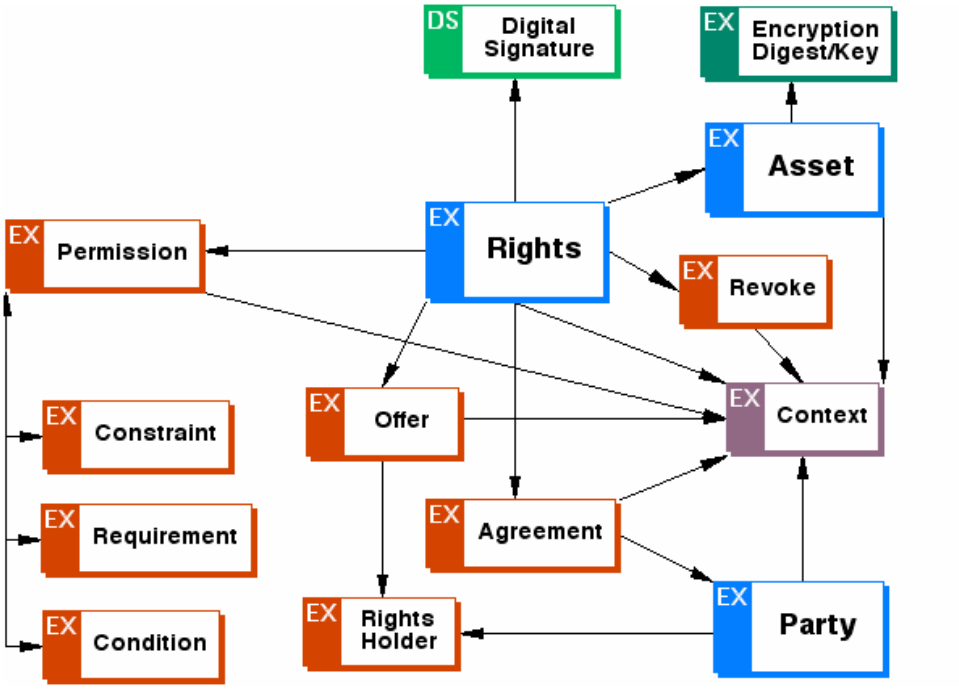


Fig. 2: Rights Expression Language [ODRL 2006b]

ODRL licenses are expressed in XML thus can be interpreted by many different systems. Through the possibility to extend the language with own data dictionaries, ODRL is not limited to specific applications domains or business models [Guth 2005].

3 Vehicle services and digital rights management

Currently, vehicle computer-systems are closed platforms. It is not easily possible for third parties to create software, which then is deployed into vehicles. Software is only produced by the car manufacturers and their suppliers. Customers cannot choose from a wide variety of software from different vendors for their vehicles and software-vendors have high barriers to enter the market of telematics. Functions available in vehicles are mostly preset when the car is bought and cannot easily or dynamically be changed afterwards. In the future, this will change with the introduction of open telematic platforms and more means of external communication features by the car (like via personal devices, the Internet or even car-to-car communication).

The security of in-car systems and software mostly depends on the secrecy of the specific command sets, their execution in a closed runtime-environment and that they are proprietary. Nevertheless, with the introduction of additional communication technologies into the car, this security may no longer be sufficient and the security-model for the vehicle software requires additional means of protection. Scenarios just as granting specific, time restricted driving permissions according to the profile of a driver, directly concern security and demand for new security models.

By transferring concepts and technologies known from traditional DRM-systems into the vehicle, two aims of an extended security model could possibly be achieved. Firstly, if vehicle services and functions are secured via DRM, the vehicular service platform can be more open and dynamic since the protection of services and functions no longer has to depend on their proprietary nature. Since all functions and services can be controlled in a fine-grained way and the DRM-system can be built in a distributed

way, it will consequently be possible to allow third parties, such as a rental car company, access to parts of the in-vehicle platform to provide dynamic services on it. Secondly, the in-vehicle software, like the firmware controlling the engine or other critical functions, could be protected by further state-of-the-art security mechanisms and, by this, making new scenarios and business models possible (for example company-directed firmware upgrades over the internet).

Fig. 3 shows our basic reference model for vehicle services using DRM-technologies. The user of the vehicle is now treated as an entity that is identified by the vehicle. There are two types of service functions. One set of functions is already present in the vehicle when it is purchased, the other set of functions is transferred into the car later on. The functions already present in the vehicle are now protected by DRM-technology, so that many functions in the car can be enabled or upgraded dynamically if the user possesses the required license. Other functions can be loaded into the car from external sources, including functionality or data which are produced by third-party OEMs. The idea is, that function usage is controlled by licenses just like in content DRM-systems.

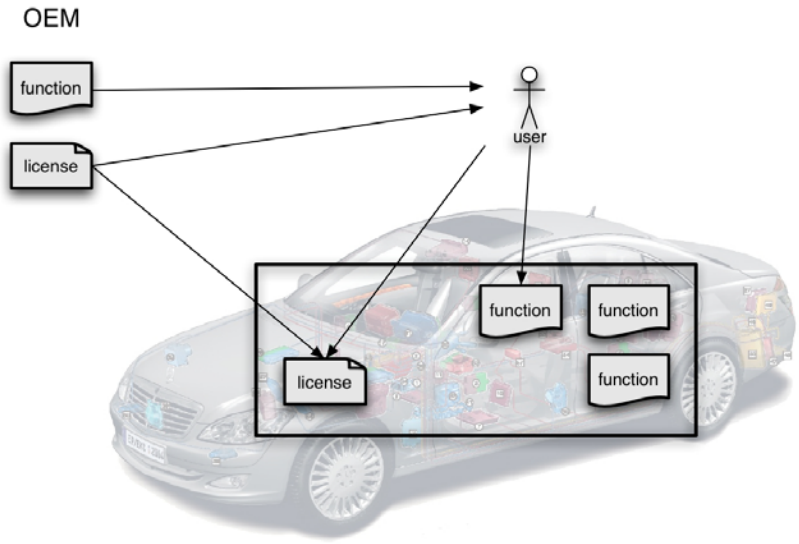


Fig. 3: DRM Vehicle Service Scenario

4 Resulting scenarios for DRM-enhanced vehicle services

We devised two scenarios for innovative vehicle services to propose the potential of our project. The first scenario is based on the fact that today, the different model variants of one car are sharing many of their physical properties, like the engine for example (platform concept). The only difference between these car variants is determined by software control over the activated functions. So, if you buy the midsize model of a car, only the software limits the horsepower provided by the engine. As well, all the different sensors for providing an electronic stabilization function may be already installed in the vehicle, but only the software reading and controlling them is missing or deactivated. If a vehicle is equipped with a DRM system, it is possible to license different functions even for a limited timespan to the driver/owner.

For example, the owner could buy additional horse-power for one weekend. The owner buys a digital license, which expresses the right to use additional horse-power for a

specified vehicle for a certain timespan. This license is then transferred into the vehicle and the built-in DRM system can check this license and activate the function.

The second scenario is heading into the opposite direction: Function restriction. It would be possible to limit to functions of the vehicle to comply with required safety and legal regulations, or for example with company policies. For a rental car it would be possible to replace today's general license to drive the car with a special license that limits the driving area to a specified geographic region. By reading the location information provided by GPS, the car can check the conditions of this license are fullfilled and disable the engine otherwise. Parents may lend their vehicle to their children and restrict their license to a maximum velocity or specific times or weekdays.

5 RightsManager

An REL, like ODRL, seems to be appropriate for the description of license requirement in DRM-protected vehicle service scenarios. The adoption of a supporting REL keeps the system open and interoperable, potentially even between different car manufactures and allowing third-parties to participate.

While the usage of a REL provides striking advantages, appropriate tools are needed to enable humans to create, verify and manage such licenses. Our project develops currently as well a RightsManager software that should allow humans to create and review licenses in a convenient way and then transform them into a REL-file. Also existing REL-based licenses should be presented to the user in a comfortable way and enable him to edit them if needed.

By using a template based user interface approach, the software should be easily adaptable to different application domains without rewriting or recompiling program code. The software is aimed to be modular and platform-independent. It should also be possible to manage the identities of service/function providers and users.

6 Related Research

One well-known project for the development of an open platform for telematic services is the EU-Project "Global System for Telematics" (GST). GST is an EU-funded integration project which aims to create an open and standardized end-to-end architecture for automotive telematics services.

To achieve its vision, GST will create an open and standardized framework architecture for end-to-end telematics. "The openness relates to the ability of the architecture to support (multiple) existing and new bearers and protocols as well as common mechanisms for the removal, updating and installation of new services and applications. Standards are necessary for the key interfaces allowing hiding the complexity and heterogeneousness of the supporting technologies" [GST 2006].

Such a platform would be a perfect candidate to include vehicle functions and services that are controlled by DRM-technologies, as investigated in our project.

7 Conclusion and Outlook

The first results of our research indicate that bringing DRM-technologies already used by the content industry into the vehicular infrastructure enables promising new application scenarios and business models. The usage of a REL for the expression of licenses

seems to be a logical prerequisite for the outlined open and dynamic service markets. REL-editors and managers designed to enable the user-friendly creation and review of licenses are practically required as well.

Further research is required about presentation and editing modes for REL-based licenses and contracts, e.g. in graphical ways. This includes as well the creation and description of templates for different application domains and the automatic GUI generation.

Further, we plan to elaborate more market/comfort and security related vehicle-service scenarios and how these scenarios can be implemented. More complex multi-tier service scenarios could finally lead to a service oriented architecture (SOA) around the vehicle. Also, the possible adoption strategy for vehicular services and DRM-technologies in vehicles has to be investigated from the perspective of the car manufacturers, the users and the market infrastructure.

References

B. Rosenblatt, Rights Expression Languages (2003): The Key to DRM Interoperability, in: Seybold Report: Analyzing Publishing Technologies, vol. 2, no. 24, pp. 3–, March 2003.

ContentGuard (2001): The need for a rights language, ContentGuard, Tech. Rep., 2001.

Contentguard (2006a): Website, Online: http://www.contentguard.com/

B. Rosenblatt (2001): Reviewing XrML 2.0., in: Seybold Report: Analyzing Publishing Technologies, vol. 1, no. 18, pp. 26–, Dec. 2001.

ODRL (2006a): Open Digital Rights Language (ODRL) Initiative Website, Online: http://odrl.net/

ODRL (2006b): Open Digital Rights Language Version 1.1. Online: http://www.w3.org/TR/odrl/

S. Guth, G. Neumann, and M. Strembeck (2005): Using ODRL to express rights for different content usage scenarios, in Second International ODRL Workshop, 2005.

GST (2006): The GST (Global System for Telematics) project website. Online: http://www.gstforum.org/

Recommending Products with a Fuzzy Classification

Henrik Stormer[1], Nicolas Werro[1] and Daniel Risch[2]

[1]University of Fribourg
[henrik.stormer|nicolas.werro]@unifr.ch

[2]University of Applied Sciences Northwestern Switzerland FHNW
daniel.risch@fhnw.ch

Abstract

Recommender systems are becoming more and more important for online shop systems. A recommender system suggests potentially interesting products to customers. However, shop administrators typically want to influence the recommendations due to the fact that not all products have the same value for the shop. The shop administrators therefore prefer to recommend products with a higher product value. This paper starts by suggesting a fuzzy classification to precisely calculate the value of the products. Afterwards the calculated product values can be utilized to influence a recommender system to suggest products with a higher value more often.

1 Introduction

In the last years, the number of recommender systems used in online shop systems has strongly increased and is becoming an important success factor for electronic commerce applications [Manber/Patel/Robinson 2000, Schubert/Koch 2002]. A recommender system can be utilized to suggest similar, related or potentially interesting products for a given customer. Most recommender systems use the collaborative filtering method in order to provide personalized information. Thereby implicit and explicit information of a customer, like past orders or viewed products, is used to calculate recommendations.

A lot of work in the field of recommender systems focuses on how to calculate appropriate recommendations for given customers [Balabanovic/Shoham 1997, Resnick/Varian 1997, Burke 2002, Adomavicius/Tuzhilin 2005]. These recommendations do not necessarily match actual business needs as e.g. for a shop administrator, not all products are equally valuable. There are items one would like to recommend more intensely than others because of higher margins or remaining items on stock. Therefore, shop administrators are keen to – at least slightly – influence the output of recommender systems to better match business needs.

In this paper we propose an approach to solve the problem mentioned above. We start by examining typical attributes that influence the value of an item from a shop adminis-

trator's perspective. These values may include profit margin, turnover or service quality. Then we will introduce a classification system based on fuzzy logic to classify all products. Fuzzy logic, unlike statistical data mining techniques such as cluster or regression analysis, enables the use of non-numerical values and introduces the notion of linguistic variables. Using linguistic terms and variables will result in a more human oriented querying process that is important, as shop administrators are typically not technicians.

The main advantage of fuzzy classifications compared to classical ones is that elements are not limited to one single class but can be assigned to several classes. Furthermore, each element has one or more membership degrees, which illustrate to what extend this element belongs to the particular classes it has been assigned to. The notion of membership gives a much better description of the classified elements and also helps to find the potential or the possible weaknesses of the considered elements.

In everyday business life, many examples can be found where fuzzy classification would or at least could be useful. In customer relationship management (CRM) for instance, a standard classification would sharply classify customers of a company into a certain segment depending on their buying power, age and other characteristics. If the client's potential of development is taken into account, the clients often cannot be classified into only one segment anymore, i.e. customer equity [Blattberg et al. 2001]. Other examples are risk management in an insurance company or client's credit worthiness in a bank. In the latter case, studies have shown that using sharp classifications, clients with almost similar risks were classified very differently. Also the opposite happened. The judgement of customers with clearly different properties was very similar.

In this paper we propose not to apply a fuzzy classification on customers but on products. The results of this classification can then be used to influence the output of a recommender system in a way that recommended items, on the one hand, match customer preferences and, on the other hand, are most valuable from a shop administrator's perspective.

The remainder of the present paper has the following structure: Section 2 defines the notion of product value and introduces the fuzzy classification concept applied to products. After a short introduction to the different types of recommender systems, Section 3 exposes two different approaches allowing the integration of the product values in recommender systems. Section 4 gives a conclusion and an outlook.

2 Fuzzy Classification of Products

A typical shop offers a large number of different products. A classification of these products based on different attributes like margin, quality or turnover can be used to gain further information and to optimise the offered product range. For customers, it has been shown that a fuzzy classification can be used to calculate an individual customer value [Meier et al 2005]. Based on these findings we assume this approach to be a promising way to gain product values as well.

2.1 Product Value

For the shop administrator, the product value may vary based on diverse characteristics like current and future demand, expected margin and turnover as well as quantity in stock. The product value is quite similar to the customer value as it predicts the fu-

ture return on what a shop administrator knows by now. In the case of customers, a company is typically interested in strengthening the relationships with promising customers having a high customer value [Werro/Meier/Mezger 2005]. This can be achieved for example by assigning personalized discounts or by giving special conditions [Werro/Stormer/Meier 2005]. The same argumentation can be used for products. Typically, the product value for the offered products varies. The reasons are a number of product attributes including:

- **Margin:** The margin is one of the most important attributes for shop administrators. The margin is the difference between purchase price and selling price. Typically this value differs from product to product. The shop administrator is normally more interested in selling products with a high margin.
- **Quality:** The quality of the product is another very important attribute. When a low quality product is sold, the chances for service costs are higher compared to a high quality product. Therefore, the shop administrator will try to sell products with a high quality to avoid service costs.
- **Size:** Size could be another important attribute. For large products, a big effort has to be done in order to send it to a customer. This includes packing, providing a logistics enterprise that transports the product and final billing. Additionally, large products occupy a greater amount of the inventory space.
- **Supplier Charge:** In brick and mortar stores, suppliers often pay for putting their products on an emphasized place. The shop administrator could retrieve a supplier charge for recommending their products.
- **Stock:** The amount and kind of items on stock influence the interest of the shop administrator to recommend products. A shop administrator is much more interested in selling items he has on stock than in reordering certain items for individual customers.

Note that these attributes may vary from shop to shop and that for concrete examples other attributes could become even more important. Note also that it is not the aim of this paper to define different product attributes that are of importance to a shop administrator. It is only important to understand that different products in the product range typically vary in their product value.

2.2 Fuzzy Classification with Linguistic Variables

The fuzzy classification principle is based on the context model proposed by Chen [1998]. In this model, a context is added to every attribute defined over a domain. A context is a partition of the domain of an attribute into equivalence classes. The definition of the equivalence classes on the domain of the attributes leads to a multidimensional classification space.

Throughout this paper, a simple example of product classification is used. In this example, products are evaluated by only two attributes, margin and quality. In addition, these two qualifying attributes are partitioned into two equivalence classes. The pertinent attributes and contexts are:

- *Margin in percent*: The attribute's domain is defined by [0,50] and is divided into two equivalence classes [0,25] and [26,50]. The first class implies a low margin, the second class a high margin.

- *Quality*: The domain of the attribute quality can be categorized in 4 categories (top, medium, sufficient, poor). The equivalent classes are (top, medium) for good quality and (sufficient, poor) for bad quality.

To derive fuzzy classes from sharp contexts, the qualifying attributes are considered as linguistic variables, and verbal terms are assigned to each equivalence class [see Zimmermann 1992]. With the help of linguistic variables, the equivalence classes of the attributes can be described more intuitively (see Fig. 1). In addition, each term of a linguistic variable represents a fuzzy set. Each fuzzy set is determined by a membership function μ over the domain of the corresponding attribute (see Fig. 2)

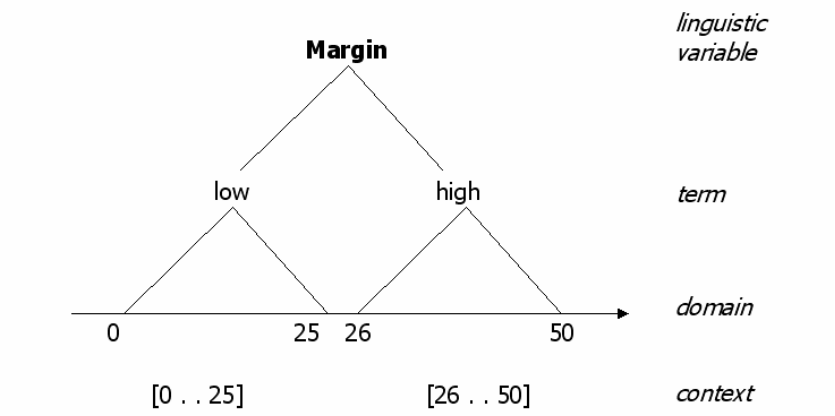


Fig. 1: Concept of linguistic variable

As margin is a numeric attribute, its membership functions $\mu_{\text{high margin}}$ and $\mu_{\text{low margin}}$ are continuous functions defined on the whole domain of the attribute. For non-numeric attributes like quality, step functions are used; the membership functions $\mu_{\text{good quality}}$ and $\mu_{\text{bad quality}}$ define a membership grade for each term of the attribute's domain. In this example, the shop administrator has to choose the right quality for each product. Another way for automatically assigning the quality to the products would be to measure the return rate of the products. In this case, the quality would be a numeric attribute expressing the percentage of returned product.

The definition of the equivalence classes of the attributes margin and quality determines a two-dimensional classification space shown in Fig. 2. The four resulting classes C1 to C4 could be characterized as 'Best Product' (C1), 'Off-grade Product' (C2), 'Less Profitable Product' (C3), and 'Non-ideal Product' (C4).

Fig. 2 shows an example with a possible product (DVD Le Doulos). With a sharp classification, this product would be classified only in class C1. However, with a fuzzy classification, this product belongs to all classes at the same time, namely (C1:30%, C2:25%; C3:25%; C4:20%).

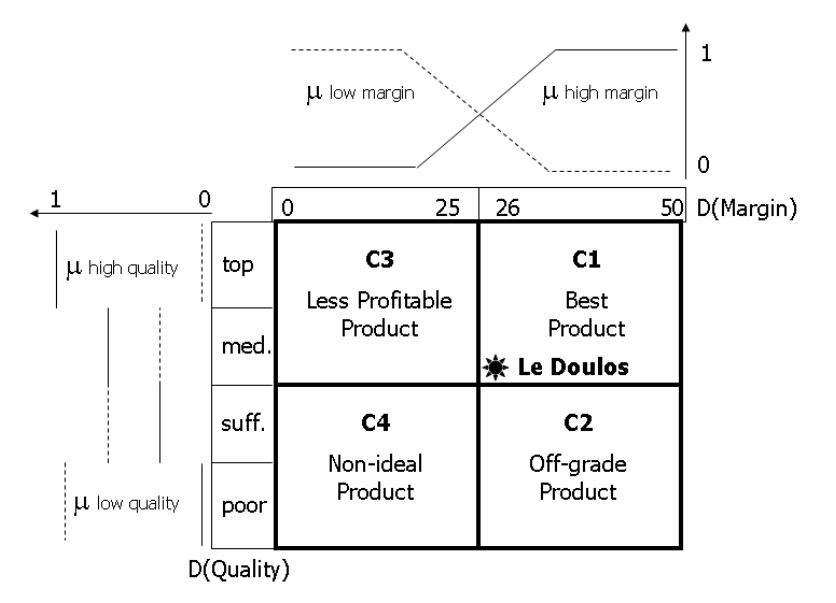


Fig. 2: Fuzzy classification space defined by margin and quality

The product value can now be easily derived from the fuzzy classification. Indeed the membership degrees of the products in the different classes can precisely determine the values they deserve. For that purpose, a rating between 0 and 1 can be associated with each fuzzy class: for instance C1 gets a rating of 1, C2 a rating of 0.66, C3 a rating of 0.33, and C4 a rating of 0. The product value can then be calculated by the aggregation of the value of the classes it belongs to in proportion to its membership degrees. The value of the DVD Le Doulos therefore is:

(1 * 0.3) + (0.66 * 0.25) + (0.33 * 0.25) + (0 *0. 2) = 0.3 + 0.165 + 0.083 + 0 = 0.55

3 Connecting a Product Classification with a Recommender System

To connect the results of a product classification with a recommender system, two different strategies can be explored:

- Use the product classification results to reorder the ranking list
- Integrate the value of a product classification directly in a recommender system

After a small introduction to recommender systems, the two different integration strategies will be demonstrated.

3.1 Recommender Systems

Recommender systems can be classified in three groups based on the approach used to generate the recommendations [Adomavicius/Tuzhilin 2005]:

- Content-based filtering approach
- Collaborative filtering approach
- Hybrid approach

For the content-based filtering approach attributes are assigned to each product. By using information retrieval techniques on those attributes it is possible to derive the similarity between the products, so that two products with common attributes have a

high grade of similarity [Basu/Hirsh/Cohen 1998]. The advantage of content-based filtering is the possibility of precisely defining relations between products, namely for cross or up-selling. However this advantage comes up at a high price. On the one hand, this approach requires the manual definition of a great number of additional information, e.g. keywords and attributes for each product. This information should be permanently up-to-date. On the other hand, the content-based filtering uses complicated data mining techniques to generate the personalized information.

In contrast to content-based filtering, the collaborative filtering approach only needs information about the user interaction and transaction such as products ratings, orders or clickstream information in order to provide recommendations. All of this information is continuously provided by the users when browsing the websites, buying or rating products. Another major difference is that the collaborative filtering approach is based on customer context information. So the strength of this approach is its full automation and its user-based semantic. However this approach requires a certain amount of data in order to provide valuable results, i.e. the number of customers and more important the quantity of users' transactions (often called the cold start problem and the first-rater problem).

The third class of recommender systems uses a hybrid approach which is a combination of the content-based and the collaborative filtering [Burke 2002]. This approach combines the advantages of having a precise description of the relationships between the objects based on the keywords and on the users' interactions. This allows pertinent recommendations from the beginning with a continuous improvement over time by gathering and using more and more users' information.

3.2 Reorder the Ranking List

The results of most recommender systems are a list of top-n products that could be used for a certain recommendation where n can be freely chosen by the shop administrator. If, for example, the shop administrator chooses the value 5 for n, a recommender system returns the top 5 recommended products for a certain user. It is now possible to reorder this list by using the product values gained from the product classification. In Fig. 3, the 5 recommended products are reordered accordingly to their values. In this example, the product DVD Léon is moved from the top rank to rank four due to its lower product value compared to the other products. Using this approach, it is even possible to calculate the top m products (with m > n), reorder the ranking list and omit the last m-n products. In this case, products with the lowest value won’t be recommended at all.

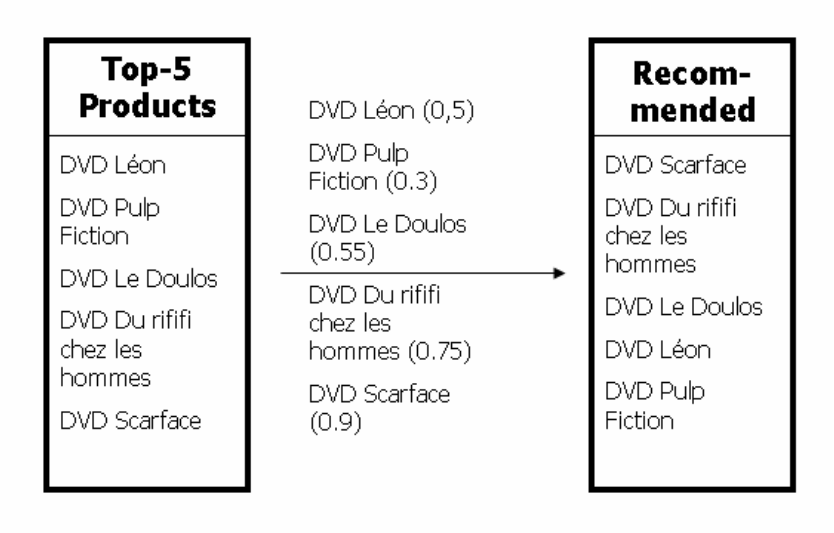


Fig. 3: Reordering of the recommendations based on the product values

3.3 Direct Integration

The second approach is to directly integrate the product value in the calculation of the recommender system. This is possible for collaborative filtering systems. These systems use as input the rating matrix R with the customers U in the row dimension and the products P in the column dimension. This two-dimensional matrix represents the relationships between users and products. Typically, the value $r_{u,p}$ for each cell is based on implicit or explicit data gained from the customer, for example the product ratings. Each cell will contain a value between -1 and +1 representing the judgment of the customer for the product where -1 denotes a strong dislike and +1 a strong affection.

In a first step, the average product value pv_{avg} should be calculated. Then, for each cell $r_{u,p}$ in the rating matrix, the product value pv_p is examined. The difference $a = pv_p - pv_{avg}$ can be calculated and added to the value of each cell: $r_{u,p} = r_{u,p} + a$.

An example of this approach is shown in Fig. 4. The rating matrix on the left side contains 5 columns (for five products) and two rows (for two users). The average product value (0.6) is determined, after this the difference $a = pv_p - 0.6$ can be calculated for each product and added to each value of the cells. The resulting rating matrix is shown on the right side. Note that products with a low product value (like DVD Pulp Fiction) resulted in a reduced rating (i.e. from 0.5, resp. 0.9, to 0.2, resp. 0.6) and products with a high product value (like DVD Scarface) came to a higher rating (i.e. from 0.1, resp. 0.6, to 0.4, resp. 0.9). A higher rating rises the chances of the products of being recommended.

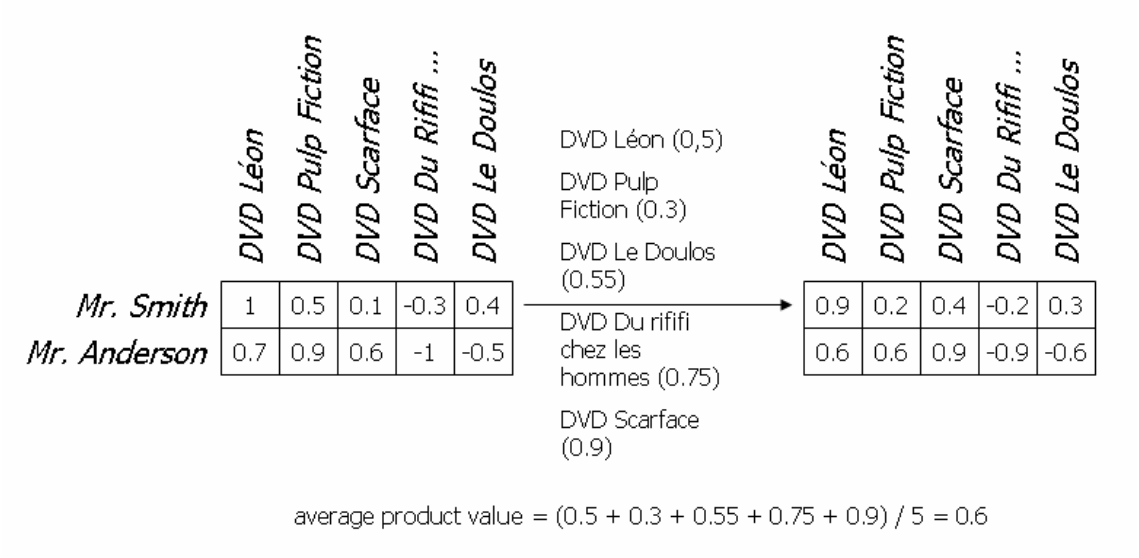


Fig. 4: Integration of the product values into the rating matrix

4 Conclusion and Outlook

We showed that a fuzzy customer classification is a practical instrument to calculate the value of the customers [Meier et al 2005]. This paper described how the idea of a fuzzy classification could be used to calculate a value for each product. For a shop administrator, the product values have similar meanings like the customer values. One possible application for the product values is the integration within a recommender system. This paper showed two different strategies to accomplish this task.

However, the product values can be used for other applications as well:

- The shop administrator can determine problematic products. In our example, these products would reside in class C4. The shop administrator could think about removing these products from the offered product range.
- The product value is a good indicator when negotiating with the suppliers.
- The product value can also be used to determine possible discounts (cf. [Werro/Stormer/Meier05]). The shop administrator could offer higher discounts on products that have a high product value.

References

Adomavicius, Gediminas; Tuzhilin, Alexander (2005): Toward the Next Generation of Recommender Systems, A Survey of the State-of-the-Art and Possible Extensions, IEEE Transactions on Knowledge and Data Engineering, Volume 17, Nr. 6

Balabanovic, Marko; Shoham, Yoav (1997): Content-Based, Collaborative Recommendation, Communications of the ACM, Volume 40, Nr. 3, S. 66-72.

Basu, Chumki; Hirsh; Haym; Cohen, William W. (1998): Recommendation as classification: using social and content-based information in recommendation, in: Proceedings of the 1998 workshop on recommender systems, Menlo Park, CA.

Blattberg, R. C., Getz, G., and Thomas, J. S., 2001, Customer Equity - Building and Managing Relationships as Valuable Assets, Harvard Business School Press, Boston.

Burke, Robin. (2002): Hybrid Recommender Systems, Survey and Experiments, User Modeling and User Adapted Interaction, Volume 12, Nr. 4

Chen, Guoging (1998): Fuzzy Logic in Data Modeling – Semantics, Constraints and Database Design, Kluwer Academic Publishers, London

Manber, Udi; Patel, Ash; Robinson, John (2000): The Business of Personalization: Experience with Personalization of Yahoo!, in: Communications of the ACM, Volume 43, Nr. 8

Meier, Andreas; Werro, Nicolas; Albrecht, Martin; Sarakinos, Miltiadis (2005): Using a Fuzzy Classification Query Language for Customer Relationship Management, in: Proceedings of the 31st VLDB Conference.

Resnick, Paul; Varian, Hal R. (1997): Recommender Systems, Communications of the ACM, Volume 40, Nr. 3, S. 56-58.

Schubert, Petra; Koch, Michael (2002): The Power of Personalization: Customer Collaboration and Virtual Communities, in: Proceedings of the Eighth Americas Conference on Information Systems (AMCIS)

Werro, Nicolas; Meier, Andreas; Mezger, Christian (2005): Concept and Implementation of a Fuzzy Classification Query Language, Proceedings of the International Conference on Data Mining, World Congress in Applied Computing, Las Vegas, USA

Werro, Nicolas; Stormer, Henrik; Meier, Andreas (2005): Personalized Discount – A Fuzzy Logic Approach, in: Proceedings of the 5th IFIP International Conference on eBusiness, eCommerce and eGovernment, I3E 2005 Conference.

Personalized Commercial Web Sites

Petra Schubert

University of Applied Sciences Northwestern Switzerland FHNW
petra.schubert@fhnw.ch

Abstract

Personalization is an interdisciplinary topic that has been discussed in marketing and information systems as well as in other research disciplines. In this paper we present findings from a longitudinal research project on personalization of e-commerce systems. The findings were taken from interviews, empirical studies, and implementation projects with company partners. There is no single strategy for a successful personalization feature: each company needs to find its own unique selling proposition. The projects showed that once this USP has been identified it can be used for building up lasting relationships with customers. There is a need for further research into personalization issues – even if there are companies like Amazon, eBay or Broadvision that already demonstrate how it can work.

1 People Want to Be Addressed Personally

Personalization is an interdisciplinary topic which has been increasingly addressed in research papers, particularly at conferences on marketing and information systems. The fact that personalization has so many facets and does not fall into a specific domain makes it hard to perform a literature research on the topic. Personalization is targeted at the fulfilment of a special customer or user requirement. It can be aimed at people as well as organizational roles in companies (e.g. a purchasing agent). Personalization in our understanding starts *after the login*. The process is context sensitive (regarding the output for a certain user) and requires learning (by the system). The interface between the customer and the system is the «point of interaction» (POI).

The author assumes that there are two reasons behind the growing attention for the necessity to address customers (or users) personally: (1) from a *marketing perspective* the increased need to offer the best product or service for a single customer thus preventing the customer from switching to a competitor and (2) from an *information systems view* the increasing computer power which makes it possible to store and process data electronically.

This paper presents the results of six years of research in the field of «Personalization of E-Commerce Applications». The activities started in the year 2000 with an empirical study about the current state of personalization in E-Commerce applications run by SMEs [Leimstoll/Schubert 2002]. The findings showed that although there were companies such as Amazon and eBay that effectively demonstrated how personalization

works, only very few companies in Switzerland were able to implement similar features into their Web environments. The companies that took part in the survey showed deficits in strategy as well as a lack of technical readiness in their information systems and databases. Nevertheless, most companies acknowledged the importance of a personal relationship with the customer and indicated that personalization issues would be approached with high priority in the future. The empirical results encouraged the research team to approach companies that would want to work on the further development of their electronic shop environments. Together with these partners we developed a project method for the design and introduction of personalization components which was prototypically tested in three cases.

At an early point of the project we decided to focus on integrated systems where an e-shop component would run as an extension of an ERP system. The objective was to reuse the existing ERP functionality for the selling process (so far used by the sales people) and adapt it to the customer interface. The requirements of the partner companies made it evident that stand-alone Web shop environments without a connection to an existing ERP system would *not* work for companies in the long run.

The intention of this paper is to give an overview of the findings from the last six years and encourage IS researchers to continue research in this area. The paper starts with a literature review displaying the diversity of the topic. The following chapter presents the personalization methodology that was developed with practitioners. Selected specific examples of personalization will be shown. The final chapter discusses the need for more research on personalization based on the findings gained up to now.

2 Literature Review and Research Methodology

2.1 Personalization and Mass Customization

Although computers store large amounts of data during the transaction with customers, there are still few web sites that offer a user-friendly, personalized interface that makes efficient use of the information stored on the system or in other user-related databases of the company.

There are two main streams of publications: publications on *mass customization* on the one hand and on *personalization* on the other hand. *Mass customization* is generally geared towards the manufacturing process (the area of engineers). It deals with the configuration of products using standard components. Dell is the most prominent example of a company that has used this approach for its business success selling computers which are configured by the customers. *Personalization*, on the other hand, is geared at the communication process (the area of marketing experts). When applied in the Web browser, it can be used to present a personal shopping environment, including navigation, design, and product presentation (cf. Fig. 1). Amazon is a prominent example for a personalized e-shop including product recommendations, personalized newsletters, wish lists, and recently even a watch list (for new products by favourite artists).

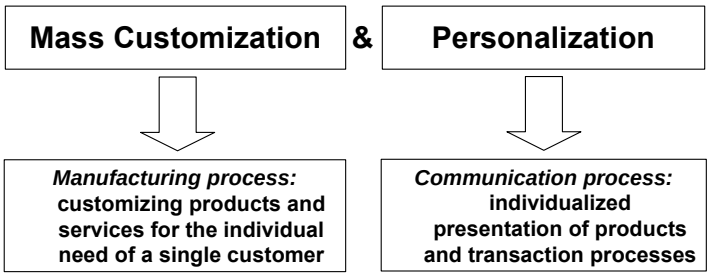


Fig. 1: Mass customization and personalization

Deitel et al. [2001] define personalization as using «information from tracking, mining and data analysis to customize a person's interaction with a company's products, services, web site and employees». Mulvenna et al. [2000] understand personalization as «the provision to the individual of tailored products, service, information or information relating to products or services. This broad area also covers recommender systems, customization, and adaptive web sites». Personalization can be used for all kinds of channels, from paper-based mailings, call centres, to Web interfaces. Personalization is usually implemented at two levels: at the level of the *interface* through which the user interacts with the content, and at the level of the *content* itself [Vassiliou et al. 2003]. The possibilities of personalizing the user interface have also been described by Peppers/Rogers [1997] as well as Allen et al. [2001].

Davis [1987] refers to mass customization when «the same large number of customers can be reached as in mass markets of the industrial economy, and simultaneously they can be treated individually as in the customized markets of pre-industrial economies». The advantage is that individualized or personalized goods can be provided without the high cost surpluses (and, thus, price premiums) usually connected with (craft) customization [Piller/Schoder 1999].

2.2 Personalization and Individualization

As can be seen from the definitions, personalization is about selecting or filtering information objects or products for an individual by using information about the individual (his customer profile). The information displayed on the screen is specifically tailored for the user. From a technical point of view, meta-information of products or information objects is matched against meta-information of users (stored in the customer profile). Personalization can be tailored to a person group or to a specific individual. In the latter case, where the information or products are only customized for one single individual we speak of *individualization* as a special form of personalization. Personalization uses information about customers. The general term for stored customer information is *«user profile»* or in the context of electronic shopping *«customer profile»*. There are various ways how e-shop operators can cultivate customer profiles e.g. «historically» by storing (1) interaction with the Web site (click stream), or (2) purchase transactions, or «explicitly» by asking (3) for preferences, or (4) ratings, or (5) by recording contextual information (e.g. time, date, place). What formerly seemed to be possible only for the corner shop whose storekeeper knew all her clients personally, reaches a new potential in the online medium where every client leaves traces and thus «teaches» the system how to treat him differently from the other customers. This form of personaliza-

tion becomes feasible with the use of predefined rules, which can be built into e-commerce environments. These automatic personalized Web sites do not achieve the high quality of corner shops but they help to establish a personal dialogue with the customers tying them closer to the electronic offer. Additionally, the time spent by the client to «teach» the system leads to increased switching cost. The underlying assumption is that the customer really *wants* to be addressed personally.

The ability to deliver personalization rests upon (1) the acquisition of a «virtual image» of the user, (2) the availability of product meta-information and (3) the availability of methods to combine the datasets in order to derive recommendations for the customer.

Mass customization can be implemented in electronic media environments using a predefined rule system which combines the advantages of mass production (the same e-shop and the same product catalogue for all clients) with the strength of made-to-order production (personalized web pages and customized products). *One-to-one marketing* is the embodiment of personalization in marketing [Peppers/Rogers 1997]. The underlying idea is to serve and address every customer according to his or her specific needs. Customer Relationship Management aims at supplying every employee (or even the client himself e.g. in an e-shop) with the relevant information at the right time with the aim to be able to offer individualized services. *Permission Marketing* is the idea of giving the customer the chance to select the kind of marketing message he or she wants to receive [Godin 1999].

The collection and use of customer information has a downside – collecting customer specific data has often a smack of spying and sniffing around [Gentsch 2002]. Other effects of careless data collection activities are intentional false statements which lead to bad data quality and therefore useless customer profiles [Treiblmaier/Dickinger 2005]. The importance of privacy and security aspects in the field of CRM has been pointed out in a recent survey by Salomann et al [2005].

Due to the ubiquitous nature of the Internet, electronic commerce does usually not stop at borders – most of its legal issues involve international legal regulations (unless the Web site explicitly excludes customers from foreign countries). The use of information about customers involves legal questions which have been addressed in a previous paper [Schubert et al. 2006].

There is an ongoing discussion on privacy that is closely related to personalization. Cranor [2003] discusses *privacy risks* associated with personalization in e-commerce applications and provides an overview of principles and guidelines to reduce these risks. He identifies the following privacy concerns: (1) unsolicited marketing, (2) system predictions are wrong (incorrect conclusions about users), (3) system predictions are too accurate (system knows things nobody knows about user), (4) price discrimination, (5) unwanted revelation of personal information to other people, (6) profile could be used in a criminal case and (7) government surveillance.

With the above mentioned information from literature in mind, we started the development of a methodology for personalization projects.

2.3 Research Methodology: Experiences from Industry Projects

The research methodology which was used to generate the findings portrayed in this paper is a combination of literature reviews, two empirical surveys, interviews with companies, company workshops, and case studies.

Since the year 2000, researchers at the Competence Center E-Business Basel (University of Northwestern Switzerland) have been involved in a longitudinal, publicly funded research project about «personalization of e-commerce applications». The project involved three different universities and ten companies that jointly worked on the development of personalization issues. The author fulfilled the role of the leading project coordinator and project manager.

The research resulted in a number of publications, for example a handbook on personalization [Schubert/Leimstoll 2002], an empirical study on personalization [Schubert/Leimstoll 2004], as well as articles on legal issues of personalized Web sites [Schubert et al. 2004/2006]. Beyond these publications the output also comprises:

- The implemented ERP/e-shop software containing personalization functions. The pilot companies (e-shop vendors) as well as their IT partners (ERP vendors) benefit from these software modules. Some of the new software modules have been included into the standard ERP software system (so other ERP customers will also profit from them).
- Four case studies describing the projects of the personalization project and their results [available at: www.e-business.fhbb.ch/publications].
- A collection of personalization functions with detailed descriptions (a so called «personalization map»). The personalization map is used for evaluation phase of a personalization project («finding the right features for a specific company»)
- A checklist on legal requirements for the application of personalization techniques

The experiences from the project showed that for most companies there is *only one or two personalization feature(s)* that qualifies to become a USP for the company. Personalization requires learning and reflects learning about the customer. This is why in some cases using the personalized software system really makes a difference for the customer (as compared to the Web sites offered by competitors).

3 The Process of Personalizing Customer Interfaces

3.1 Customer Profile Life Cycle

The mechanism that drives personalization is the learning process during which information is collected about the customer and used to tailor products or services to the needs of the individual or user group. Seen from a technical level, personalization can be divided into four steps (cf. Fig 2):

Step 0 – Modelling Customer Profiles (requirements analysis)
Step 1 – Data Input
Step 2 – Data Processing
Step 3 – Information Use

The techniques for capturing customer profile information vary and often require the active engagement of the customer. There are different possibilities to acquire information about a customer: (1) the user maintains the user profile herself (*explicit* input) or (2) the system monitors the user in her browsing or shopping behaviour and determines her interests from using information clustering techniques (*implicit* input).

1) Explicit information input (also called «reactive» approach)

One way to gather data is to *explicitly* ask the customer to fill in her preference profile. This can be done by selecting preferences from a *classification scheme* provided by the Web site or by explicitly rating products or information items from which the likes and dislikes can be derived. Examples for services offering personalization based on explicit information inputs are MyYahoo and the Amazon Recommendation Center.

2) Recording customer activity (also called «non-reactive» approach)

Shops usually record transactions in *databases*. This can be done both online and offline. Large Swiss offline companies such as SWISS, Manor, Migros or Coop have introduced membership card programs to identify customers during their purchase transactions and to keep an identified log on their transactions (e.g. Migros Cumulus Card). These card programmes are based on different kinds of «currencies». Airlines use miles and offer free trips, UBS has a special Keyclub programme with plenty of specials (products, events, activities – provided by partner companies), the Manor MyOne card «pays» with discount coupons, Migros' Cumulus Card offers a one percent discount at the POS, the Coop Supercard is based on points that can be transferred into special giveaways. All these companies «pay» their customers for revealing their individual shopping behaviour. In an e-shop, however, vendors collect this kind of information «for free». This is an advantage that needs to be harnessed.

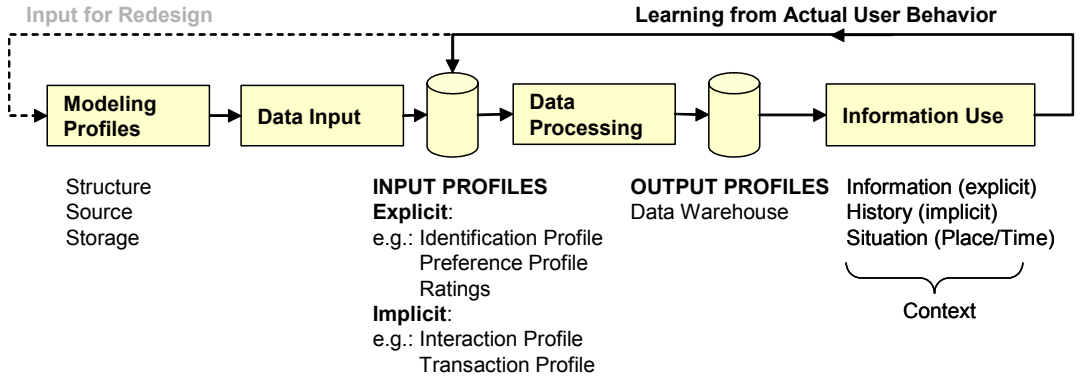


Fig. 2: Customer Profile Life Cycle [following Schubert/Leimstoll 2002, 21]

In addition to information about *transactions*, online shops store information about the browsing behaviour of customers. Page visits can be tracked and the time a customer spends on a particular page can be stored. The main problem with the tracking of browsing behaviour is the identification of the user. Since the information about the IP address of the requesting client is often insufficient for identification due to the use of dynamic IP addresses (e.g. different proxy applications or dial-ups) current sites try to solve this problem with the help of setting local browser cookies (which an increasing number of users declines). This is one of the reasons why – in our projects with partner companies – users were required to login before the actual recording started. Fig. 2. provides an overview of the *customer profile life cycle* as proposed by Schubert and Leimstoll [2002].

In their paper „Motivating Human-Agent Interaction: Transferring Insights from Behavioural Marketing to Interface Design" Spiekermann and Paraschiv [2000] point to the fact that personalization of user interfaces depends on the intensity of the interaction

with the user interfaces. The more information about preferences is available from the user the better the computer can react. The benefit that a customer can take from an e-commerce service depends largely on the readiness of the customer to actively provide information. If a customer provides false information, the recommendations derived from this data tend to be useless. The main reason for demotivation is the missing «learning» from user interaction.

3.2 Customer Data is Spread Throughout the Company

Information about customers is spread throughout the company. Different departments often work with different software systems which again are based on various databases. Only few companies have managed to introduce a uniform view of all the information stored in the company. Even fewer have a universal user interface at their disposal. The access to information involves power and people are often reluctant to share their information with others – even when working in the same company. In interviews with company representatives, we often heard statements such as «we cannot use this information because it *belongs* to a different department and they are not ready to share it with us». This kind of «departmental egoism» is a hindrance to customer relationship management and requires management attention.

Fig. 3. shows a structural view of the information that is stored in databases using different applications. In order to best serve the customer and achieve a high level of personalization, the e-shop requires access to all customer-related information. The information about the customer needs to be structured using a *common classification scheme*. The scheme provides the meta-data that is needed to match customers with products. It is also used to derive possible customer interests from the click stream (pages accessed). This activity requires each Web page to be annotated with the meta-data from the common classification scheme.

The process of personalizing a website or an e-shop as shown in Fig. 3 starts with the interaction between the user (no. 8) and the e-commerce application (no. 7). The user also interacts with other applications or services of the company (no. 6, e.g. call centre, store) or external sites and services (e.g. market surveys). Data generated from these interactions is represented by the dashed line on the right. Data generated by the interaction between user and e-shop is represented by the solid line on the left. User related data is usually stored in different data bases and heterogeneous formats (no. 1). Data objects that contribute to a better understanding of individual user needs have to be identified (input data). These data objects are (E)xtracted from the original source, (T)ransformed into a pre-defined structure and finally (L)oaded into a centralized data warehouse for customer profiles (INPUT PROFILES, no. 2). The resulting data warehouse contains data about user profiles, products and page content as well as information *about* this data (meta-data, no. 3). In order to use customer profiles in an e-shop or in other applications, the information needs be processed (no. 4). This can be done using two different approaches: (1) *Rule-based processing* works on an if-then basis, (2) *automated processing* applies data mining approaches for discovering previously hidden patterns (cf. knowledge discovery in databases, KDD). Data mining is the process of storing and interpreting data recorded in business processes, e.g. a POS transaction. Whereas data mining addresses all kinds of real-world business processes, web mining focuses especially on data accrued from the Web. Data mining is the extraction of interesting and potentially useful information from user activity on the Internet [Kimball/Merz 1996; Spiliopoulou 2000; Adomavicius/Tuzhilin 2001]. The results of the

processing algorithms are stored in well-structured data marts containing individual profiles and content (no. 5). The content of these data marts (OUTPUT PROFILES) can be used as input for all kinds of applications (no. 6 and no. 7) and can contribute to improve user interfaces and services.

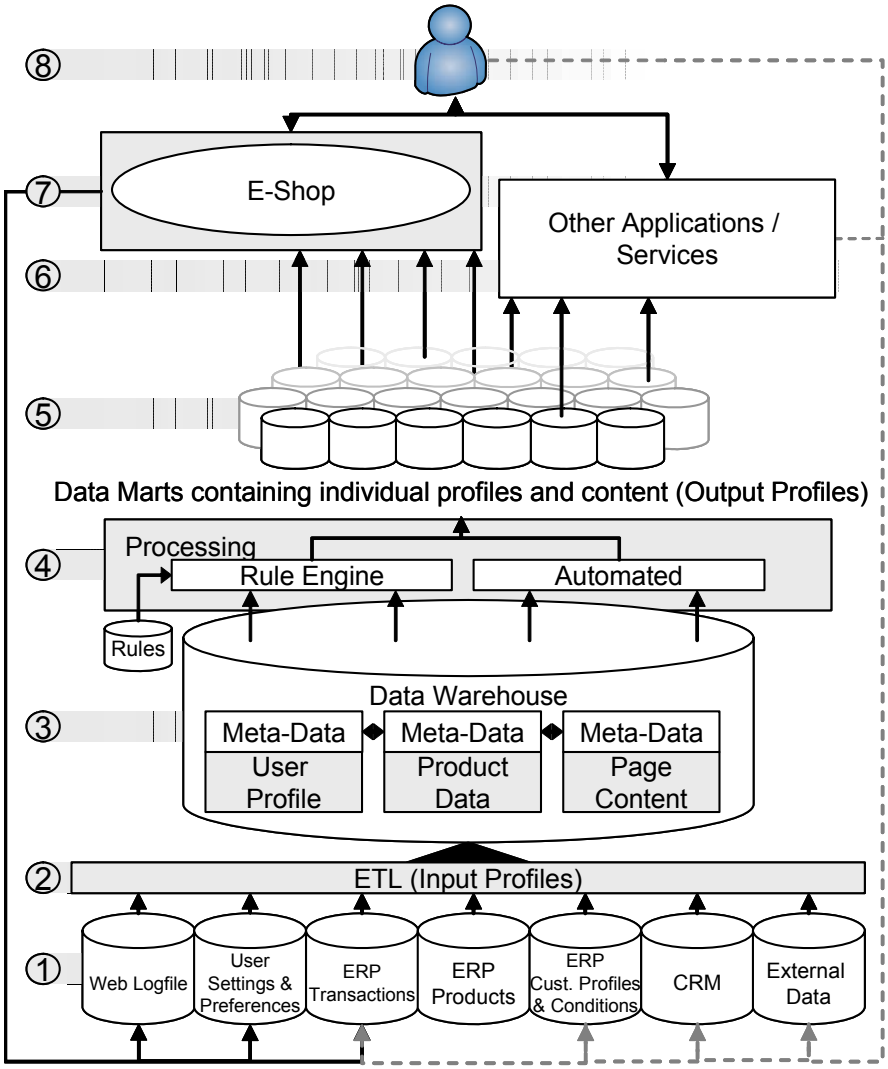


Fig. 3: A technical view on personalization

The starting point for a personalization project is the identification of all customer-related data available in the company (level 1 in Fig. 3). Data sources and data objects need to be selected. The term «data source» refers to any repository containing customer-related data objects. Most companies store a lot more data than they actually use. Therefore, it is important to identify particular data objects that contribute to a better understanding of individual customer needs.

Customer relationship management systems are a valuable source for personalization as they are optimised to support the relationship with the customer. CRM systems store all kinds of information about the customer ranging from basic information such as name and address to the full history of company-customer interaction (e.g. inquiries, purchase transactions, claims). The databases contained in CRM systems are a valuable information source which can be harnessed for personalization. Most CRM systems are built upon existing software for enterprise resource planning (ERP).

ERP systems comprise a whole class of software products which are geared at the automatization and control of business process throughout the whole company. They supply software modules which support almost all critical business processes and departments (e.g. accounting, procurement, human resources, sales, production, and logistics). The ERP databases are another valuable source for personalization since they contain the critical company information namely product catalogues, customer database, sales figures, accounting, and the like. In recent years, ERP systems have been further developed to meet the requirements of the Internet. In the last three years, traditional ERP functionality has been extended into the Internet environment. Customers can directly access data in the ERP system using Web interfaces. ERP systems which have been equipped with these new e-commerce interfaces have been coined «ERP II» by Gartner Group.

After selecting the appropriate databases, the information is loaded into an information warehouse. An information warehouse contains the result of an ETL process, an extended, improved and optimized representation of products, sales and customer data. They are usually used to process raw data for later use in executive information or decision support systems (EIS or DSS). In the context of our project these databases are an important source for personalization.

3.3 INPUT/OUTPUT Profiles and Marketing Rules

Fig 4. shows an example for the matching of customer profile and product profile. In this example, the information is collected from the e-shop (registration and click stream), and combined with offline information from the customer value card and responses of the customer to certain marketing measures. The customer profile is based on the same meta-information from the *common categorisation scheme* that the company uses to classify their products. Products are grouped into product categories, price categories and product groups. Events have additional tags such as region, type, and others.

The example shows the application of three marketing rules on a specific customer. The customer enters the homepage of «her» e-shop (after the login). The implemented scripts on the homepage display three individualized product offers: (1) tickets for a tennis event, (2) the latest Nike indoor tennis shoes, and (3) further links to current fantasy DVDs. These rules apply because the customer has bought tennis equipment in the past and has shown an above-average interest in DVDs in the area of fantasy.

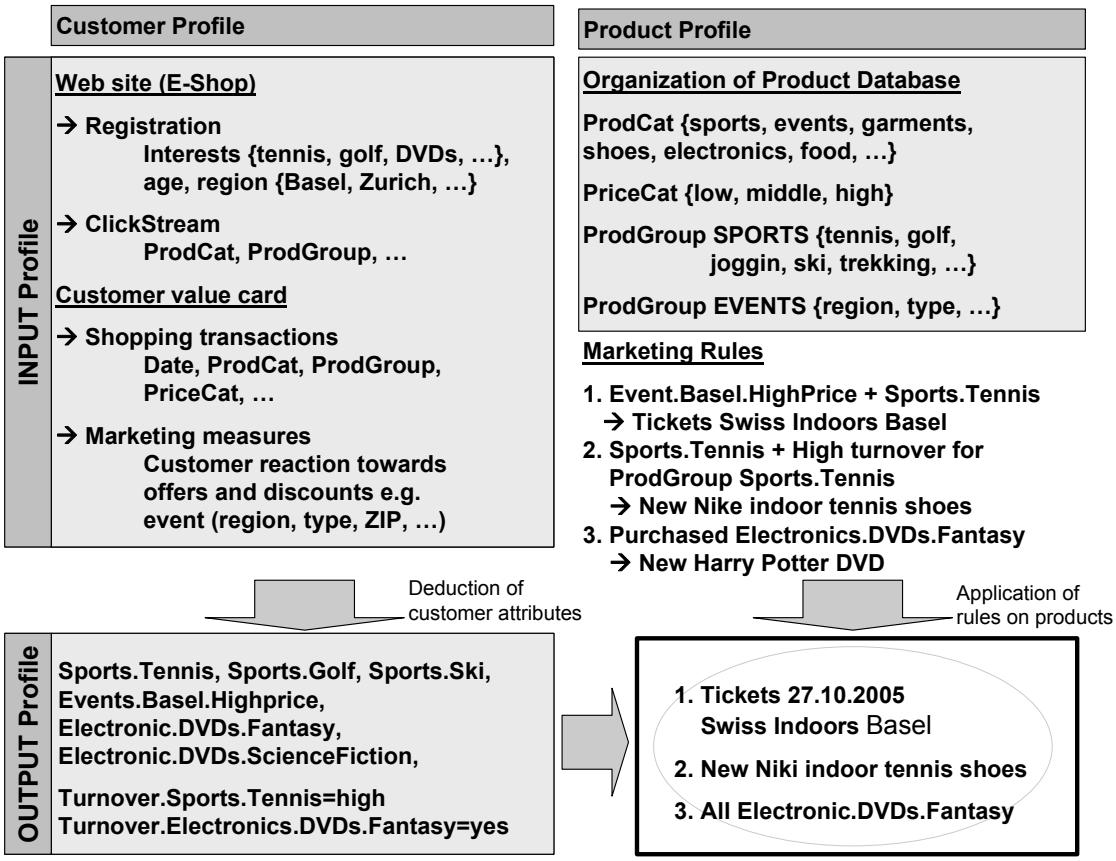
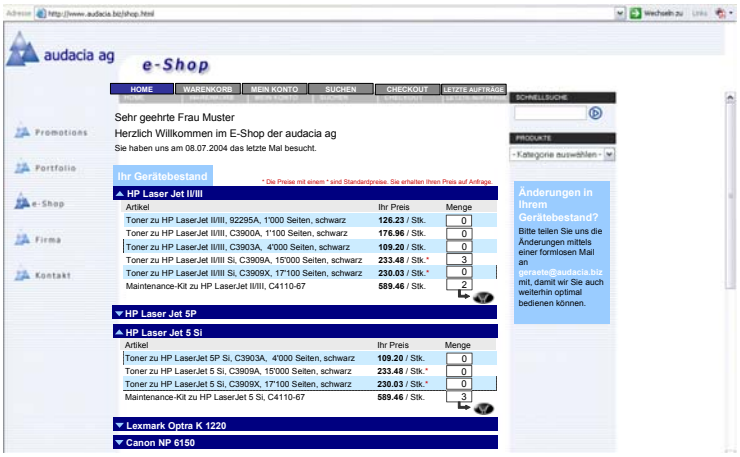


Fig. 4: Matching Customer Profiles with Product Profiles: An Example.

4 Research Results

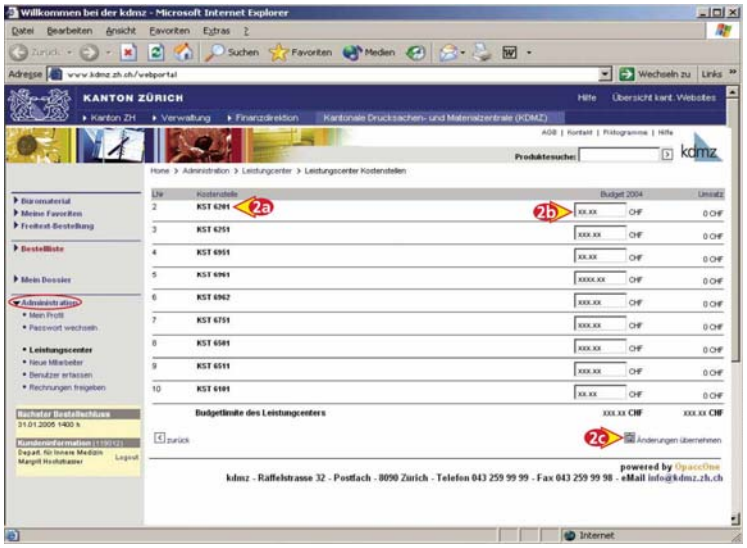
4.1 Case Studies: Implementation of Personalization Software in Three Companies

The following figures show screen shots from the company projects. As mentioned above, the project work showed that there was no single strategy for a successful personalization feature: each company needed to find its own unique selling proposition.



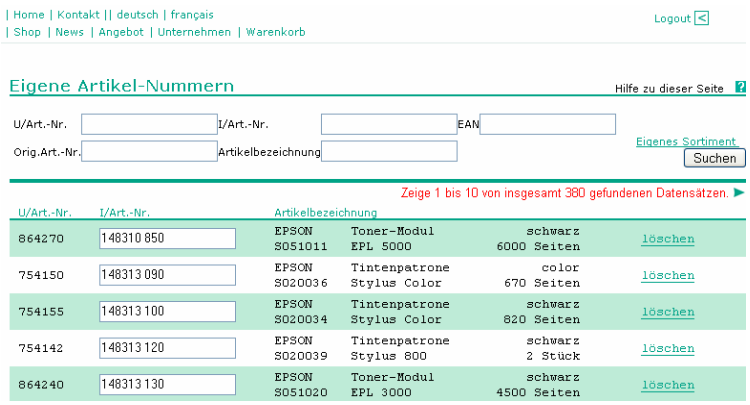
Vendor of printer equipment:

Customer-specific product selection. Customer only sees the equipment for devices that he/she owns.



Procurement support for a hospital:

Each user in a hospital has a different budget for the procurement of medial products. The budget limits can be individually set by the system administrator.



Reseller of printer equipment:

Resellers can enter their own matching article numbers for their products. Their end customers can then use their product numbers although the orders are places in the original seller's shops.

4.2 Methodology for Personalization and Personalization Mind Map

The fist step of each personalization project was the identification of the personalization features that needed to be implemented for the individual project partner. In order to facilitate the process and to structure the discussion, we developed a personalization mind map (Fig. 5). The mind map contains a structured view of the world of personalization functions. It is beyond the scope of this paper to present the contents of the

mind map. For a detailed description of the personalization features contained in the map the reader is referred to [Schubert/Leimstoll/Risch 2006].

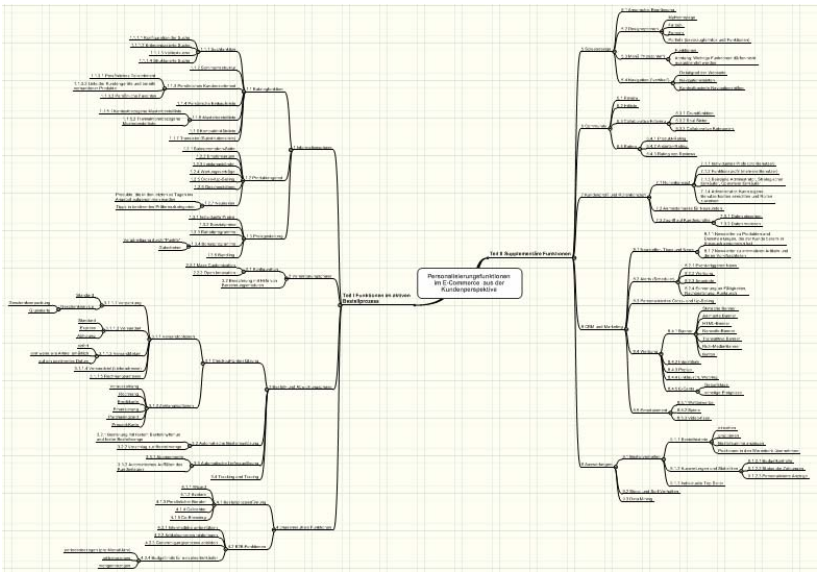


Fig. 5: Personalization Mind Map

The personalization features in the mind map are structured according to the buying process and complementary functions (Fig. 6).

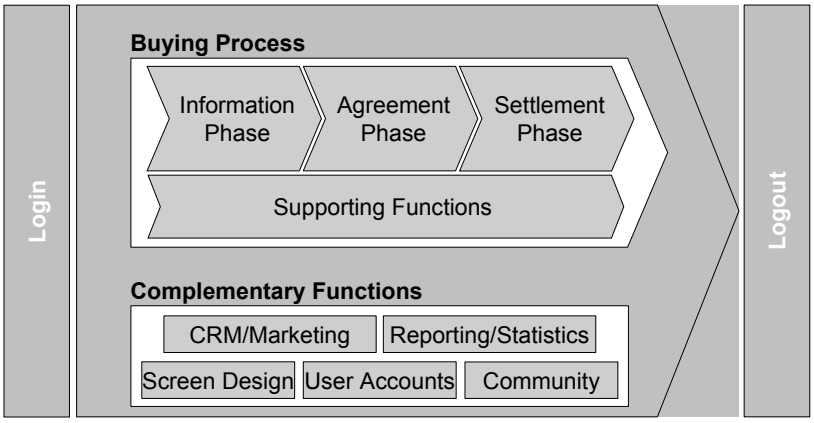


Fig. 6: Personalization Functions

5 Discussion: Why is there a need for more research on personalized Web applications?

Amazon and eBay are examples of new economy companies and are pure online players whose business models are solely based on the application of Internet technology. The programming of personalization functions is an integral part of their business model. However, the contained knowledge is not publicly available. It represents a USP for these companies. European companies will need to acquire their own knowledge in the art of personalization in order to be able to compete in the battle for online customers. Besides, the Amazon approach is mainly focused on (a) collaborative filtering and (b) the relationship with private end consumers (B2C). Most companies go further also

looking at other personalization mechanisms (e.g. procurement support) and optimizing B2B commerce transactions which represent the major part of all online transactions. The potential of B2B e-commerce has been pointed out e.g. by Naville and Pfitzer [2001].

Assuming there is no need for further investigation of the personalization of e-commerce applications would be like claiming we do not need to search for new pain killers once that Bayer had brought out its first pain killer product (Aspirin) on the market. Personalization is a knowledge requiring process that cannot be easily copied by looking at the output (e.g. the Amazon user interface). If European online vendors do not want to give way to American Internet companies such as Amazon they need to acquire the knowledge behind personalization functions themselves and transfer it to the business world. There is a second reason why Amazon differs from most companies: Amazon is a pure online player. There are many «real world» companies that have extended their business into the online realm, adding an e-shop to their existing distribution channels. These companies face a history of information systems. Their data is scattered among different operational systems with many heterogeneous databases (cf. Fig. 3). They are confronted with the problem of (1) selecting, (2) transforming and (3) optimizing their multiple data sources into one accessible homogeneous data source (enhanced with meta-data) – unlike Amazon which is a pure online player and started with an optimized database for a pure online shop.

In summary:

- Companies need to acquire the knowledge that is hidden in the Amazon system.
- Companies need to go beyond the fragmented approach of collaborative filtering.
- Most companies face a different starting position since they are not pure online players and are confronted with an existing IS landscape that needs to be harmonized.

The company Broadvision offers e-commerce software that was developed from the ideas of two marketing researchers: Don Peppers and Martha Rogers [1997]. The software is commercially available and could be used by companies. Broadvision involves high investment costs. It is not suited for small or medium-sized companies. The software offers a shop environment including all databases that are needed to store information about customers, products and Web content. It is thus optimized for pure online businesses. Besides, Broadvision offers a static rule engine where marketing rules can be defined. It does not offer pattern exploration or any kind of explorative mechanisms for data analysis. Marketers may set their rules – the system performs the output based on these rules.

In summary:

- Broadvision software is not suited for most companies since it does not natively integrate the existing databases.
- Broadvision software is too expensive for most companies.
- Broadvision software allows for static rule setting but not for explorative profile mechanisms.

Future research will have to take a closer look at the generation of customer profiles and rules. The homogenization and accessibility of customer information will be one of the major topics of future information management. Personalization is only one possi-

ble use in this context. In future personalization projects, we also intend to measure the return on personalization (ROI) from an economic perspective (increase in customer base, increased sales, etc.).

References

Adomavicius, Gediminas; Tuzhilin, Alexander (2001): Using Data Mining Methods to Build Customer Profiles, in: IEEE Computer, Vol. 34, No. 2, Feb. 2001, pp. 74-82.

Allen, Cliff; Kania, Deborah; Yaeckel, Beth (2001): One-to-One Web Marketing, Wiley, New York, 2001.

Cranor, L. F. (2003): 'I didn't buy it for myself' – Privacy and ecommerce personalization. Proceedings of the Workshop on Privacy in the Electronic Society (WPES '03), Washington DC, USA, 2002.

Davis, S. M. (1987). Future Perfect. Reading, MA: Addison-Wesley, 1987.

Deitel, H.M.; Deitel, P.J.; Steinbuhler, K. (2001): E-Business and E-Commerce for Managers, Prentice Hall, 2001.

Gentsch, Peter (2002): Customer acquisition and retention on the Internet (original title: Kundengewinnung und -bindung im Internet), in: Schögel, M.; Schmidt, I. (Eds.): E-CRM, pp. 151-180, Düsseldorf: symposion, 2002.

Godin, Seth (1999): Permission Marketing: Turning Strangers into Friends and Friends into Customers, New York: Simon & Schuster, 1999.

Kimball, Ralph; Merz, Richard (1996): The Data Webhouse Toolkit: Building the Web-Enabled Data Warehouse, New York: Wiley & Sons, 1996.

Leimstoll, Uwe; Schubert, Petra (2002): E-Commerce Survey 2002: E-Business in SMEs – Application, Potential, and Strategies, original title: „E-Commerce-Studie 2002: E-Business in KMU – Einsatz, Potenziale und Strategien", Working Report No. 6. Basel: University of Applied Sciences Basel (FHBB), Institute for Applied Business Economics, 2002

Mulvenna, Maurice D.; Ananad, Sarabjot S.; Buchner, Alex G. (2000): Personalization on the Net using Web Mining, Communications of the ACM 43 (8), pp. 80-83, 2000.

Naville, Martin; Pfitzer, Marc (2001): Trekking to the top: winning in business-to-business e-commerce, Boston: Boston Consulting Group, 2001.

Peppers, Don; Rogers, Martha (1997): Enterprise One to One: Tools for Competing in the Interactive Age, New York: Bantam Doubleday Dell, 1997.

Piller, F. T.; Schoder, D. (1999). Mass Customization und Electronic Commerce – An Empirical Assessment for the Deployment in German Enterprises (original title: Mass Customization und Electronic Commerce – Eine empirische Einschätzung zur Umsetzung in deutschen Unternehmen.), Zeitschrift für Betriebswirtschaft, 10, 1999.

Salomann, Harald; Dous, Malte; Kolbe, Lutz; Brenner, Walter (2005): Customer Relationship Management Survey, Status Quo and Further Challenges, University of St.Gallen, 2005.

Schubert, Petra; Kummer, Mathias; Leimstoll, Uwe (2004): Legal Issues of Personalized E-Commerce Applications, in: Proceedings of the European Conference on Information Systems (ECIS 2004), June 14-16, Turku, Finland, 2004.

Schubert, Petra; Kummer, Mathias; Leimstoll, Uwe (2006): Legal Requirements for the Personalization of Commercial Internet Applications in Europe, in: Journal of Organizational Computing and Electronic Commerce (JOCEC), Vol. 16, Issue 3/4, 2006.

Schubert, Petra; Leimstoll, Uwe (2002): Handbook on Personalization of Electronic Commerce Applications (original title: Handbuch zur Personalisierung von Electronic-Commerce-Applikationen), Working Report No. 7. Basel: University of Applied Sciences Basel (FHBB), Institute for Applied Business Economics, 2002.

Schubert, Petra; Leimstoll, Uwe (2004): Personalization of E-Commerce Applications in SMEs: Conclusions from an Empirical Study in Switzerland, in: Journal of Electronic Commerce in Organizations (JECO), 2 (3), July-Sept 2004, pp. 22-40.

Schubert, Petra; Leimstoll, Uwe; Risch, Daniel (2006): Personalization Beyond Recommender Systems: An Application-Oriented Overview of Personalization Functions, in: Proccedings of the I3E 2006 Conference, Oct 11-13, 2006, Turku, Finland (currently under review).

Spiekermann, Sarah, Parachiv, Corina (2002), Motivating Human-Agent Interaction : Transferring Insights from Behavioral Marketing to Interface Design, Journal of Electronic Commerce Research, Vol.1, No. 2, 2002

Spiliopoulou, Myra (2000): Web Usage Mining for Web Site Evaluation, in: Communications of the ACM (CACM), Vol. 43, No. 8, August 2000, pp. 127-134.

Treiblmaier, Horst; Dickinger, Astrid (2005): Potentials and limitations of Internet-based data collection for CRM (original title: Potenziale und Grenzen der internetgestützten Datenerhebung im Rahmen des Customer Relationship Management), in: Ferstl, Otto K.; Sinz, Elmar J.; Eckert, Sven E.; Isselhorst, T. (Hrsg.): Wirtschaftsinformatik 2005 – eEconomy, eGovernment, eSociety, pp. 191-208, Heidelberg: Physica-Verlag, 2005.

Vassiliou, Charalampos; Stamoulis, Dimitrios; Spiliotopoulos, Anastasios; Martakos, Drakoulis (2003): Creating adaptive web sites using personalization techniques: a unified, integrated approach and the role of evaluation, Adaptive evolutionary information systems, pp. 261-285, Idea Group Publishing, 2003.

myLandscapes.ch – Explaining Recommender System Principles in a Web-based Application

Daniel Risch

University of Applied Sciences Northwestern Switzerland FHNW
daniel.risch@fhnw.ch

Work in Progress

Abstract

myLandscapes is a personalization demonstrator offering insight into some common personalization and recommender systems approaches. Instead of products that are offered in e-shops, myLandscapes provides pictures of landscapes which can be rated, labelled and sent to friends. myLandscapes is able to predict future user ratings and to explain similarities both between users and pictures. The predicted values are used to display landscapes based on user's preferences. The main advantage of offering pictures in this application is that users do not need previous knowledge in a specific domain. People can easily assess whether or not they are attracted by a landscape and therefore cannot only rate pictures without previous knowledge but can also judge resulting predictions at first glance. The application is a first prototype and will be further developed in the future.

1 Introduction

Personalization is about the interaction between a company and a customer on a one-to-one basis. The aim is to match user needs and therefore maximize the long term customer value. Due to the interactive characteristics of web-based applications – compared to other media like newspaper, television or radio – the WWW is particularly suited for personalized services. Over the past years there has been a lot of research in the broad field of personalization focusing on recommender systems e.g. by Sarwar et al. 2000, Adomavicius and Tuzhilin 2005, Herlocker et al. 2004. Privacy concerns have been discussed by Ackermann and Cranor 1999, Preibusch 2005, Risch and Schubert 2005. Complementary research on personalization concepts was presented by e.g. Peppers and Rogers 1997, Pal and Rangaswamy 2003, and Schubert and Koch 2002. Most publications implicitly mention the need of customer and content specific data to adapt interfaces, customize content and predict future user needs. To really match user needs on a one-to-one basis, customer specific data has to be available in an appropriate amount and in fairly good quality. As only a small part of customer specific data like e.g. contact information can be used directly to support cus-

tomers and to personalize their shopping experience, data like ratings of products, transaction history or logfile data has to be analysed and aggregated to get useful information.

This paper introduces a personalized, web-based application which aims to demonstrate different personalization and recommender systems approaches. It represents work in progress at the Competence Center E-Business Basel.

2 Motivation

Personalization of e-commerce applications has been a major research area of our research group during the last six years. The literature research and the information we obtained throughout our projects with partner companies showed that the profit of personalized applications as well as the knowledge that could be gained by analyzing customer specific data is still not sufficiently exploited. To demonstrate the potential of personalization features, we decided to set up a so called personalization demonstrator which is able to explain some personalization and recommender system concepts.

Another motivational aspect for this project is based on work by Herlocker et al. [2000]. They point out that recommendations are often computed in a black box and users are not able to effectively understand why certain products were suggested to them. Therefore, myLandscapes (www.mylandscapes.ch) is meant to provide as much information about the computation and origin of recommendations as possible.

Finally myLandscapes.ch serves as demonstrative part of a Ph.D. thesis on the usage of customer profiles in e-commerce applications.

3 myLandscapes.ch

3.1 Concept

The idea of myLandscapes.ch was to set up an application which should be able to apply and explain personalization and recommender systems approaches. Instead of products like CDs or DVDs myLandscapes “provides” pictures that can be rated, tagged and sent to friends. There are some advantages of rating pictures instead of movies (e.g. www.movielens.org) or CDs and books (www.amazon.com, www.gnode.net) in an application that aims to demonstrate the functionalities of recommender systems: Humans are able to judge visual impressions rather quickly and therefore do not need to know a lot about a specific contextual area. This reduces (a) the time needed to judge the “products” on the Web site on first sight and (b) the time needed to judge the *recommendations* for the products.

As can be seen in Figure 1 the main window of myLandscapes is divided into four areas. Area 1 marks the title bar and contains some superior navigational elements. In the second area the landscape-photographs are displayed. The third area shows additional information on how the pictures are selected and includes functionalities to rate, label, and search photographs. Area 4 contains the secondary navigation right below the photograph and all explanatory information to guide the user.

To enter myLandscapes the user must register by entering username and password. Further information can be provided voluntarily. After a new user has registered, he will be asked to rate 10 randomly selected pictures of the myLandscapes database. These

ratings are needed to set up a basic profile of a new user. Then the user is free to explore the other parts of myLandscapes.

In the following sections we will provide insight into the different parts of myLandscapes.

3.2 “Landscapes”

The transactional area of myLandscapes is labelled with “landscapes”. There are four subcategories, namely “rate”, “label”, “search” and “send”.

In the “rate”-section the user can rate any picture on an 11-point-scale from 1 to 10 by clicking on one of the straps on the right hand side. In this mode the pictures are displayed randomly. If a picture has already been rated by a particular user in an earlier session, he receives rating information and can either keep the former rating or overwrite it by a new one.

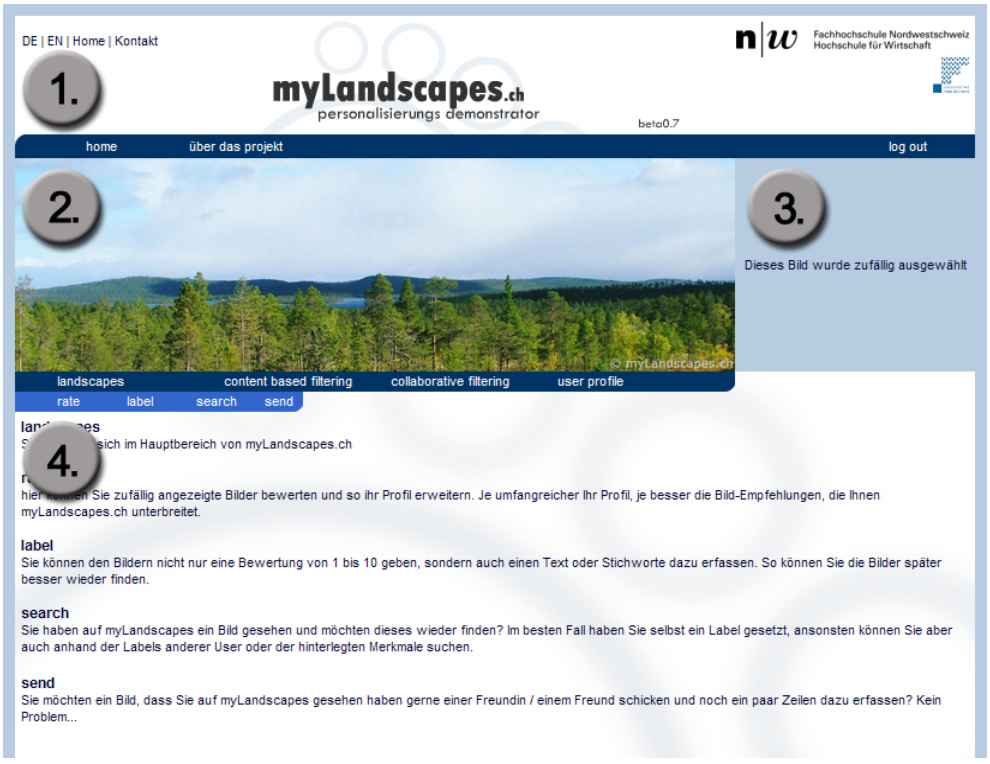


Fig. 1: User interface of myLandscapes.ch

In the “label”-area the user can add as many tags to a picture as he likes. This is useful to find specific pictures in future sessions.

To find pictures that were previously labelled by the current user or by other users he can navigate to the “search”-area. There are two possibilities to find particular pictures: (a) to search in the labels of all users or (b) to limit the search-functions to the own labels.

If a user has found a photograph that he would like to send to a friend, he can click on the send button while the photograph is displayed in area 2. After entering the message and an E-Mail-address myLandscapes sends an e-mail to the receiver, telling him that a myLandscapes-E-Card is waiting for him or her on the myLandscapes server.

3.3 Content Based Filtering

As mentioned above, myLandscapes provides insight into recommender systems approaches. These approaches are normally divided into content-based and collaborative filtering methods and have been broadly addressed in research (see for a state-of-the art discussion [Adomavicius/Tuzhilin 2005]. Content-based filtering follows the idea of recommending similar items based on similar item characteristics. Therefore every item has to be described in a pre-defined, structured manner.

In the case of myLandscapes, every picture is described based on colour, time of year, items on the photograph, keywords, town/region, and country. A software agent compares the characteristics of every picture with the characteristics of all the other pictures and calculates the degree of similarity. This is done by summarizing all matching characteristics (one point for every match) and dividing it by the number of single characteristics of picture A.

For every picture that is shown in area 2 of the interface, myLandscapes.ch displays three pictures that are most similar to the first one. For every picture the user has the possibility to ask myLandscapes why this picture is referred to as similar to the other one. myLandscapes then presents the attributes of picture 1 and picture 2 in a table. Matching characteristics are marked green (Figure 2).

picture 1

attribute	category	weight
Natur	Keyword	0.8
Weiss	Color	0.8
Grün	Color	0.8

picture 2

attribute	category	weight
Natur	Keyword	0.8
Küste	Keyword	0.8
Weiss	Color	0.8

Fig. 2: Comparison of similar pictures

3.4 Collaborative Filtering

In contrast to content-based filtering, the collaborative filtering approach uses the similarity of users to recommend items which similar users have bought or rated with high values. In the collaborative filtering area the application presents four pictures that are most likely to match user's preferences. The pictures are chosen based on estimated ratings for pictures the user has not rated yet. The estimation process can be divided into two steps. First a group of K nearest neighbours has to be found. Therefore the similarity of every pair of customer is calculated. This is done by using the cosine similarity measure shown in (a) [Sarwar et al. 2000, 162; Adomavicius/Tuzhilin 2005, 738]

$$sim(a,b) = d(x,y) = \cos\alpha(\vec{x},\vec{y}) = \frac{\vec{x}\cdot\vec{y}}{|\vec{x}|\cdot|\vec{y}|} = \frac{\sum_{i=1}^{n} x_i y_i}{\sqrt{\sum_{i=1}^{n} x_i^2}\sqrt{\sum_{i=1}^{n} y_i^2}} \qquad \text{(a)}$$

where $d(x,y)$ is the degree of similarity between user A and user B ($sim(a,b)$). The similarity is calculated based on the rating vectors $\vec{x}$ for user A and $\vec{y}$ for user B. x_i refers to the rating value of user A for item i, whereas y_i refers to the rating value of user B for item i. The advantage of the cosine similarity measure compared to other similar-

ity measures (e.g. city-block-distance) is, that the values for $d(x, y)$ are standardized to +1 for identical vectors, 0 for orthogonal vectors and -1 for converse vectors. Therefore, users with a similarity near +1 are most similar. The group of K nearest neighbours can then be chosen by simply selecting any number of K users with the highest similarity value. Figure 3 shows a section of the overview of K nearest neighbours for user A, including the name of the corresponding neighbour, the number of ratings, the calculated cosine similarity measure and a graphical representation of the similarity. The number of ratings refers to the number of pictures that have been rated by both, user A and user B. To avoid very similar neighbours based on only one corresponding rating, the similarity in myLandscapes is only shown if user A and user B have both rated at least 3 pictures which have been also rated by the other user.

Neighbour	# of ratings	cosine similarity
Marc	9	0.97099
Uwe	7	0.799922
Raphael	9	0.786239

Fig. 3: Overview of K nearest neighbours for user a

After having calculated the similarities between user A and all other users, a memory-based (also heuristic-based) approach is used which has been described in earlier work [e.g. by Shardanand/Maes 1995; Resnick et. al 1994]. To calculate predictions of ratings for pictures that user A has not rated yet, different approaches have been proposed. One widely used approach which also considers that users may use the rating scale differently is shown in (b). It therefore uses the adjusted weighted sum.

$$r_p(a,i) = \bar{r}_a + \frac{\sum_{b \in K_n} (r_{b,i} - \bar{r}_b) \cdot sim(a,b)}{\sum_{b \in K_n} sim(a,b)} \qquad \text{(b)}$$

In (b) the variables are named as follows;

$r_p(a,i)$ refers to the predicted rating of user A for item i,

$\bar{r}_a$ is the average rating of user A,

$r_{b,i}$ is the rating of user B for item i,

$\bar{r}_b$ indicates the average rating of user B,

$sim(a,b)$ is the cosine similarity measure from formula (a) and

K_n refers to the K nearest neighbours.

After having calculated the predicted ratings for user A, the pictures with the highest predicted rating value are shown in the section on collaborative filtering.

3.5 User profile

In the “user profile” section every user can browse the data which is stored about him. Starting with the section myData he can access the area with the registration data (username, password, gender, year of birth) and change it if necessary. myHistory offers some insight into the user’s logfile information by displaying user date and time of the last visit, number of visits and number of rated pictures. The section myRatings

provides an overview on all rated pictures of the user and also mentions the rating value as well as date and time on which the rating was entered. As shown in Figure 3, myNeighbours shows the five users that are most similar to the user that is logged in. Finally, myPreferences lists the probable preferences of a user based on its ratings and the characteristics of every rated picture.

4 Limitations

The Personalization Demonstrator myLandscapes is still under development. There are still some shortcomings in respect to usability and technical implementation. Moreover, it has not yet been tested by a large number of people. This is necessary to optimize the interface as well as the used algorithms.

5 Further Work

The current state of myLandscapes is satisfactory to demonstrate some basic personalization and recommender systems approaches. The shortcomings mentioned in section 4 will be addressed in future versions of the Web site. The rating scale which at the moment is limited on one dimension will be enhanced by further dimensions to improve the predictions and to test more sophisticated approaches. The testing of the application with a large number of students will be performed shortly.

6 Conclusion

myLandscapes aims at providing insight into personalization functions and recommender systems methods. Even if some real world applications make intensive use of recommendations, most users are not able to reason why certain items have been suggested to them. This can lead to the belief that shop administrators do not really use sophisticated recommender systems but instead pretend to create a personal note at the same time offering regular items on stock.

Once myLandscapes will be finished, it should become a self-explanatory application which offers insight into the ways of how recommendations can be made. It can help interested web users and customers to get a deeper understanding of what e-commerce applications mean when talking about personalization in general or use claims like “especially for you”, “customer with similar taste” or “your group of neighbours”.

References

Ackermann, Mark S.; Cranor, Lorrie F., Reagle, Joseph (1999): Privacy in E-Commerce, Examining User Scenarios and Privacy Preferences, Proceedings ACM Conference on Electronic Commerce, No. 11 / 1999, pp. 1-8.

Adomavicius, Gediminas; Tuzhilin, Alexander (2005): Toward the Next Generation of Recommender Systems, A Survey of the State-of-the-Art and Possible Extensions, IEEE Transactions on Knowledge and Data Engineering, Issue 17, No. 6, pp. 734-749.

Herlocker, Jonathan L.; Konstan, Joseph A.; Riedl, John (2000): Explaining Collaborative Filtering Recommendations, Proceeding of Computer Supported Cooperative Work Conference, 2000.

Herlocker, Jonathan L.; Konstan, Joseph A.; Terveen, Lorgen G.; Riedl, John T. (2004): Evaluating Collaborative Filtering Recommender Systems, ACM Transactions on Information Systems, Issue 22, No. 1, pp. 5-53.

Pal, Nirmal; Rangaswamy, Arving (2003): The Power of One, Gaining Business Value from Personalization Technologies, Trafford Publishing, Victoria, 2003.

Peppers, Don; Rogers, Martha (1997): Enterprise One to One, Tools for Competing in the Interactive Age, Currency Doubleday, New York, 1997.

Preibusch, Sören (2005): Implementing Privacy Negotiations in E-Commerce, DIW Berlin - German Institute for Economic Research, Berlin, 2005.

Resnick, Paul; Iacovou, Neophytos; Suchak, Mitesh; Bergstrom, Peter; Riedl, John (1994): GroupLens: An Open Architecture for Collaborative Filtering Netnews, Proceeding of Computer Supported Cooperative Work Conference.

Risch, Daniel; Schubert, Petra (2005): Customer Profiles, Personalization and Privacy, Proceedings of the CollECTeR 2005 Conference Furtwangen, pp. 1-12.

Sarwar, Badrul; Karypis, George; Konstan, Joseph; Riedl; John, ; John, (2000): Analysis of Recommendation Algorithms for E-Commerce, Proceedings of the EC'00, Minneapolis, 2000.

Schubert, Petra; Koch, Michael (2002): The Power of Personalization, Customer Collaboration and Virtual Communities, 2002.

Shardanand, Upendra; Maes, Pattie (1995): Social information filtering, algorithms for automating "word of mouth", Proceedings of the SIGCHI conference on Human factors in computing systems, Denver, Colorado, 1995.

Activity-Centric Collaboration with Many to Many Group Membership

Roger Tagg

University of South Australia
Roger.Tagg@unisa.edu.au

Abstract

Recent developments in groupware are embracing a theme of activity centric collaboration, with greater integration between the different aspects of information work. However many information workers today are involved in multiple groups, whose memberships often cross organizational boundaries. This paper reviews recent groupware developments including the work of the author, and suggests an architecture for how knowledge can be managed in such situations. It ends by discussing the critical success factors, both technical and socio-organizational, for achieving a quantum improvement in IT support for this pattern of collaboration.

1 Introduction

Today's groupware, especially email, is often accused of worsening rather than alleviating work overload. However, future developments promise a greater emphasis on the tasks that workers must do, rather than requiring them to attend to a burgeoning stream of unprioritized incoming messages. Also, coherent attempts are being made to better integrate groupware tools with all the other work that individuals have to do.

However increasingly, the attention of a worker is not limited to the affairs of a single group hierarchy. Many information workers are contractors and consultants, and work on multiple topics and themes. Group memberships are many-to-many (see Figure 1).

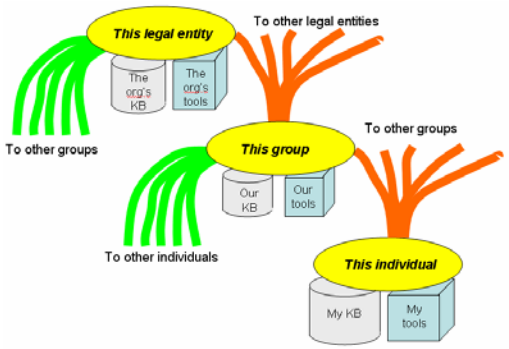


Fig. 1: A Many-to-many Collaboration Model

Even if groupware is improved, problems will still exist if the groupware is different between a user's groups, and even within groups, as can happen with e-business and virtual organizations. Message passing, with simple extensions such as file attachments and appointments, is standardized enough, but exchange of other basic forms of group knowledge, such as tasks or events is hardly standardized at all.

The next section reviews some of the recent developments in groupware. After this, work done on the author's projects is outlined, and an overall architecture is proposed. Sections 4 and 5 assess the critical success factors for such an architecture to become reality, which leads to a conclusion.

2 Review of Current Developments and Proposals

Current developments can be summarized under three main headings: *activity-centric*, *cross-application* and *context recognition*. A good overview of the field can be gained through the report of a workshop on PIM - Personal Information Management (Jones and Bruce, 2005). For an example of a commercial product development, see the press release for Lotus Notes Hannover (IBM, 2005).

2.1 Activity-Centric

Several studies, including (Geyer et al, 2003) and (Bellotti et al, 2003), have made the point that an individual's work needs to be oriented towards the work to be done, rather than the messages that appear in an inbox or folder. These studies have observed that overload is worsened by the fact that individuals are often involved in several threads of work concurrently, and that the information for any one thread is scattered, for example in "inbox", "sent items", email archive folders and folders outside of the email system. (Bellotti et al, 2003) introduced the concept of "thrasks" – a combination of threads and tasks – in their TaskMaster prototype. ActivityExplorer (Muller et al, 2004) recognizes tasks within "activity threads". Both these prototypes have been tested in sizeable trials. Other noteworthy proposals are TaskMinder (Landry et al, 2003) and a combination of FRODO TaskMan and brainFiler (Maus et al, 2005). Lotus Notes Hannover also promises to support activity-centric collaboration.

2.2 Cross-application

SAP has announced NetWeaver (SAP, 2003) which has facilities to support cooperative work across multiple applications, included as an optional extension of their mySAP Enterprise Portal. At Microsoft, projects to integrate email with workflow and other applications have been described by (Venolia, Dabbish et al, 2001). ActivityExplorer also supports object types from multiple applications.

2.3 Context Recognition

Ever since offices were no longer able to afford intelligent human secretaries, researchers have been trying to build tools that can reliably determine what a message, or a document, is all about. The themes of text mining and categorization have become popular research areas, e.g. (Ananiadou et al, 2005). These themes are related to ontologies as part of the "semantic web". However most groups and individuals cannot be expected to build and maintain their own ontology. Text mining has been used to generate domain ontologies, e.g. (Dittenbach et al, 2004). (Boardman et al, 2002) built a

prototype, Workspace Mirror, which combined a knowledge structure between file, email and bookmark folders, with a possible future extension to project management. A number of attempts have been made to link ontologies and knowledge structures to groupware, e.g. brainFiler (Maus et al, 2005), K-Discovery (Smolnik and Nastansky, 2002).

3 Work Done and Proposed Architectures

A project theme at this author's university has been running for around three years. Originally the goal was to see how workflow principles could be adapted to integrate better into an administrative environment where there is high turnover of staff, high volatility of group membership and a need for newcomers to be helped to follow required processes.

Our original interest was in enabling process managers, who were not workflow experts, to tune their processes and negotiate their integration with those of business partners. We started to model some of our own processes, with the idea of allowing process owners to make modifications.

In previous project, this author had developed a workflow system that sends workflow task prompts to each user's email inbox. This overcomes the problem of users having to look in two places for work prompts, but for most users their inbox is already overloaded and inadequately structured. We therefore experimented with an email preprocessor that uses a simple ontology to extract tasks from incoming email (Punekar, 2005). The user's interface is with a "task database" in which keywords representing ontology concepts and instances are appended to the original messages

The above project depends on each user having a personal ontology. Since we do not expect each user to build his or her own ontology, we have built an end-user friendly tool for importing and editing ontologies (Einig et al, 2006). However we realize that this still leaves the task of recognizing context by relating text strings to ontology concepts and instances, and also that the instance data is often separate from the ontology, in databases and files about customers, products etc.

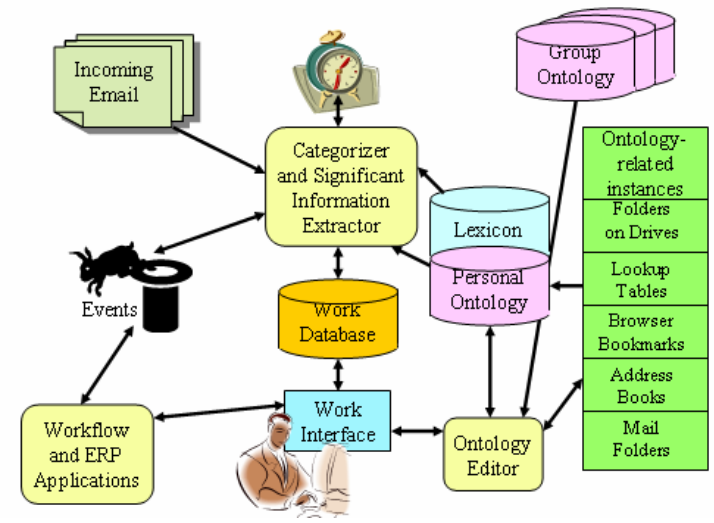


Fig. 2: The role of Ontology and Lexicon in a work pre-processor approach

Figure 2 shows the relationship between the previous two projects, the key software components being the Categorizer and the Ontology Editor.

In another project (Mahalingam, 2005) we experimented with replacing free-form email by forcing people who send messages to "our" group to use a "contact us" web form. Such a form contains a message box, but requires that certain classifying data are entered – a style often used by large companies and government departments that have a website. The work included a facility for a recipient to design and add his/her own "contact us" forms.

As an approach to integrating a user's view of all his/her work, we have also designed a dashboard in the form of a set of agent-supported drop boxes arranged around the central working area of a large screen. However although we have built and tested some prototypes, our feeling is that no one component justifies a major trial on its own, and that we will need to offer a package that is comprehensive enough to show adequate benefit to encourage real users to participate.

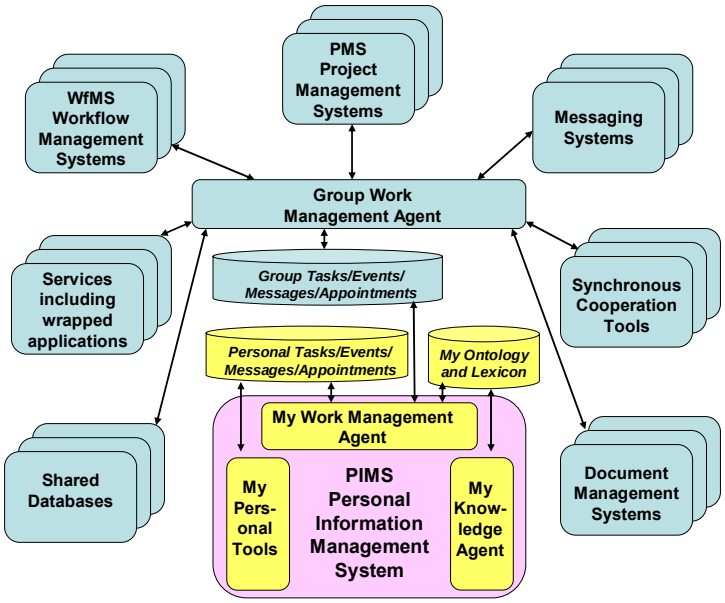


Fig. 3: Integrating one User's PIMS with Multiple Groupware

Recently, we have turned our attention to the problems of many-to-many group membership. Figure 3 shows our proposed architecture for supporting activity-centric work management where multiple groups are involved. The groupware and application systems round the outside are provided by those organizations that support the groups. The keys to the architecture are a) the collaboration between the PIMS Work Management Agent and those of the various groups; and b) the ability of a Knowledge Agent to work in the background, maintain an ontology and help to classify the user's work in a consistent fashion.

4 Technical Implications and Limitations

Two main technical limitations apply: a) the ability of the text mining algorithms and ontology tools to present good enough categorizations to the users and b) the existence of standard XML dialects to reliably exchange tasks, events and other business objects. Although text mining is a well-established research area, practical use is still not

well-developed. For tasks, although a standard PMXML has been proposed (Volz, 2002), but as discussed by (Curran et al, 2004), it has not been adopted in Microsoft Project and has yet to be adopted widely. It also seems too heavy on Project Management to be useful for other sources of tasks such as ERP systems, Workflow Management Systems and groupware clients such as MS Outlook.

In addition, many users are constrained by the amount of display screen they can view. A typical computer screen is small in comparison with a user's desk, not to mention walls. Serious mission critical work often uses very large or multiple screens, and some office users have 2 or even 3 screens side by side.

5 Socio-organizational Implications and Limitations

Many of today's information workers are overloaded, and do not have time – even if they have the expertise – to create explicit rules or maintain their own ontology, so no proposed system can expect acceptance unless most of this work is done automatically. Overload is considered by many, e.g. (Kirsh, 2000) to be caused as much by frequent changing of context as by sheer volume. So no solution that adds more interfaces will be successfully adopted either – even some features of current groupware are not widely used. This is a special challenge for the multiple group situation, because the default is to have to learn each group's different interface. Changing to activity-focussed work will also mean a major culture change for many individuals, as would putting the onus on senders to formalize and categorize their messages.

On the organizational side, an implication is that all the groups that users belong to need to have enough infrastructure to support the integration that each user will require. Since some groups, e.g. in virtual organizations, may be volatile or short-lived, they may not be able to justify setting up such infrastructure.

6 Conclusion

So far, a number of interesting prototypes have been built and user trials have been run, although usually with "captive" users, such as interns and colleagues within the researchers' organizations. However today's information worker already has made a large investment in learning a range of tools to support his or her various group activities. In order to make a quantum improvement in effectiveness and reduction of overload, the two key hurdles, we believe, are Integration and Context Recognition. To integrate in an activity-oriented manner requires a common currency, not only for messages, but for tasks and events.

Technical solutions to most of the issues discussed in this paper are not in short supply, except perhaps in the area of context recognition. The more serious limitations are likely to be social and organizational. However if business is not to be swamped by the tide of information overload, the challenges need to be met. It is likely that only when all the components of a solution are good enough will there be a quantum improvement. Just as VisiCalc heralded the adoption of spreadsheets, it may be that the way forward lies in the hands of an entrepreneurial vendor – who has the resources to bring all the related technologies together and launch a product into the market, rather than banking on any one field of specialized research.

References

Ananiadou, S; Chruszcz, J; Keane, J; McNaught, J; Watry, P (2005): The National Centre for Text Mining: Aims and Objectives, http://www.ariadne.ac.uk/issue42/ananiadou/

Bellotti, V; Ducheneaut, N; Howard, M; Smith, I (2003): The Design and Evaluation of a Task Management Centered email Tool, Proceedings of the 2003 CHI Conference, Fort Lauderdale, Florida (2003)

Boardman, R; Sasse, M; Spence, R (2002) Life beyond the Mailbox: A Cross-Tool Perspective on Personal Information Management, Proc. CSCW 2002 Conference Workshop on “Redesigning Email for the 21st Century”

Curran, K; Flannagan, L; and Callan, M (2004): PMXML: An XML Vocabulary Intended for the Exchange of Task Planning and Tracking Information, Information Technology Journal 3 (2), pp 192-5, 2004.

Dittenbach, M; Berger, H; Merkl, D (2004): Improving Domain Ontologies by Mining Semantics from Text, Proc. 1st Asia-Pacific Conference on Conceptual Modelling, Dunedin, New Zealand, http://www.crpit.com/confpapers/CRPITV31Dittenbach.pdf

Einig, M; Tagg, R; and Peters, G (2006) Managing the Knowledge Needed to Support an Electronic Personal Assistant, In Proc. ICEIS (Intl Conference on Enterprise Information Systems), Paphos, Cyprus

Geyer, W; Vogel, J; Cheng, L-T; Muller, M (2003): Supporting Activity-centric Collaboration Through Peer-to-Peer Shared Objects, IBM Research Report RC-22877 (W0308-061)

IBM (2005): With the unveiling of the next release of Lotus Notes, code-named Hannover, Press Release, http://www-306.ibm.com/software/swnews/swnews.nsf/n/nhan6dbjwg

Jones, W; Bruce, H (2005): A report on the NSF-sponsored workshop on Personal Information Management”, Seattle, WA, USA, January 2005, http://pim.ischool.washington.edu/final%20PIM%20report.pdf

Kirsh, D (2000): A Few Thoughts on Cognitive Overload, Intellectica, http://icl-server.ucsd.edu/~kirsh/Articles/Overload/published.html (2000)

Landry, B; Nair, R; Pousman, Z; Tungare, M (2003): TaskMinder: A Context- and User-Aware To-do List Management System, http://www.sims.berkeley.edu/~rnair/taskminder_paper.pdf

Mahalingam, N. Potential for Process Knowledge Management Techniques in Administration, Masterate Thesis, University of South Australia, July 2005

Maus, H; Holz, H; Bernardi, A; Rostanin, O (2005): Leveraging Passive Paper Piles to Active Objects in Personal Knowledge Spaces, http://www.dfki.uni-kl.de/~maus/dok/MausHolzBernardi+05.pdf

Muller, M; Geyer, W; Brownholtz, B; Wilcox, E; Millen, D (2004): One-Hundred Days in an Activity-Centric Collaboration Environment based on Shared Objects, Proceedings of CHI Conference, Vienna, Austria (2004)

Punekar, S (2005) Ontology Based Add-In for Automatic Classification of Incoming E-Mail, Masterate Thesis, University of South Australia, July 2005

SAP (2003): Collaboration with SAP NetWeaver, Solution Brief, http://www.sap.com/solutions/netweaver/pdf/BWP_Collaboration_NetWeaver.pdf

Smolnik, S; Nastansky, L (2002): K-Discovery: Using Topic Maps to Identify Distributed Knowledge Structures in Groupware-based Organizational Memories, Proc. 35th Hawaii International Conference on System Sciences, 2002.

Venolia, G; Dabbish, L; Cadiz, J; Gupta, A (2001): Supporting Email Workflow, Microsoft Research Technical Report, ftp://ftp.research.microsoft.com/pub/tr/tr-2001-88.pdf

Volz, R (2002): PMXML - a XML standard for Project Management, http://www.vrtprj.com/content/istandards/pmxml_en.html

Collaborative Model Management Platform – Requirements and prototypical Implementation

Dominik Vanderhaeghen[1] and Peter Loos[1]

[1] Institute for Information Systems (IWi)
at the German Research Center for Artificial Intelligence (DFKI GmbH)
{vanderhaeghen|loos}@iwi.uni-sb.de

Abstract

With information gaps across the borders of an enterprise business process coordination turns out to be a highly complex task in enterprise cooperation. Especially for network design and implementation, information modelling serves as a fundamental starting point. However, efficient modelling support for cross-organisational modelling has not been provided by ordinary Business Process Management methods and tools in the past. Thus, in the paper, the authors depict a modelling approach dedicated to a global and a local information description and a collaborative management of information models by the use of a respective model management platform. The latter supports the collaborative creation and application of models in network environments.

1 Introduction

The planning and design of enterprise networks lead to complex challenges: Networks consist of autonomous economic entities, usually with a common target definition [Leimeister et al. 2004]. Beyond this, – as an example – virtual enterprises are characterized by common resources and interfaces [Specht/Kahmann 2000] due to numerous points of contact. At least two different organizations collaborate in order to create a common added-value. To do so efficiently the collaboration resp. integration of network participants is required.

Business processes have proven to be the ideal design items in conjunction with the use of graphical methods and tools from a conceptual point of view [Hammer/Champy 1993]. However, with information gaps across the borders of an enterprise business process coordination turns out to be a highly complex task in the network.[3] Thus, adequate instruments have to be designed and supported by Information and Communication Technology (ICT). For the collaborative planning and design of an enterprise network, information modelling serves as the fundamental starting point. Information models depict attributes and parameters necessary for requirement definitions. They com-

[3] Cf. requirements e.g. described in [Zang et al. 2004].

prise knowledge about business logic, data interfaces, or organizational responsibilities within a network. The structured design and provision of information for business and IT specialists is essential for an efficient setting-up of a network. As traditional Business Process Management (BPM) approaches and tools do not provide support sufficiently, existing approaches and tools have to be extended.

In the paper, the authors depict an approach towards information modelling and model management in networks. The authors distinguish two modelling levels due to abstraction and selection of process information and the need for information security in cross-organizational collaborations. To support modelling tasks efficiently, a collaborative platform for the modelling and management of models in distributed environments is described. Due to requirement descriptions have already been depicted in e.g. [Adam et al. 2005a; Theling et al. 2005] this paper focuses on the description of solutions disregarding general requirements already described in former work. The paper ends with a conclusion and an outlook on future research in the cross-organizational modelling and model management area.

2 Modelling in Enterprise Networks

The systematic planning and design of business processes in enterprise networks demands a set of integrated methods and tools from the business concept level up to the implementation into ICT-systems. Existing BPM methods and phase models have to be used as a foundation and have to be adapted to the specifications of VE networks. Especially because of its completeness of vision and its proven practicability, both in the scientific and the economic context, the "**ARIS House**" [Scheer 1994] is accepted as a generic framework for BPM. Hence, it serves as a basis for further considerations. The ARIS House describes a business process, assigning equal importance to the questions of organisation, functionality and the required documentation. First, it isolates these views for separate treatment in order to reduce the complexity of the description field, but then all the relationships are restored using a control view introduced for this purpose. Within the different ARIS views, information modelling serves as the main instrument [Adam et al. 2005a].

To meet the design and implementation requirements of networks, instruments to describe as-is states and to design to-be states of network objects are considered in the dimensions of the ARIS House. Business analysts and IT specialists have to consider product and service descriptions, business process models and organisational structures for network planning, design and implementation. The transition between as-is and to-be in collaborative product development or process engineering is achieved by a successive synchronisation of organizations. Planning, design and implementation of a network require increased communication efforts between business partners involved: Thus, information is exchanged in the form of information models which depict e.g. partner input/output descriptions, interface requirements, or process information.

Due to the characteristics of networks, knowledge is a critical resource. It is only shared with partners under given circumstances. Based on [Adam et al. 2005a], knowledge is classified as such

- to be managed on a **global level** and such
- to be managed on a **local level**.

Both description levels form a knowledge classification which is represented in the ARIS House by a vertical axis (global knowledge) and a horizontal axis (local knowledge) (cf. Figure 1).

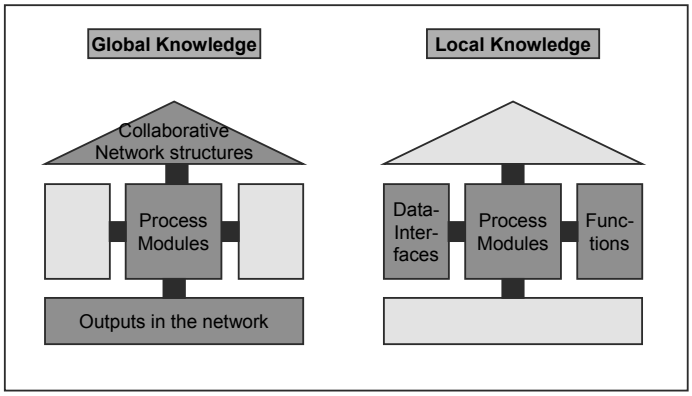


Fig. 1: Global and local knowledge in networks [Adam et al. 2005a]

Global knowledge comprises partner-spanning relevance on the one hand as e.g. a change of network structure due to partners leaving a network. This implies that products or services may be no longer available within the network. Thus, such information is *globally* important. Global models contain general conditions for e.g. application of ICT in a network. On the other hand, local knowledge as detailed processes or process interfaces is kept within the borders of an enterprise or bilaterally exchanged with direct business partners only. Consequently, models are required on a global and a local description and application level. While local information models are not made public to all business partners, global models intend a coordination of all partners.

To support local and global modelling in networks efficiently, the blueprint of a distributed model management platform is described in the following.

3 Platform for Collaborative Model Management

Networking enterprises implicates a close connection between discrete economic entities. However, the general design and implementation of internal business processes and ICT are usually managed without external exertion of influence. But at the same time internal organizational knowledge is shared selectively within enterprise networks in the form of models [Adam et al. 2005a]. The intended coordination of business partners requires information processes between decision makers and actors in order to harmonize network actions. Thus, we propose an approach towards a collaborative model management platform. To plan, to design and to implement networked business processes, modelling is conducted in a **distributed** manner between two or more organizations. Integration of models becomes a critical task due to heterogeneous modelling frameworks and modelling tools being in use in enterprise networks [Theling et al. 2005].

The authors describe a platform which is installed and applied in an enterprise network by every single participant organization. The platform mainly consists of a web-based front end, a model and model meta-data repository, interfaces to existing BPM tools and converters for the transfer and transformation of information models towards different syntactical representations. It is applied by multiple system instances which are able to communicate to each other. Main target is the management of local and global

models due to the approach described in section 2. In the following, the authors revert to main challenges of the platform only. External integration of tools is not described.

3.1 User Interface and Authorization

In the platform, a web-based user interface is provided to enable easy user access to information. Security requirements are met by a session-based module to manage login data. This function is applied in a cross-organisational manner, too: Authentication is provided to external users by giving access on models which are stored in a single platform instance (c.f. also section 3.2). Single Sign-On (SSO) facilitates the work with different integrated modelling tools. The user interface provides a distinct navigation structure. Easy and quick access to basic functions is ensured by two navigation bars for every user role. Figure 2 illustrates the user interface with basic modules.

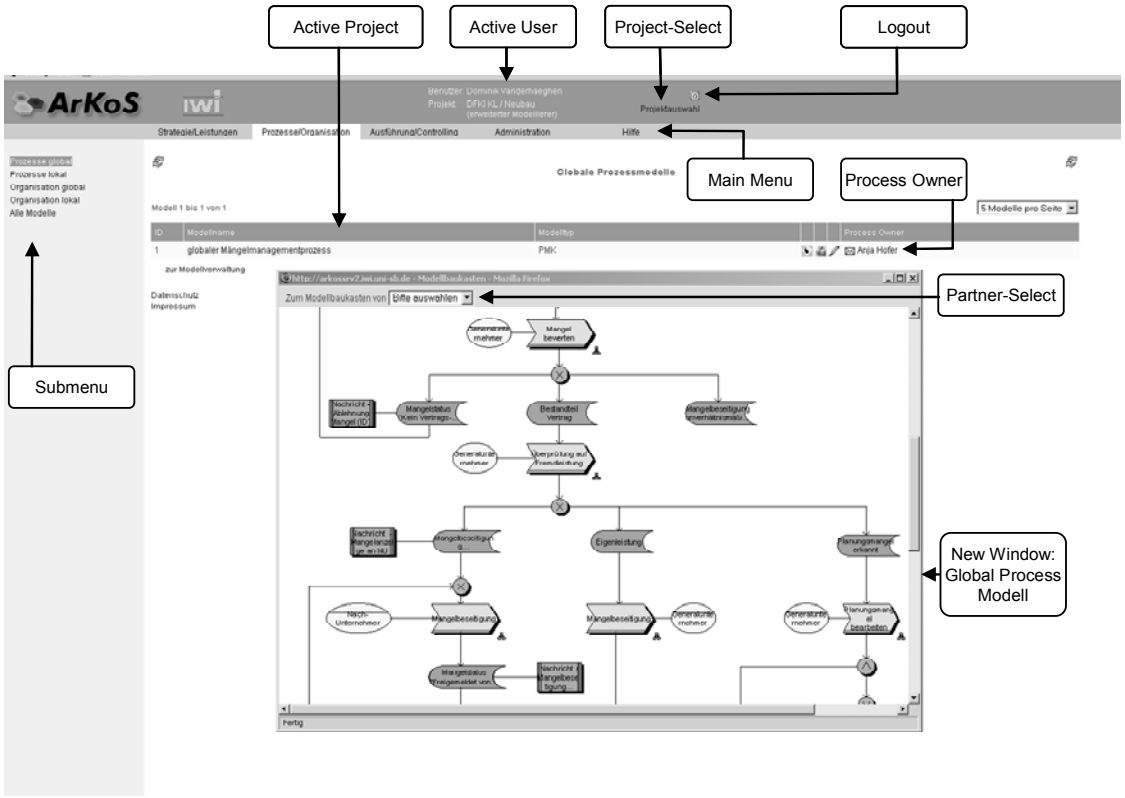


Fig. 2: Platform User Interface

3.2 Information Access across multiple Platform Instances

Network participants are allocated in distributed environments. The coordination of collaboration partners requires communication efforts. In our approach, this communication is realized with a distributed information exchange of models. However, in a network the exchange of information requires measures building trust between business partners [Ratnasingam 2003].

On a communication layer, necessary access authorization for model exchange can be designed on a global level (ensuring communication between all partners) and a local level [Adam et al. 2005b]. On a local level, communication is negotiated bilaterally (e.g.

for information exchange between exact two partners). Based on these two levels of spatial distribution, access authorities are realized in two steps.

Firstly, unique access information is given to all partners in a network (global partner user name and global partner password). Access information is associated to one running project. The project is named unique by every partner. Conciliated access information is achieved in combination with a first network exchange of models. Information models depicting the overall organizational network structure are transmitted to all partners for network management purposes. Thereby, partners get information in two different dimensions: On the one hand global information for network planning and design is exchanged with organisational models. These models also contain knowledge about project partners and mutual business process dependencies. Partner addresses (Unified Resource Locators (URL) of corresponding platform instances) are added as attributes to global organisational models. On the other hand, the global access data is inserted to the global model. On a protocol layer information access is encrypted via Internet by Secure Hyper Text Transfer Protocol (HTTPS).

Thereby, every partner gets all necessary information for a bilateral exchange of data between direct business partners. With

- the knowledge which *partner combinations* require bilateral communication in the network,
- single *partner addresses* (URL) known to the network,
- global and unique access information known to the network and
- secure *communication channels* with encryption mechanisms

the first stage of cross-organisational access framework is achieved. It enables data exchange in distributed environments.

With global knowledge about business partners, detailed information can be transferred in a second step. Partners once identify the need for communication within a network project by organisational dependency descriptions (cf. step 1). Consequently, business processes of business partners have cross-organisational interfaces to be aligned. Synchronisation and communication are facilitated by models and their bilateral exchange. Models depict necessary information on a partner's public processes and interface descriptions. They offer a possibility to recognize mutual dependencies and to react by process reengineering or customization of application systems. To facilitate the exchange of detailed models on a local (bilateral) level, every partner requests individual access information (partner's local user name and password) to its direct business partner. Hereby, the unique project identification number and globally known username and password are transmitted in association to the request. Partners check if a request is valid (correct partner request URL, correct project ID, correct global access information) and accept or deny a request. If accepted, a partner creates access information for the business partner request. If it is not valid, the request is ignored. Successful access is valid for a whole project duration and must not exceed a given time limit. With the created local user name and password, business partners get access to the information another partner has directly made public to him. This information is managed in platform instances in the form of models as public business process models, public ICT interface descriptions or product and service trees.

A cross-organisational and distributed communication between business partners is accomplished.

3.3 Distributed Information Exchange and Repository Storage

In a network, models might occur in different syntactical representations. This is related to the use of heterogeneous modelling languages and supporting tools. Control instances might be missing as some forms of collaboration networks only imply equal participants being part of a network. Examples are enterprise networks without one or more central, steering management occurrences. Thus, it is not possible to enforce a common syntactical representation for models or an use of special languages and tools. However, an agreement has to be established either on a local level between collaboration partners or on a global level to get a collaboration-wide and standardized default. In the latter case, the default needs a partner-wide acceptance. In the first case, an agreement between at least two network partners is satisfactory.

Coordination efforts in modelling need to be reduced or even minimized. A standardized description of information with one storage format becomes necessary. The format needs independency from tool providers as it requires a common acceptance among all network partners. The Business Process Modeling Notation (BPMN) provides an appropriate modelling language. It helps to describe process information on a conceptual level. The BPMN addresses modelling experts as well as IT specialists [White 2004]. It is supported by various tool providers. However, – although suitable – a standardized BPMN description format based on XML does not yet exist. Thus, based on the BPMN meta-model, a XML-based description and storage format has been designed and implemented [Theling et al. 2005; Vanderhaeghen et al. 2005]. Local process models in heterogeneous representations are transformed to BPMN-compliant representations and syntactically stored as BPMN models in a platform repository. With transformation and standardized representations, process models become syntactically understandable for all network participants. BPMN acts as a common denominator for information description and information storage.

3.4 Synchronization of Models

To apply existing models of participants in a enterprise network, private models from BPM or software engineering are selected due to their relevance for network coordination. Hereby, a selection of models is copied and stored in the collaborative model management platform with a unique backtracking to their original model instances. The assumed repository of private process models are hidden to business partners and managed in separate tools not accessible to unauthorized (external) people. Thereby, critical information models which must not be made public are protected. Participants of a network are able to manage their collaborative relationships with a pool of selected models being necessary for network and partner coordination.

Figure 3 depicts the proposed synchronization procedure which assures that model copies – selected for collaborative application and thus managed in the platform – enable retraceability to their local source pendants. A need for model alignment is identified by working with these copies of models. With new collaborative requirements, private models may be changed and updated for their collaborative application afterwards.

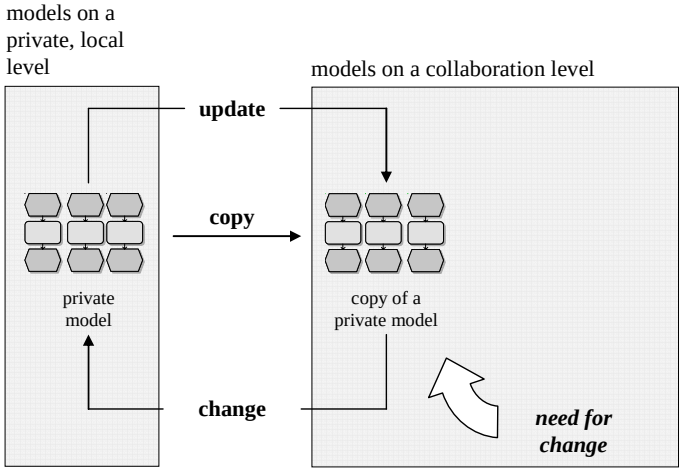


Fig. 3: Synchronization Procedure

4 Conclusions

As described in Section 1, enterprise network coordination turns out to be a highly complex task due to the variety of influencing factors. Former research has shown the need for special coordination efforts and the development of enhanced methods and tools for collaborative modelling in networks. Hereby, modelling serves as an established instrument for the design and implementation of enterprises and their role in networks. While modelling primarily has been treated for intra-organizational purposes in the past, new requirements towards enterprise-spanning modelling have to be considered. The approach described in this paper reverts to problems evolved from former research (cf. Section 1).

In the paper, the authors have presented an integrative approach which is dedicated to the collaborative management of cross-organisational models in networks. To support modelling efficiently a platform for a collaborative model management has been described due to enterprise network requirements. In future work, the platform approach has to be evaluated. Moreover, negotiations of modelling conventions and consistency checks for network models have been identified as additional starting points for future work.

The work, presented in the paper, has been developed within the research project “ArKoS – Architecture for Collaborative Scenarios”, funded by the German Federal Ministry of Education and Research (BMBF). The authors want to thank Mr. Adam, Mrs. Hofer and Mr. Zang as well as Mr. Panfilenko and Mr. Woldert-Jokisz for their contribution within the project.

References

Adam, Otmar; Chikova, Pavlina; Hofer, Anja; Zang, Sven; Vanderhaeghen, Dominik (2005): e-Collaboration architecture for customer-driven business processes in inter-organizational scenarios, in: Funabashi, Matohisa; Grzech, Adam (eds.): Challenges of Expanding Internet: E-Commerce, E-Business, And E-Government., Berlin: Springer, 2005, pp 63-77.

Adam, Otmar; Hofer, Anja; Zang, Sven; Hammer, Christoph; Jerrentrup, Mirko; Leinenbach, Stefan (2005): A Collaboration Framework for Cross-enterprise Business Process Management, in: Preproceedings of the First International Conference on Interoperability of Enterprise Software and Applications INTEROP-ESA'2005 Geneva, Switzerland, Geneva 2005, pp. 499-510.

Hammer, Michael; Champy, James (1993): Reengineering the corporation: a manifesto for business revolution. New York: Harper Business, 1993.

Leimeister, Jan- Marko; Weigle, Jörn; Krcmar, Helmut (2004): Effizienz virtueller Unternehmen: Ein Vergleich zweier Projekte bei AGI. Hohenheim: Universität Hohenheim, 2004.

Ratnasingam, Pauline (2003): Inter-Organizational Trust for Business-to-Business E-commerce. Hershey et al.: IRM Press, 2003.

Scheer, August-Wilhelm (1994): Business Process Engineering : Reference Models for Industrial Enterprises. Berlin: Springer, 1994.

Specht, Dieter M.; Kahmann, Joachim (2004): Regelung kooperativer Tätigkeit im virtuellen Unternehmen, in: Albach, Horst; Specht, Dieter; Wildemann, Horst (Hrsg.): Virtuelle Unternehmen, Gabler, 2000, pp. 55-73.

Theling, Thomas; Zwicker, Jörg; Loos, Peter; Vanderhaeghen, Dominik (2005): An Architecture for Collaborative Scenarios applying a common BPMN-Repository, in: Kutvonen, Lea; Alonistioti, Nancy: Distributed Applications and Interoperable Systems: 5th IFIP WG 6.1 International Conference, DAIS 2005, Athens, Greece, June 15-17, 2005. Lecture Notes in Computer Science, Volume 3543, Berlin: Springer-Verlag, 2005, pp. 169-180.

Vanderhaeghen, Dominik; Zang, Sven; Scheer, August-Wilhelm (2005): Interorganisationales Geschäftsprozessmanagement durch Modelltransformation. Saarbrücken: Universität des Saarlandes, 2005, Vol. 182.

White, Stephen Andrew (2004): Business Process Modeling Notation (BPMN). BPMI.org. http://www.bpmi.org/bpmi-downloads/BPMN-V1.0.pdf. 2004.

Zang, Sven; Hofer, Anja; Adam, Otmar (2004): Cross-Enterprise Business Process Management Architecture - Methods and Tools for Flexible Collaboration, in: Meersmann, Robert; Tari, Zahir & Corsaro, Angelo (Hrsg.): On the Move to Meaningful Internet Systems 2004: OTM 2004 Workshops, Berlin: Springer Verlag, 2004, pp. 483-494.

Carrier Model for Semantically Annotated Information Goods[4]

Wolfgang Maass[1], Wernher Behrendt[2] and Aldo Gangemi[3]

[1] Furtwangen University
wolfgang.maass@hs-furtwangen.de

[2] Salzburg Research Forschungsgesellschaft
wernher.behrendt@salzburgresearch.at

[3]Institute of Cognitive Sciences and Technology (CNR)
gangemi@loa-cnr.it

Abstract

Sharing and trading of information goods requires efficient and effective means for search and evaluation of the content carried by the information goods. The hurdle to overcome is the information paradox according to which, information goods obtain qualities of experience goods. This article describes an approach how ontology-based semantic annotations of information goods might reduce this paradox. At the centre of this approach is a generic container model called knowledge content object (KCO).

1 Introduction

The WWW can be perceived as a huge information market where supply and demand meet. If content has sufficiently high value for actors representing the demand side, it will generate market prices. This kind of content is generally termed "paid content" as a special form of information goods and is viewed as a digital product ([Boll/Klas 2000; Choi et al 1997]). [Shapiro/Varian 1999] define the term *information good* very broadly. "Essentially, anything that can be digitised - encoded as a stream of bits - is information. [....] Baseball scores, books, databases, magazines, movies, music, stock quotes, and Web pages are all information goods". Based on the definition of [Choi et al. 1997] anything one can send and receive over the Internet has the potential to be a digital product. "Information is a primary example of a digital product, for example knowledge-based goods that can be digitised and transferred over a digital network". The term paid content is in this article used as the non-free sales and distribution of information-based content products.

Research on the economics of information distinguishes between *search products* and *experience products* [Bloom 1989]. Search products are goods or services for which the most essential attributes can easily be evaluated prior to a purchase and provide a

[4] Based on results of the IST-FP6 project METOKIS (http://metokis.salzburgresearch.at/) that has been co-funded by the European Commission.

basis for an informed buying decision because consumers can verify claims before purchase [Franke et al. 2004]. Society is very much accustomed to buying search products such as cars, houses and computers. Experience products are goods or services for which the cost to evaluate the most essential attributes is so high that direct experience is often the evaluation method with the lowest costs in terms of time, money, cognitive effort, or other resources ([Franke et al. 2004]). Because of the difficulty involved in evaluating claims for experience products, consumers will be more sceptical of claims for experience products in comparison with search products. As Varian points out [Varian 2000], information has properties that are likely to cause difficulties for market transactions: (1) *experience good*: information needs to be experienced before you know what it is, (2) *returns to scale*: high fixed production costs and almost no reproduction costs, and (3) *public good*: information goods are typically non-rival and sometimes non-excludable [Varian 2000]. These three properties are the main reasons why the traditional content industry struggles to find business models that can be used with digital media. Hence, enrichment of information goods with semantic annotations evaluable by consumers provides the basis for shifting information goods into the class of search products, which we would expect to facilitate consumers' buying decisions.

Throughout this article we will explore the potential for paid content, of semantic annotations that provide on the one hand a facility for interoperable markets for paid content and on the other hand a means for product self-descriptions, which has strong influence on consumer buying decisions. First, we will briefly discuss application situations from which we will derive requirements for the intended semantically annotated content structure and the underlying technical content carrier architecture. In subsequent sections, we will introduce a semantically enriched container model (KCO). KCOs are exchanged over a transmission infrastructure that is based on a generic content carrier architecture (KCCA) which enables the interoperation of heterogeneous content repositories. Finally, economic implications of this approach are discussed before we will summarise and give an outlook on future work.

2 Knowledge intensive information goods

An analysis of several hundred existing paid content business models ([Stahl/Maass 2003]) resulted in a classification of five central elements to which digital content has to respond during different phases of its life cycle [Maass et al 2004, Behrendt et al 2005].

1. *Content descriptions:* provide the propositional content that is announced by a digital content on an abstract level.
2. *Community descriptions*: information about the organisational structure (roles, rights, obligations and prohibitions) by which a content product can be used and information that influences trust such as certificates and brand name information.
3. *Business descriptions*: describes the business and legal requirements during information and negotiation phases. After a purchase, contracts will be enforced according to mutually agreed rights and obligations.
4. *Presentation descriptions*: describes the presentation modes to which the information of a content product can be adapted to by rendering and other application-specific means.

5. *Trust and Security descriptions*: content must be associated with some measure of trust for the end user, and for the content provider, there must be some security features which guarantee that the content will not be illegally copied or otherwise misappropriated.

Based on this conceptualisation the concept of a Knowledge Content Object (KCO) intends to provide a structure on the computational level that can be implemented in digital infrastructures. From the ontological viewpoint given by the foundational ontology DOLCE+ [Masolo et al. 2003] and its extensions (a modular library called DDPO [Gangemi et al. 2004]), a KCO is to be distinguished from the abstract concept of an information object that carries meaning on cognitive and abstract level, independent of any technical realisation.

2.1 An Ontology of Information Objects

The main distinctions in the reused ontologies, which are imported here, include:

- the topmost class is called *particular* (any entity)
- *objects* (e.g. a *dog*) and *events* (e.g. a *barking*) belong to disjoint classes
- *physical* (e.g. a *brick*) and *social* (e.g. a *contract*) objects belong to disjoint classes
- attributes of particulars (e.g. a *colour*, or a *spatio-temporal location*) are represented as *regions* within *quality spaces*, with a possible associated metrics
- social objects include *descriptions* (the public, communicable counterpart of agents' conceptualizations, including also *plans*), which can define *concepts* (e.g. the *role of customer*), encode (or be expressed by) *information objects* (a *sentence*, or a *music chart*), provide unification criteria for *collections* (a *group of people*), etc.
- concepts can be either *roles* played by objects, *tasks* executed during actions (e.g. a *door opening task*), etc.
- concepts from descriptions provide constraints for other particulars: if a configuration of particulars satisfies those constraints, then a *situation* emerges that satisfies the concepts' description (typical applications of constraint unification include *regulations*, *plans*, *social relationships*, etc.).

The previous distinctions are supported by a large axiomatization.[5] Here, we concentrate on their application as a foundation for KCO implementation and deployment.

For example, a usage context of a content object may require us to talk about the digital reproduction of a painting that is owned by an institution, and such institution is willing to commercialize the reproduction at certain conditions that include differentiation for users, pricing, regulations to be followed, inclusion of content metadata, explanations, interpretations, ways of rendering it, etc. This context is complex, and requires a subtle differentiation of the various entity types involved in it.

According to DDPO, a content (information) transferred in any modality is a kind of social object called *Information Object* (IO). Information objects are *spatio-temporal reifi-*

[5] The full OWL axiomatization of DOLCE, DnS, DDPO, IO, etc. can be downloaded from: http://dolce.semanticweb.org.

cations of pure (abstract) information as described e.g. in Shannon's communication theory, hence they are assumed to be in time, and realized (materialized) by some entity. Information objects are the core notion of a *semiotic ontology design pattern*, which employs typical *semiotic relations* (c.f. [Gangemi et al. 2004]).

We present the axiomatization of KCOs in OWL abstract syntax. We firstly present the definition of `DnS:information-object`, which encodes the basic axioms of an ontology of semiotics extending the basic DOLCE ontology:

```
Class(DnS:information-object complete
 intersectionOf(
 DOLCE:social-object
 restriction(DnS:about allValuesFrom(DOLCE:particular))
 restriction(DnS:realized-by someValuesFrom(DOLCE:information-realization))
 restriction(DnS:interpreted-by allValuesFrom(Actions:agent))
 restriction(DnS:expresses allValuesFrom(DnS:description))
  restriction(DnS:ordered-by someValuesFrom(DnS:information-encoding-system))))
```

The definition says that information objects are necessarily *encoded* by some information encoding system, must be *realized* by some particular, can *express* a description, and, if that description is satisfied by a situation, can be *about* that situation, or some entity in its setting and can be *interpreted* by agents that can conceive the description expressed by said IOs.

For example, Barry Levinson´s movie "Wag the Dog" is an IO, it is *ordered* by modern American English language (the information encoding system), is *realized* by, e.g., an DivX copy, *expresses* a certain plot on the media industry and politics and its related meaning, is *interpreted* by an agent in the role of a spectator with an average knowledge on making movies and election campaigns, and it is *about* certain entities and facts.

These *semiotic* relations constitute a typical *ontology design pattern*, so that any composition of relations can be built starting from any node in the pattern or in an application of the pattern.

3 Semantic Modelling of Knowledge Content Objects (KCO)

The notion of a knowledge content object is based on business requirements (see section 1), and builds upon previous approaches to multimedia and hypermedia document models. Related work includes [Boll/Klas 2001, van Ossenbruggen 2001, Zillner et al 2004]. The strength of KCOs lies in the combination of business- and domain-specific semantics (cf. section 1) that are tied into DDPO (cf. section 2).

Derived from the analysis of business models and paid content products, we have developed a KCO structure consisting of six facets. Several of these facets are subdivided into further KCO sub-facets. At the "atomic" level, it is intended that each of the leaf elements is associated with well-defined operational semantics, in order to enable organisations to quickly deploy KCOs as part of their information infrastructure.

Facets	*Elements*	*Short Description*
Content Description	Multimedia Characterization	How to access the content. This description includes information about the Content Format, Encoding, Storage Location, ... Depending on the domain, the Media Format Description of MPEG7[6] or the content level description as defined in the NewsML[7] standard are good examples of content descriptions.
	Content Classification	How to classify the content: Keywords and concepts assigned to the content object based on a classification schema. Dublin Core or LOM are such classification schemas. The ITCP thematic thesaurus[8] and the ICON Class classification system[9] are well known controlled vocabularies in their domains.
	Propositional Description	What the content means. This semantic description is about the subject of the Content Object and not about the Content object itself.
Presentation Description	Spatio-temporal rendition	How to present the content: Description of how the content (and the Knowledge) of the KCO is presented to users. Presentation includes the rendering, rendition as well as interaction models. The SMIL[10] standard is clearly related to this facet.
	Interaction-based rendition	
Community Description	User task	How the Content is typically used: Description of Plans, Tasks, Roles and Goals in the context of a community which uses KCOs
	User community	
	Usage history	How the Content was used/changed: List of actions performed with the KCO during its lifecycle
Business Description	Negotiation protocol	How to trade the content: Business processes define special plans (negotiation protocols) and roles (auctioneer, seller, buyer,…) related to some business activity. This facet can be viewed as a specialisation of the community facet.
	Pricing scheme	
	Contract information	
Trust & Security	none	How to protect the content:
Self-description	none	How to understand the KCO: Specification of the (inner) structure of the KCO (e.g., active facets, ontologies used) in machine-interpretable form.

[6] http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm

[7] http://www.newsml.org/pages/index.php

[8] http://www.iptc.org/NewsCodes/

[9] http://www.iconclass.nl/

[10] http://www.w3.org/TR/2005/REC-SMIL2-20050107/

The first facet is what we call the *content description*. The KCO carries a list of media references which are intended to point to real media files. So the collection of these referenced media files is actually, the full intended content of the KCO. In order to make this content accessible for machines, we provide a simple referential mechanism to associate arbitrary logic descriptions to the media files. For this, the propositional content facet is linked to a domain ontology which represents the universe of discourse for all content descriptions of this KCO. We also include a facet element which allows the use of existing classification and meta data schemes that need not necessarily be linked to the DOLCE foundational ontology. Its purpose is to enable the migration of media and their associated metadata into the KCO structure. This provides a basis for *ontological alignment* at a later stage.

The second facet is the specification of time-based spatial *presentation of, and interaction* with, complex content. Given some media tokens, we specify on one or more temporal “tracks” which describe *when* the associated media data will be rendered, and *where* they will be rendered (in terms of spatial arrangements). The second facet element deals with *interaction* and *dialogue*. Here, the semantic annotation specifies whether the presentation is entirely pre-programmed, whether it is entirely open (e.g. web based navigation) or whether it follows some dialogue pattern where humans and system take conversational turns in order to navigate the knowledge/information structure. This description defines one or more discourse structures that can be associated with the content for its rendering.

The third facet, *community description*, describes the context in which a content can be used. This covers three facet elements: *user tasks*, which are formally described by reference to an ontology of plans and tasks; *user community*, which describes the situations with corresponding roles (rights and obligations) that users would take in order to manipulate or consume the content; and *usage history*, keeping traces of previous use in order to support workflow systems as well as collaborative filtering systems. The latter can be achieved by keeping track of user data when the KCO is being "touched" by that user. Depending on legal and contractual aspects of this facet, the filtering may be more or less anonymous.

The fourth facet, *business description*, contains a specification of the business semantics associated with the KCO. This comprises the facet element negotiation protocol which describes the business scripts by which a contract is being negotiated. A negotiation protocol is described as a DDPO *plan* that can be represented and processed in OWL-DL format [Gangemi et al 2004]. The pricing scheme is used for restricting the price policies that can be applied during the negotiation. It is grounded in DDPO as the *regulation* concept. In the simple case of a fixed-price scheme, the negotiation is reduced to a simple over-the-counter (OTC) purchase. The pricing scheme is required for price differentiation strategies that are defined by the seller on the basis of a differentiating factor such as age, quantity discount or date of content origin (see [Stahl/Maass 2004, van Ossenbruggen et al. 2001]). The resulting contract is also a plan in the DDPO ontology that describes the situation in which agentive roles can be taken by agents and act by using described tasks. We distinguish between pre-existing content and prospective content. Pre-existing content is already available at contracting time while prospective content is produced during execution time of the contract.

The fifth facet, *trust and security*, is currently deemed out of the scope of our project although we acknowledge the need for inclusion of the issue, in the overall framework of METOKIS. The framework is rounded off with the sixth facet, *self-description*.

The KCO model is translated into an OWL ontology, which specializes the IO branching of DDPO foundational ontology (ref. [Behrendt et al. 2005]).

4 Electronic Markets based on KCCA enabled infrastructures

In order to make use of the semantic richness that can be expressed with KCOs we need an infrastructure whose components support the functionality afforded by the KCO. The Knowledge Content Carrier Architecture (KCCA) does this in the shape of services which are logically clustered by KCCA's components arranged in a 3-tier architecture. This gives rise to the following structural core components: (1) KCO Service API - offering the functions described by the facets in table 1, (2) KCCA Registry and Manager - managing a federation of KCO-aware nodes, (3) KCTP Service - a protocol to exchange service requests across KCCA nodes and (4) KCCA Profiles - Services for the wrapping and integration of data sources.

One of the assumptions of our work is that eventually, most information systems will make use of two further components: firstly, reasoning services based on ontologies and secondly, a task execution environment that will support the definition and execution of flexible workflows. KCOs are designed to support such an architecture through their content description (this is where reasoning services can access the KCO) and through their community description (describing the tasks for which this KCO is useful and the roles of actors that would do the tasks).

We envisage future publishing environments to use an integrated framework consisting of the components described. This will leave the application builder to focus on application and domain specific adaptations, and on the tailoring of the presentation /interaction layer to the needs of the customer.

The following architectural overview shows the full picture combining KCCA components, reasoning and task execution environment, as well as domain specific adaptations and the application layer.

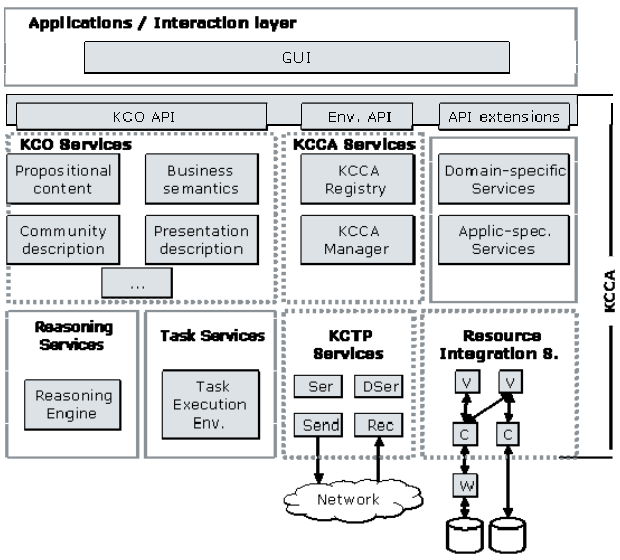


Fig. 1: Knowledge Content Carrier Architecture (KCCA).

The KCO services offer access to the operational semantics of the KCO facets. The KCCA Registry and Manager component keeps track of how a federation of KCO aware information systems is set up. The KCCA environment keeps information about information sources, wrappers and maintains state in user sessions that may span requests and transactions across the federation. The KCTP Services define a stateful protocol[11] that allows communication between KCCA nodes by exchanging serialised RDF graphs. The KCCA Integration Services give assistance in binding non-KCCA resources to a KCO aware system. This is done by a two-stage mapping process. The external information source is first mapped into an equivalent RDF schema which we call "context profile". This can be a "naive" mapping to RDF. Next, a view is defined over the context profile and this view is made KCO compliant ("view profile"). The provider of an external information source needs to write a wrapper which provides the context profile for the resource. The KCCA integrator uses the context profile to create the view profile.

5 Economic implications

From an economic point of view five hypotheses can be derived from the KCO carrier model for information goods: (1) reduction of transaction costs, (2) increase of perceived value of high-quality information goods, (3) increased competition in markets for information goods and induced price reduction, (4) reduction of operational costs by reuse of knowledge, and (5) positive influence on the consumer's decision making. These hypotheses are discussed in turn.

KCO-contained information goods are designed to be shared and traded by electronic markets because they can leverage the standardised format of KCOs. Any kind of information good is wrapped into a homogeneous format that can be carried by any KCTP-supporting infrastructure. Facet information can be perceived as plug-ins delivered by providers. The facet information provided can be used by consumers of electronic markets to reduce their information costs [Bakos 1991, Malone 1987].

As a consequence of the first hypothesis, users will be able to evaluate the value of information goods for less cost which should increase the diffusion and adoption particularly of complex information goods [Maass/Stahl 2006]. In general it can be assumed that high-quality information goods will extend their reach and life time, i.e. increase of revenue for paid contents.

If semantically annotated information goods reduce transaction costs and increase their reach, the size of markets should increase, too. Because KCO-contained information goods provide a modular but sufficiently complete structure, consumers gain improved means for product comparison. Obviously, providers will reduce this effect by differentiation of their provided semantic information. Commoditised information goods, such as stock or weather information, are likely to become target of intensified competition [Bakos 1991, Malone 1987].

If hypotheses 1 to 3 will hold, then it can be assumed that consumers will be more willing to use electronic markets as knowledge channels, i.e., they outsource knowledge competencies to external providers. Organising and archiving knowledge coded in information sources is handed over to external services if it is more effective and efficient

[11] The protocol is FIPA-based and can be implemented on top of SOAP or http.

than internal provisioning [Apostolou et al. 2005]. Container models, such as KCO, enable this outsourcing process for complex information goods. This process starts with simple information goods such as bookmarks (e.g. del.icio.us or shadows.com), pictures (flickr.com, bubbleshare.com), videos (videoegg.com and jumpcut.com), feeds (feedblendr.com), wikis, blogs and email conversations (9cays.com) but started even with complex information goods such as software repositories (sourceforge.net, collab.net).

Finally, recent results in researching consumer behaviour indicate that information given by electronic recommender systems positively influence consumers' decision to buy a particular good and furthermore reduce the amount of alternative goods considered [Häubl/Murray 2006]. In particular facets 1 to 5 contain information which is likely to be used by consumers for making their decision. However, empirical tests will be required to evaluate this hypothesis.

6 Summary and open issues

We have discussed how information goods can be semantically described by and included into a KCO container model. Other approaches such as Adobe's XMP[12] follow similar goals. It is most likely that several other architectures will appear before a solution is accepted by a large audience. The KCO/KCCA approach paves the ground and explores application areas and technological solutions.

In the future we will investigate how KCO-embedded information goods can be used to generate new kinds of information goods. This can be either done manually as part of an editorial process or automatically based on plans and situations. For instance, new information goods can be aggregated based on user preferences, willingness-to-pay or user locations to name a few. How and by which means KCO facet information can be processed is part of future research.

References

Apostolou, D., Mentzas, G., Abecker, A., and Maass, W. (2005). Challenges and directions in knowledge asset trading. Intelligent Systems in Accounting, Finance and Management, 1-16.

Bakos, J. (1991): A Strategic Analysis of Electronic Marketplaces, MISQ, 15(3), S. 295-310, 1991.

Behrendt, W., Gangemi, A., Maass, W., & Westenthaler, R. (2005). Towards an Ontology-based Distributed Architecture for Paid Content.. In Gómez-Pérez, A., & Euzenat, J. . (Eds.), Springer (pp. pp. 257). Berlin.

Bloom, P. (1989): A Decision Model for Prioritizing and Addressing Consumer Information Problems. Journal of Public Policy & Marketing, 8 (1). 1989, 161-180.

[12] http://www.adobe.com/products/xmp/

Boll, S. and Klas, W. (2001): ZYX - A Multimedia Document Model for Reuse and Adaptation. In: IEEE Transactions on Knowledge and Data Engineering, 13(3), 2001, pp. 361-382.

Choi, S.Y., Stahl, D.O. and Whinston, A.B. (1997): The Economics of Electronic Commerce. Macmillan Technical Publishing, Indianapolis, 1997.

Franke, G., Huhmann, B. and Mothersbaugh, D. (2004): Information Content and Consumer Readership of Print Ads: A Comparison of Search and Experience Products. Journal of the Academy of Marketing Science, 32 (1). 2004, 20-31.

Gangemi, A., Borgo, S., Catenacci, C. and Lehmann, J. (2004): Task Taxonomies for Knowledge Content, METOKIS Deliverable, D07, 2004.

Häubl, Gerald and Kyle Murray (2006), "The 'Double Agent' – Benefits and Pitfalls of an Electronic Agent's Personalized Product Recommendations," Sloan Management Review, 47, 3, forthcoming.

Maass, W., & Stahl, F. (2006). Adoption and Diffusion in Electronic Markets: An Empirical Analysis of the German Paid Content Market. Electronic Market, forthcoming.

Maass, W., Goyal, S., and Behrendt, W. (2004). Knowledge Content Objects and a Knowledge Content Carrier Infrastructure for ambient knowledge and media aware content systems. In Knowledge-based Media Analysis (pp. 449-456). London: QMUL.

Malone, T. (1987): Modelling Coordination in Organizations and Markets, Management Science, 33, 1987, 1317-1332.

Masolo, C., Borgo, S., A., G., Guarino, N. and Oltramari, A. (2003): The WonderWeb Library of Foundational Ontologies, 2003.

Reich, S., Behrendt, W., Eichinger, C. and M., Schaller, M. (2000): Document Models for Navigating Digital Libraries. in International Conference on Digital Libraries, (Kyoto, 2000), 277-284.

Shapiro, C. and Varian, H.R. (1999): Information rules - A Strategic Guide to the Network Economy. Harvard Business School Press, 1999.

Stahl, F., F., S. and Maass, W. (2004): Paid Content - Paid Services: Analysis of the German Market and Success Factors of 280 Business Models, =mcminstitute, University of St. Gallen, St. Gallen, 2004, 163.

van Ossenbruggen, J., Geurts, J., Cornelissen, F., Rutledge, L. and Hardman, L., (2001): Towards Second and Third Generation Web-Based Multimedia. in The Tenth International World Wide Web Conference, (Hong Kong, 2001), 479-488.

Varian, H.R. (2000): Markets for Information Goods. in Monetary Policy in a World of Knowledge-Based Growth, Quality Change, and Uncertain Measurement, 2000.

Zillner, S., Westermann, U. and Winiwarter, W. (2004): EMMA - A Query Algebra for Enhanced Multimedia Meta Objects. CoopIS/DOA/ODBASE, 2. 1030-1049.

Adaptive MarketPlace for Linking and InterFacing small and medium sized companies in the software industrY (AMPLIFY)

Henning Baars, Stefan Jesse, Sixten Schockert[1] and Mischa Seiter[2]

[1] Universität Stuttgart, Chair of Information Systems I and II
{baars|jesse|schockert}@wi.uni-stuttgart.de

[2] International Performance Research Institute
mseiter@ipri-institute.com

Abstract

For SMEs in turbulent business environments, frequent formation and reconfiguration of Virtual Organisations (VOs) becomes imperative. Critical challenges of effective and efficient VO set-up arise when trying to find a constellation of harmonising partners who are able to provide complementing products and services. The research project AMPLIFY addresses these issues by developing a solution for an open source marketplace that supports linking and interfacing of SMEs. This research in progress paper gives an overview of the current status of the project.

1 Motivation and Objectives

The core ingredient for a successful virtual organisation (VO) is a constellation of harmonizing partners who are able to provide both complementing and clearly defined products and services. The choice of partners is a pivotal factor that influences the behaviour of the partners in the inter-organizational network [Child/Faulkner 1998, p. 92; Bronder/Pritzl 1992, p. 36]. Missing fit has dramatic consequences: conflicts, opportunistic behaviour and instability.

For small and medium-sized enterprises (SMEs) in increasingly dynamic business environments, frequent VO formation and reconfiguration becomes imperative; effective and efficient VO set-up turns into a continuous and vital challenge [Kasper-Fuehrer et al. 2003]. The complexity of this task stems from a wide spectrum of relevant soft and hard factors to be considered, e.g. “organisational culture”, “skills and experience” etc. If partners’ goals are not compatible, network coordination is very expensive, at risk or even impossible [Sydow 2003, p. 312].

A prime example for such a dynamic business environment is the software sector. In essence, small and medium-sized software companies have to cope with the following challenges and changes [Crook 1996; Krishna et al. 2004, McGuire 1998]:

1. A rise in the complexity regarding system integration (esp. because of the establishment of highly distributed e-business systems), connectivity (e.g. the need to handle a variety of heterogeneous mobile devices) and flexibility (e.g. because of the proliferation of “Service-Oriented Architectures”).
2. A significant increase in competition from large international IT service providers (esp. in “offshore” countries).

The natural answer to these demands is specialisation, i.e. a focus on specific technologies, solutions or services. The downside of this approach is a decrease in the capability to deliver complete solutions for complex business demands. This in turn triggers the need for flexible and ad-hoc-cooperation among different software companies. While larger IT corporations usually have less problems to access possible partners and moreover have the possibility to make use of a plethora of B2B-collaboration solutions, small and medium sized software companies are usually more isolated.

The research project AMPLIFY (Adaptive MarketPlace for Linking and InterFacing small and medium sized companies in the software industrY) addresses the challenges associated with VO set-up by aiming at the provision of a marketplace solution for the software industry. AMPLIFY supports identifying possible partners, setting up a collaboration environment, negotiation of service and product specifications and the assessment of partners and projects. The solution will reside on a shared knowledge base containing both structured data and semi-structured documents, which are integrated based on a coherent set of semantics and can be analysed with Text and Data Mining components. The AMPLIFY software is conceived to be fully integrable in other Business Environments by the facilitation of a Service-Oriented Architecture (SOA). It thereby builds an innovative bridge between Business Intelligence technologies and innovative approaches to inter-business system integration. Moreover AMPLIFY will incorporate feedback mechanisms for evolution and self-adaption.

Chapter 2 gives a short overview of the relevant state of the art. Chapter 3 introduces the AMPLIFY solution from a conceptual (chap. 3.1) and a technical (chap. 3.2) viewpoint. Chapter 4 summarizes the findings and provides a short outlook.

2 State of the art

AMPLIFY builds up on conclusions that suggest the necessity of industry specific marketplaces that support the forming of VOs under consideration of complex sets of domain specific attributes for partner identification. This kind of solution is primarily beneficial for industries which are project-driven like the software industry. [Nayak et al. 2001, pp. 81]. By focusing on the formation of VO complementary consortiums AMPLIFY transcends established E-Business-approaches like those discussed in [Mahadevan 2003]. The result of a market survey and literature review reveals that a collaborative business network solution for partner identification, partner collaboration and partner assessment does not exist. Although there are piecemeal tools for sub-tasks of a VO set-up, there is no solution that covers all aspects in a single and integrated approach.

In detail there is no...

- …solution for finding partners that incorporates systematic encapsulation in industrial, cultural and organisational knowledge needed for this task. Sophisticated partner selection is one of the key decisions for new inter-organizational networks for it has strong impact on productivity, quality and competitiveness of the network [Ellram 1990, Möller/Gamm 2005].
- …solution that includes partner identification as well as partner collaboration and partner assessment in an integrated fashion.
- …solution offering automatic and structured negotiation of requirements and Service Level Agreements (SLAs).
- …coherent set of criteria for finding and evaluating potential partners for business networks in the software sector. Rather there is great variety of selection criteria in literature; e. g. [Dickson 1966] identifies 23 commonly used selection criteria; [Ellram 1990] emphasizes financial issues (e.g. financial stability an economic performance) and managerial, organizational and cultural issues (e.g. strategic fit and top management compatibility) as well as technological/technology issues (e.g. design and manufacturing capabilities) [cf. Weber et al. 1991 for an overview].
- …marketplace solution including advanced data mining and OLAP (OnLine Analytical Processing) functionalities like trend analysis, association analysis, categorisation and clustering.
- …solution that includes a connection of Business Intelligence and Semantic Web technologies for the integration of structured data and unstructured documents.

3 The AMPLIFY Solution and its features

3.1 Supported Process of AMPLIFY

The AMPLIFY solution features can be arranged along the general process of setting up a virtual organisation [cf. e. g. Mowshowitz 2002]. Figure 1 breaks this process down in roughly six phases and visualizes the supported (sub-) processes and functions.

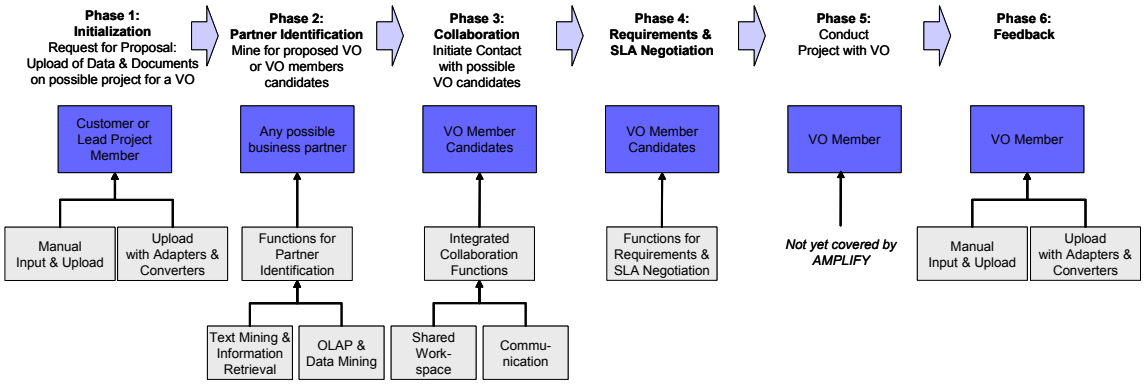


Fig.1: Processes supported by AMPLIFY

Phase 1: Initialization

In the initialization phase request for proposals on possible projects for a VO are published. Web interfaces for the automatic import of data and documents on planned VOs from proprietary systems as well as functions for a manual input/upload of such data are provided.

Phase 2: Partner Identification

Phase 2 comprises functions for an effective and user friendly identification of proposed VOs or potential business partners based on both structured data and unstructured documents. These functions are based on data mining, OLAP and semantic web technologies and consider a wide array of technical, organisational and business related parameters. An important prerequisite for these features is the formalisation (in a machine-readable form) of semantics for the successful cooperation of SMEs with an industry specific focus on the software sector. The “IT Infrastructure Library” (ITIL, see www.itil.co.uk) will be used for structuring and describing the services to be provided by the partners of proposed Virtual Organisations.

Phase 3: Collaboration

Phase 3 initiates the contact with possible VO candidates by an automatic set-up of collaborative environments with shared workspaces and synchronous communication functions for the interaction on a person-to-person level.

Phase 4: Requirements & SLA Negotiation

The virtual organization approach makes explicit the need for dedicated management activities that explore and track the abstract requirements needed to realize some objective while simultaneously, but independently, investigating and specifying the concrete means for satisfying the abstract requirements [Mowshowitz 1997, p. 375]. Therefore Phase 4 consists of functionality for the elicitation, analysis and management of requirements and service level agreements necessary for contracting of the proposed VO. Methods which foster the differentiation of requirements and solutions like e. g. Quality Function Deployment [Herzwurm et al. 2000] have to be supported. Formal assistance in setting up adequate documents as well as semantic support by best practice specifications will assist the VO members to form a solid base for project execution.

Phase 5: Project execution

This phase is up to now not covered by the AMPLIFY solution. But extensions in future concerning ongoing project and/or quality management facilities are possible.

Phase 6: Feedback

Phase 6 provides functionality for feedback and calibration that allow a constant optimisation and adoption of the AMPLIFY marketplace. By incorporating a rich set of data collection and feedback functions, the AMPLIFY solution becomes an evolutionary Business Networking tool. It collects aggregates and distributes industry knowledge for the purpose of founding dynamic VOs among SMEs in the software industry.

3.2 AMPLIFY architecture

The AMPLIFY component will be open source and will be build upon a flexible Service-Oriented Architecture (SOA) that is designed for an addition of functions to automati-

cally trigger business modelling software for process interconnection, or for adding connectors to proprietary ERP software of the involved partners. Starting point for the proposed system vision is a layered approach to architecture definition that reflects state-of-the-art approaches (e.g. cf. [Medjahed et. al 2003]). The 4-layer-architecture for the AMPLIFY system is visualized in Figure 2.

Presentation Layer

The presentation layer consists of a portal for presentation of the AMPLIFY functionality to users of potential business partners/VO members with localisation and personalisation features and web service components for presenting the AMPLIFY functionality to automatic "agents" from other complementary systems. The difference to the web services in the SOA Integration Layer is that the SOA Integration Layer is developed to access functions from other systems while web service components in the presentation layer make AMPLIFY functionality accessible to other systems.

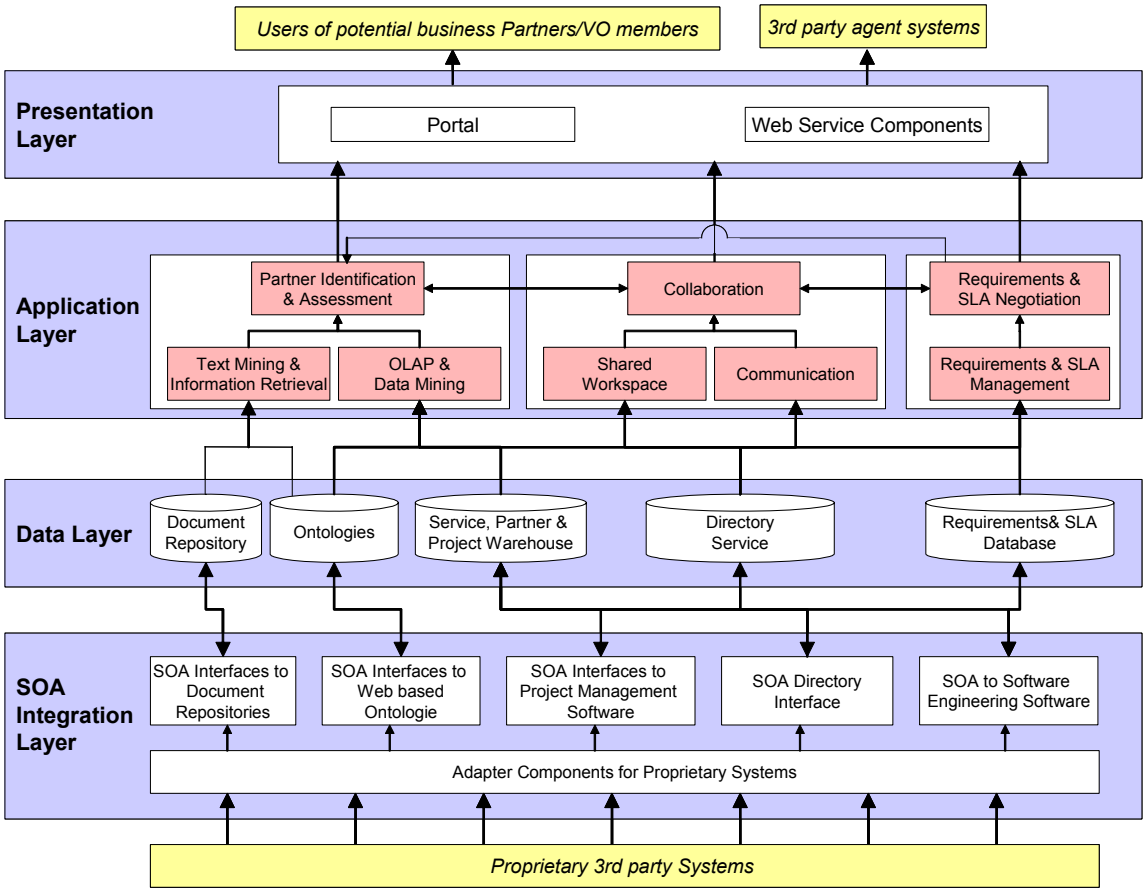


Fig. 2: AMPLIFY layered architectural approach

Application Layer

The core functionality regarding the proposed benefits for the SMEs relies in the functions for partner identification and assessment, collaboration, and negotiation of requirements and service level agreements. For each of these functional blocks individual components are defined. A text mining & information retrieval component for accessing knowledge stored in unstructured documents, an OLAP & data mining component to effectively query knowledge in the form of structured data and a partner identification & assessment component which binds together the two before mentioned com-

ponents for integrated knowledge access. A shared workspace for potential VO consortiums, a communication component for synchronous interaction between VO member candidates and a collaboration component that integrates these two functions. At last Requirements & SLA Negotiation components that enable a data-based driven specification of the services and products which will be exchanged between potential VO partners.

Data Layer

The AMPLIFY solution is in essence an evolving knowledge base which incorporates industry specific semantics (here: the software sector). The knowledge has to be stored in adequate repositories which have to provide access interfaces to the functions in the application layer and must be able to persistently keep relevant knowledge both in the form of structured data and unstructured documents. Moreover ontologies codify semantics which can be used by all other components and the directory service component provides administrative services for the whole platform.

SOA Integration Layer

To exchange data and documents between different AMPLIFY service providers as well as to build connections to third party proprietary systems of the SMEs' users, there have to be interfaces which are easily accessible over open network environments. This is especially relevant for automatic data and document up-load and exchange. All relevant integration components are placed in a "SOA Integration Layer". SOA can be seen as an application architecture in which all functions, or services, are defined using a description language and have invokable interfaces that are called to perform business processes [Dostal/Werner 2005]. Each interaction is independent of each and every other interaction and the interconnect protocols of the communicating devices (i.e., the infrastructure components that determine the communication system do not affect the interfaces). Because interfaces are platform-independent, a client from any device using any operating system in any language can use the service. In many cases there will be "adapter components" which have to be developed for different types of systems. The architecture of this layer will be flexible enough to dynamically add or exchange such adapters.

4 Summary and Outlook

The core functionality regarding the proposed benefits of AMPLIFY for the SMEs relies on the functions for partner identification and assessment, collaboration, and negotiation of requirements and service level agreements. We believe that the exploitation of the AMPLIFY platform provides business value to the participating SME companies who use the platform to form business networks as well as to marketplace providers who host and maintain the open source AMPLIFY solution and use the shared AMPLIFY data base for its customers on a fee-basis. Bundled with the hosting, the platform providers can offer added-value-services like training, consulting and support. To achieve this, in-depth requirements analysis and continuous validation of results will be conducted. So far we experienced tremendous interest in joining the project – especially from European SMEs but also from the standardisation forum itSMF (see www.itsmf.com). This underscores the possible impact of the project results.

References

Bronder, C., Pritzl, R. (1991): Leitfaden für strategische Allianzen, in: Harvard Manager, Vol. 13, No. 1, pp. 44-53.

Child, J., Faulkner, D. (1998): Strategies of Cooperation: Managing Alliances, Networks, and Joint Ventures, Oxford, 1998.

Crook, C. (1996): Strategic Planning in the Contemporary World: Nonlinearity, Complexity and Incredible Technological Change, in: American Programmer, Vol. 8, No. 3, March 1996, pp. 9-14.

Dickson, G.W. (1966): An analysis of vendor selection systems and decisions, in: Journal of Purchasing, Vol. 2, No. 1, 1966, pp. 5-17.

Dostal, W.; Werner, S. (2005): Service-orientierte Architekturen mit Web Services: Konzepte - Standards – Praxis, Heidelberg – München: Elsevier, Spektrum Akad. Verlag, 2005.

Ellram, L.M. (1990): The Supplier Selection Decision in Strategic Partnership, in: Journal of Purchasing and Materials Management, Vol. 26, Fall 1990, pp. 8-14.

Herzwurm, Georg; Schockert, Sixten; Mellis, Werner (2000): Joint Requirements Engineering. QFD for Rapid Customer-Focused Software and Internet-Development, Braunschweig – Wiesbaden: Vieweg – Gabler Verlag, 2000.

Kasper-Fuehrer, Eva C.; Ashkanasy, Neal M. (2003): The Interorganizational Virtual Organization, in: International Studies of Management & Organization, Vol. 33, No. 4, Winter2003, pp. 34-64.

Krishna, S.; Sahay, S.; Walsham, G. (2004): Managing cross-cultural issues in global software outsourcing, in: Communications of the ACM, Vol. 47, No. 4, April 2004, pp. 62-66.

Nayak, Nitin; Bhaskaran, Kumar; Das, Raja (2001): Virtual Enterprises – Building Blocks for Dynamic e-Business, in: Australian Computer Science Communications, Vol. 23, No. 6, January 2001, pp. 80-87.

Mahadevan, B. (2003): Making Sense of Emerging Market Structures in B2B E-Commerce, in: California Management Review, Vol. 46, No. 1, Fall2003, pp. 86-100.

McGuire, Eugene G. (1998): Complexity, Chaos and Software Development: Issues in Innovation and Diffusion, in: Tor Larsen, Eugene McGuire (Ed.): Information Systems Innovation and Diffusion: Issues and Directions, pp. 435-444, Hershey, USA - London, UK 1998.

Medjahed, Brahim; Benatallah, Boualem; Bouguettaya, Athman; Ngu, Anne H. H.; Elmagarmid, Ahmed K. (2003): Business-to-business Interactions: Issues and Enabling Technologies, in: The VLDB Journal - The International Journal on Very Large Data Bases, Vol. 12, No. 1, 2003, pp. 59–85.

Möller, Klaus; Gamm, Nils (2006): Partner Selection and Network Performance - an Empirical Analysis of Impact and Mediating Factors in German Business Networks (2006), to appear in: Economics and Management of Networks: Franchising Net-

works, Cooperatives and Strategic Alliances, Springer 2006 (paper presented at the International Conference on Economics and Management of Networks - EMNet 2005, Budapest, 15.-17.9.2005, www.univie.ac.at/EMNET/2005/index2005.htm).

Mowshowitz, A. (1997): On the Theory of Virtual Organization, in: Systems Research & Behavioral Science, Vol. 14, No. 6, Nov./Dec1997, pp. 373-384.

Mowshowitz, A. (2002): Virtual Organization: Toward a Theory of Societal Transformation Stimulated by Information Technology, Westport, CT: Quorum Books, 2002.

Sydow, J. (2003): Management von Netzwerkorganisationen: Zum Stand der Forschung, in: Sydow, J. (Ed.), Management von Netzwerkorganisationen, pp. 293-354, Wiesbaden 2003.

Weber, Charles A.; Current, John R.; Benton, W.C. (1991): Vendor selection criteria and methods, in: European Journal of Operational Research, Vol. 50, No. 1,1991, pp. 2-18.

Management of Business Processes: The contribution of Risk Management

Amadou Sienou[1], Achim P. Karduck[2], Elyes Lamine[1] and Hervé Pingaud[1]

[1] Ecole des Mines d'Albi Carmaux, Centre de Génie Industriel,

Campus Jarlard Route de Teillet 81 013 Albi Cedex 09, France
{sienou, lamine, pingaud}@enstimac.fr

[2] Hochschule Furtwangen University, Faculty of Computer Science

Robert-Gerwig-Platz 1, 78120 Furtwangen, Germany
karduck@fh-furtwangen.de

Abstract

The changing business environment challenges organisations to aim for agility and performance driven management through process focused thinking. This means, managing explicitly the business process by combining continuous process improvement and process reengineering. However, the outcome of process management effort is risky because of the lack of operational information about the future process. This paper is about analysing the contribution of risk management to support the management of business processes in order to increase the organisations' maturity.

1 Introduction

The management of business processes is an approach, which promotes business agility and continued improvement of business performance. It is an approach to cope with changes due to innovations, mutations of customers' expectations and increasing competition (Hammer and Champy 1993; Burlton 2001; Harmon 2002).

The agility that organisations acquire through process thinking is however constrained by the quality of business processes. The challenge is to deal with process outcome uncertainties. This paper is about analysing the contribution of risk management to support the management of business processes.

First of all, we shall analyse the concept of business process and business process management, then show the relationship between processes and risks before analysing the possible contribution of risk management.

2 On business processes

Davenport defines a business process as „*a structured, measured set of activities designed to produce a specific output for a particular customer or market*" (Davenport

1993), while Hammer focuses on the structure of business processes by defining it as a set partially ordered activities aimed at reaching a well-defined goal (Hammer and Champy 1993). The concept of business process is subject to 2 aspects: the process and the business.

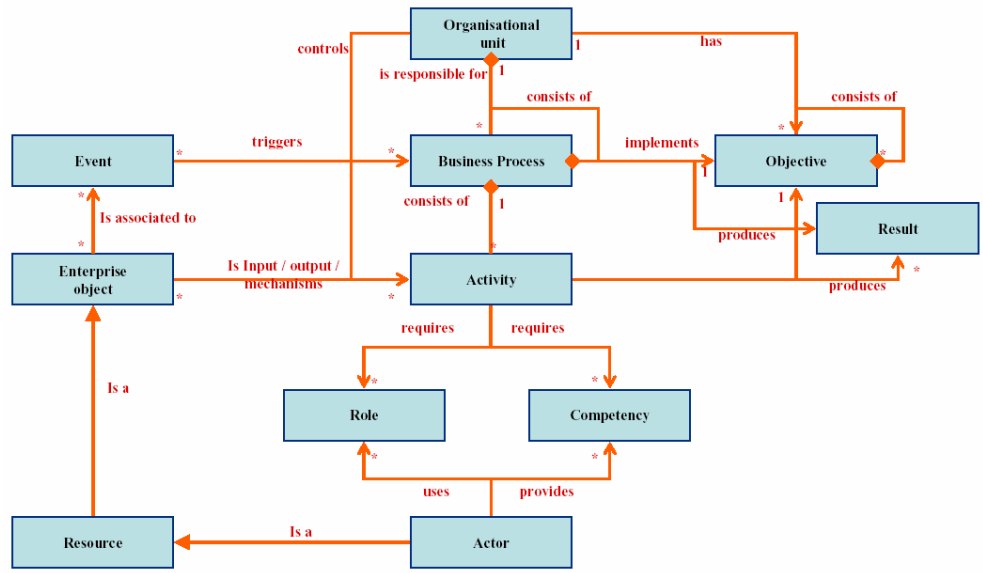


Fig. 1: Concepts of a business process (UML[13] description) - synthesis of (Vernadat 1996; Vernadat 2002; Morley, Hugues et al. 2005; Pépiot 2005)

A process is a holistic structure (Fig. 1) of activities organised in time and space, which use control mechanisms and resources in order to make transformations for a given purpose. A process is also a mechanism aiming at coordinating activities of interdependent actors interacting for a given purpose.

In the concept of business process, the word “business” stays for value creation. A business process is a process which «creates outputs that is of value for the customer»(Hammer and Champy 1993); it «achieve[s] a defined business outcome» and is a step in the value chain (Davenport and Short 1990; Harmon 2002).

3 The management of business processes

According to Burlton, R. the management of business processes is an interdisciplinary process that «*ensures continued improvement in an organization’s performance*.» (Burlton 2001). It consists of combining two management paradigms (process reengineering and continuous improvement) in order to increase the global performance of an organisation.

The management of processes ensures the coordination of enterprises’ resources in order to deliver the performance required by customers.

[13] UML: Unified Modelling Language is a graphical modelling language defined by the OMG (www.omg.org).

In contrast to authors like Burlton, R. who consider the external performance of organisations, Harmon, P. emphasises the internal performance and define the management of business processes as *«aligning processes with the organization's strategic goals …»* by adopting a vertical integration of metrics, horizontal integration of processes, and forming process managers (Harmon 2002).

A third class of authors, those of the workflow and process automation community, adopt a technical approach to the management of processes defined as *«supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes*».(Aalst, ter Hofstede et al. 2003).

The management of business processes is a management paradigm, which consists of designing, controlling and improving business processes in order to improve the organisation's maturity; i.e. to improve the organisation's ability to reach expected global performances in a changing environment (Sienou 2006) and to repeat success. It is an approach to promote agility and high performance in dynamic environments.

The process of managing business processes is an iterative and incremental:

1. Plan: Definition of management and performance objectives. Planning of the management project.
2. Design: Process engineering and strategic alignment.
3. Deploy: Configuration of business processes, support and enabling processes. Implementation, acquisition or integration of information systems.
4. Control: Monitoring and diagnosis of the executed process. Handling of deviations and providing feedback.
5. Improve: Evaluation of the process in order to understand the need for re-engineering and continuous improvement. Definition of objectives and plans for the next phase.

4 A challenge: the management of outcome uncertainty

As conceptualised in the Fig. 1, Business processes are defined for a given purpose. They produce results which shall satisfy the purpose. Events are happenings in the environment which are able to trigger reactions in business processes. Some reactions such as the triggering condition may be solicited. Another class of reactions are unsolicited. They probably cause dissonance between the result of a process and the objective for which it has been designed. This class of events engender situations which prevent from the value creation or affect the created value.

The management of outcome uncertainty of a business process depends on the engineering context of the process and its operational environment. Both contexts present the following two challenges (Sienou, Karduck et al. 2006):

1. At which level of uncertainty should an organisation decide to avoid the implementation of a process? This question relates to the organisation's ability to manage processes successfully.
2. "With which level of confidence will a process lead to the expected performance?" This question relates to the organisation's ability to control the operational process.

These problems are not new. They have been addressed by researches on multiple fields like system engineering and project management. Since an organisation is a system, we believe that it is possible to transfer methods of system engineering and system control such as risk management, to the management of business processes in order to better manage organisations.

5 On Risk Management

The concept of risk is subject to various definitions. From the financial perspective, risk is understood as the "*variance of return*" (Markowitz 1952). From the project management perspective, it is defined as a *"measure of the probability and consequence of not achieving a defined project goal*" (Kerzner 2005).

In (Bernard, Aubert et al. 2002), the authors define risk as a probable event and its impact on an entity and proposes the following unified conceptual model (Fig. 2) of risk.

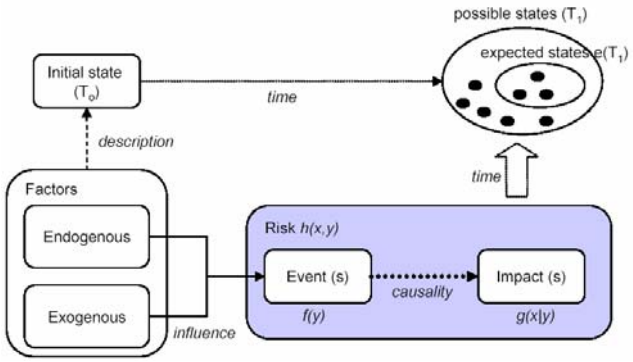


Fig. 2: A conceptual model of risk (adapted from (Bernard, et al., 2002)).

Given an initial state of an entity, probable events may affect it (the entity) during its evolution and cause deviations from the expected future states. Risks factors are concrete or abstract objects (endogenous or exogenous) which are able to affect the likelihood or the impact of events. The impact is defined as the effect, may it be positive or not, of the event on the entity supporting the risk.

Risk management is a methodological approach to continuous identification, analysis, control and monitoring of risky situation and events by proactively using adequate processes, methods and tools in order to balance the effort of managing events and the impact of these events.

6 Business Process and Risk Management

As shown in the Fig. 3 (model based in the SADT/IDEF0), a business process consumes resources (mechanisms) in order to transform input into output (result and performance) with regard to control factors which may be objectives and constraints. Exposed in a dynamic environment, a business process may deviate from the normal course of performance. A process risk is any probable event able to cause the deviation from the expected outcome (Fig. 3).

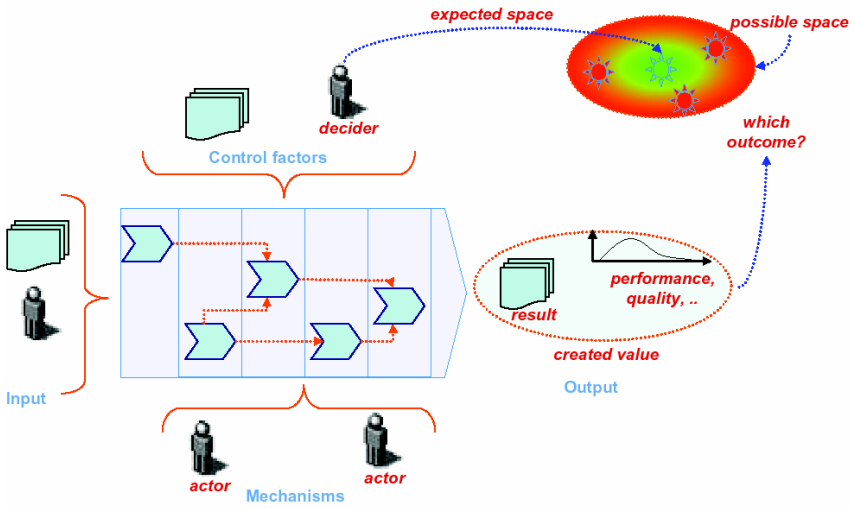


Fig. 3: Understanding process risks

Previous research shown the possibility to integrate both processes, risk management and business process management in order to increase the process management maturity (Sienou, Karduck et al. 2006). In this case, risk management acts as a support process for process management.

Because of the properties of events, an integration of process and risk management is subject to some challenges:

1. Since business process risks are events which occur in a given business context, domain specific knowledge is required in order to manage process risks. This makes it difficult to transfer or reuse risk management. It is possible to address this problem by considering risks in generic models of business processes and then to deploy the later in a partial business domain. In a particular business situation, the partial model may be refined with specific knowledge.
2. Risk treatment implies business process changes or the review of the purpose of the business process. Risk control at the operational time of business processes is therefore an expensive project. It is therefore worth to integrate risks management in process planning and engineering in order to anticipate undesired results.
3. Events are complex structures with multiple interdependencies, chains of time variant and interdependent impacts.
4. Business process management is a cross-organisational concern. It is a challenge to consider subjective aspects of risks in a cross organisational situation. The management of process risks requires therefore consensus between many stakeholders of the business process: the definition of risks, a common understanding of risk management strategies and risk appetite.

We address the challenges by introducing a framework with methods, tools and processes. In Fig 4, we propose a vertical and horizontal integration of risk management into process management.

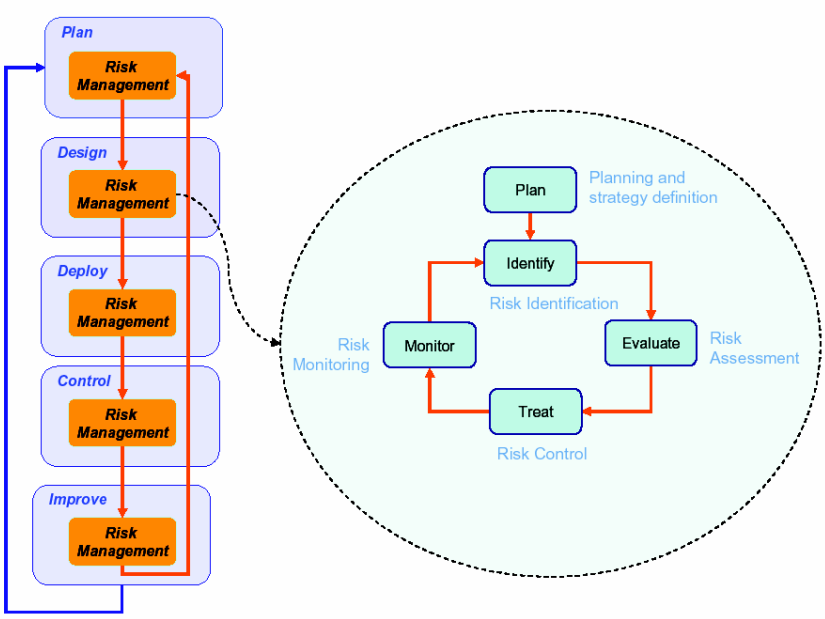


Fig. 4: The Integration of Risk and Process Management

1. Horizontal integration: in a given process management phase, one applies the risk management process in order to manage uncertainties or opportunities specific to this context. Risk treatment during a given lifecycle phase may include for example the specification of characteristics that shall be verified in the next lifecycle phase of the design process; i.e. risk treatment during the process planning may include for example the specification of flexibility as a requirement for process design.
2. Vertical integration: one transposes information about risk management while moving down in the process management lifecycle. This incremental process extends the iterative structure of the risk management process. It is possible since information accuracy and experiences increase with process management lifecycle phases.

7 Related work

We propose an approach, which is similar to the concept of the COSO's Enterprise Risk Management-Integrated Framework (COSO, 2004). The model of the COSO integrates the management of risks in various levels of an enterprise with regard to the strategic, operations, reporting and compliance objectives. Our work can be interpreted as a specialisation of the COSO's framework. We consider particularly all components of risk management regarding the strategic and operations objectives but emphasise business processes.

8 Conclusion and future work

Enhanced with risk management, the process management system shall be able to anticipate outcome uncertainties of business processes. We propose vertical and horizontal integration of risk management in process management, which covers process risks during the conception as well as the operational lifecycle phase of business processes.

In the future, we plan to integrate business process and risk meta-model, to design the building blocks of the framework, and finally, to evaluate to idea in interdisciplinary fields.

References

Aalst, W. v. d., A. H. M. ter Hofstede, et al. (2003). Business Process Management: A Survey. International Conference on Business Process Management (BPM 2003), Eindhoven, The Netherlands, Springer-Verlag.

Bernard, J.-G., A. B. Aubert, et al. (2002). Le risque: un model conceptuel d'integration. Montréal, CIRANO: Centre interuniversitaire de recherche en analyse des organisations.

Burlton, R. T. (2001). Business Process Management: Profiting From Process. Indianapolis, USA, Sams publishing.

Davenport, T. H. (1993). Process Innovation. Reengineering Work through Information Technology. Boston (MA), Harvard Business School Press.

Davenport, T. H. and J. E. Short (1990). "The New Industrial Engineering: Information Technology and Business Process Redesign." Sloan Management Review: 11-27.

Hammer, M. and J. Champy (1993). Reengineering the Corporation: A Manifesto for Business Revolution. New York (NY), Harper Business.

Harmon, P. (2002). Business Process Change: A Manager's Guide to Improving, Redesigning, and Automating Processes, Morgan Kaufmann.

Kerzner, H. (2005). Project Management: A Systems Approach to Planning, Scheduling, and Controlling. New York, NY, John Wiley & Sons.

Markowitz, H. M. (1952). "Portfolio Selection." Journal of Finance 7(1): 77-91.

Morley, C., J. Hugues, et al. (2005). Processus Métiers et S.I.: Evaluation, modélisation, mise en oeuvre. Paris, France, Dunod.

Pépiot, G. (2005). Modélisation des entreprises sur la base des compétences. Laboratoire de gestion et procédés de production. Lausane, Ecole Polytechnique Fédérale de Lausanne. Thèse de doctorat.

Sienou, A. (2006). Gestion des Processus Métiers: Principes et Concepts. Research report. Albi, Ecole des Mines d'Albi-Carmaux, Centre de Génie Industriel.

Sienou, A., A. P. Karduck, et al. (2006). Towards a Framework for Integrating Risk and Business Process Management. the 12th IFAC Symposium on Information Control Problems in Manufacturing (INCOM 06), Saint-Etienne, France.

Vernadat, F. (1996). Enterprise modeling and integration: principles and applications. London (UK), Chapman & Hall.

Vernadat, F. (2002). "Ueml: Towards a unified enterprise modelling language." International Journal of Production Research 17: 4309–4321.

Integration of Customer & Commercial Logistics' processes

Vérane Humez, Matthieu Lauras and Lionel Dupont

[1] Ecole des Mines d'Albi-Carmaux
Department of Industrial Engineering
verane.humez@enstimac.fr, matthieu.lauras@enstimac.fr, lionel.dupont@enstimac.fr

Abstract

Buyer's expectations regarding customer service increased in recent years. We know that the aim of the supply chain concept is the customer satisfaction. Supply Chain Management (SCM) considers, most of the time, flows of supplying, production and distribution but Customer & Commercial Logistics (C2L) is unusual. Nevertheless, it is the unavoidable interface between SC and customers. This working paper talks about the problem of integration and interoperability of C2L processes in SC. A method is considered to study this question and the approach is declined on a real case.

1 Introduction

Supply Chain Management (SCM) is a major component for increasing performance and competitiveness of companies. A supply chain brings products and/or services to the ultimate customers through a network of entities. SCM is defined by two main areas (according to [Stadtler 2005]):

- the network integration: management of cooperation between the network's entities and their ability to work together;
- the network coordination: management on each entity of the supply chain, in order to effectively control flows and achieve the supply chain goals.

So, SCM not only tries to control the performance of individual predefined processes as well as expected collaborative processes. It also has to deal with continuous improvement of those processes in order to maintain them at a high level of integration.

After having worked on continuous improvement of the principal material flows processes (procurement, manufacturing and physical distribution), more and more companies wonder about the effectiveness, the efficiency and the relevance of their "Customer and Commercial Logistics (C2L)" processes (or, in a restrictive way, "sales administration"). Actually, over the last decencies, organizations have tried to improve their internal processes with a three dimension objective: cost reduction, cycle time reduction, Quality improvement. But today, for some of them these criteria only constitute "order qualifier". They must develop other "order winner" to stay competitive. For most of them, customer's services constitute the fourth dimension such required. Many au-

thors as [Kuglin 1998][Colin/Paché 1999] highlight existing progress margins of the interfaces between supply chains and customers.

So in this context the problem that we want to study concerns how to control these interfaces? This working paper deals with this question by developing a business process approach. Firstly, we try to define C2L processes and their links with the well-known concept of Customer Relationship Management (CRM). Secondly, we propose to start to study the problem of integration of theses processes. Thirdly, we present an industrial case study.

2 Identification of C2L processes and connections with CRM

"Customer and Commercial Logistics" (C2L) is defined as the whole of the processes allowing managing the flow of orders and managing customer relationship [Lin/Shaw 1998]. The following parts propose to identify the key C2L processes and to study the links with CRM concepts.

2.1 C2L Processes

The customer satisfaction constitutes the heart of the performance of supply chains [Kuglin 1998]. However, in a context of hard competition, customers can allow themselves to change supplier quickly. Their selection criteria are relative to finance, reactivity but also service and even sometimes feelings (need for recognition, listening...). Supply chains have to increase their performance in working on four axes: to satisfy customer requests; to manage the supply chain's uncertain events with respect to customers; to coordinate the customers' risks with respect to the whole supply chain; to develop customer loyalty. To do that, they have to develop their communication, cooperation and coordination capabilities. This characterizes the integration concept (Vernadat, 1996).

So in practice, it is a question of developing integration in the supply chain of processes, which are associated to the customer service [Lalonde et al. 1988]. Such a step is naturally articulated around a function of C2L. Works of [Lauré/Lebascle 1998] allow us identifying five fields in this function. For each field, [Lauras/Dupont 2006] have to put forward some key processes inspired in particular by works of [Croxton et al. 2001]. The next table synthesize these results.

FIELDS of C2L	KEY PROCESSES
Demand management	Animation of sales forecast and treatment, Available To Promise process, Stocks Deployment process, Coordination with other SC Planning processes (marketing, production, supply, distribution)
Order fulfilment	Analyse and manage orders, Order fulfilment process, Coordination with other SC Execution processes (sales, distribution)
Credit management	Edition and billing control, Cashing management, Customer risk
Customer Service Management	After sale process, Return process, Contact Management
System administration	Management of the Data Base (Customer, Products), Administration of the C2L IT

Table 1: Key processes of C2L

2.2 Customer Relationship Management (CRM)

CRM can be defined as a cross-functional process to achieve a continuing dialogue with customers, through all their contact and access points, with personalized treatment of the most valuable customers, to increase customer conservation and the effectiveness of marketing initiatives [Day/Van Den Bulte 2002]. In other words, CRM is an integrated approach to identifying, acquiring, and retaining customers. CRM includes the storing of customer information in a database (or data warehouse) and using the information in a way that improves the customer's "experience". To do that, 3 functions are developed: Operational CRM; Analytical CRM; Collaborative CRM [Freeland 2001]:

- Operational CRM means supporting the so-called "front office" business processes, which include customer contact. Tasks resulting from these processes are forwarded to employees responsible for them, as well as the information necessary for carrying out the tasks and interfaces to back-end applications are being provided and activities with customers are being documented for further reference.
- In analytical CRM, data gathered within operational CRM are analyzed to segment customers or to identify cross- and up-selling potential. Data collection and analysis is viewed as a continuing and iterative process. Ideally, business decisions are refined over time, based on feedback from earlier analysis and decisions. Business Intelligence offers some more functionalities as separate application software.
- Collaborative CRM facilitates interactions with customers through all channels (personal, letter, fax, phone, web, e-mail) and supports co-ordination of employee teams and channels. It is a solution that brings people, processes and data together so that companies can better serve and retain their customers. The data/activities can be structured, unstructured, conversational, and/or transactional in nature.

2.3 Gap analysis between CRM and C2L processes

Operational and collaborative CRM can be considered as a part of Customer Service Management C2L Field and of System Administration C2L Field. The C2L operations are much larger. The C2L operational processes support the CRM philosophy by developing the possibility of electronically gathering, storing, analyzing and using customer-specific data [Risch/Schubert 2005]. But on the other hand the CRM philosophy is mainly oriented in a proactive way (identify new customers, product performance issues…) whereas the operational C2L processes are simply executive ones.

By data mining and applying business intelligence orientations, analytical CRM allows to anticipate and proactively solve customer service needs. In that way, analytical CRM supports decisions on market segmentation, guest segmentation and owner segmentation. CRM concepts work for effective services marketing. Analytical CRM finally defines the strategy to operate in the C2L processes.

3 Problematic of integration of C2L processes

C2L constitutes, for the customer, the single operational interface with the supply chain from the expression of its needs (orders) to the cashing and the treatment of possible complaints. [Freeland 2001] estimates for example that it is not possible to act effec-

tively on the supply chain added value produced for customers if the Marketing, Sales, Production and Distribution processes are not coordinated with C2L processes.

Integrated logistics management focuses on co-ordinating all logistics activities in a system that will simultaneously attempt to minimize total distribution costs and maintain desired customer service levels [Gopal/Cypress 1993; Kenderdine/Larson 1988]. So a first stake for the SC consists in supporting the integration of the C2L processes [Lin/Shaw, 1998] by optimizing the coordination with other nodes of this SC: material logistics, distribution logistics, sales, supply/procure, marketing, and of course customer.

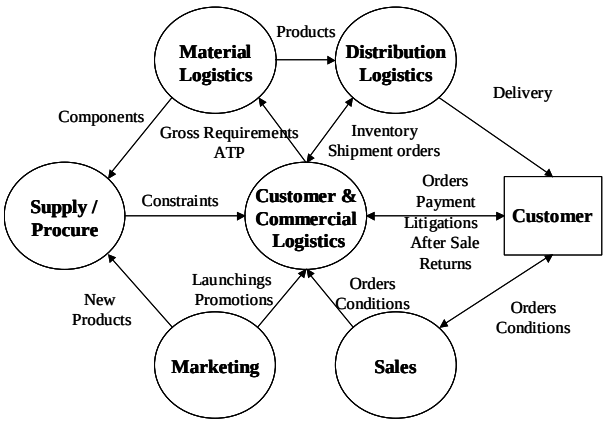


Fig. 1: Integration of Customer & Commercial Logistics in the supply chain.

A second stake is to implement an initiative of continuous improvement by mutualizing needs and skills on the one hand and by developing “transversality” of the solutions and tools on the other hand.

There are several data-processing solutions that could support C2L operations (CRM, ATP, Category management, Data-Warehouse, Business Intelligence…). But their implementation within distributed organizations is particularly problematic and only few solutions are proposed by the literature. So the problem of integration could have some consequences in terms of interoperability of the applications (ability of a system to work with other systems without special effort from user [Konstantas et al. 2006]).

4 The method proposed

To solve the problem, we must define a method to integrate the C2L processes in a SC and a continuous improvement approach. The concern of our problem is to structure the knowledge of these processes at a generic level. Then 3 key steps were defined:

1. qualify the studied system: process cartography of C2L and interactions
2. qualify the performance of these processes: state of the system
3. make improvements: maximise the performance

Only the first step has been developed so far. Classically, we identify two types of processes that must set up in order to produce a value for the customer:

- The operational processes are seen as sequences of activities, which use Resources and transform Inputs into Outputs according to pre-established individual Controls. These sequences must be structured in order to produce a value for the

customer. We talk about the control function: knowledge about the behaviour of the organisation is used to find an appropriate action.

- The decisional processes fix the Controls and the Resources of the operational activities. We could identify a loop to evaluate and adapt control level by changing goals if necessary.

Our approach consists in modelling these processes with Enterprise Modelling methods. We have chosen the GRAI method [Ducq et al. 2001] to model the decisional processes and the BPMN [www.BPMI.org] to model the operational processes.

Two phases are classically proposed:

- A preliminary investigation is carried out to facilitate the formulation of the interview supports on the basis of the reference frame of diagnosis proposed by [Lauras et al. 2006]. This phase consists in some interviews with the persons in charge for C2L processes and those who maintain frequent interactions with C2L.
- The second phase consists in modelling processes in order to develop steps 2 and 3 of our global methodology.

5 Application in a pharmaceutical and cosmetic context

The preceding method is applied to a pharmaceutical and cosmetic industry around three C2L projects. They concern the customer service process (1 mission) and the order fulfilment processes (2 missions). In this paper only the first one is discussed.

The customer service management process is the firm's face to the customer. It provides the single source of customer information, such as product availability, shipping dates and order status [Croxton et al. 2001].

Fifty hours of interviews with people in charge of customer service management were carried out to observe and analyze the customer service operations. Thus, we identify two types of processes:

- The GRAI methodology used to define the decisional processes allowed to identify some lacks in horizontal link between decision-making centres that underline some problems of coordination. The consequence is an important loss rate of calls, and a dissatisfaction of customers.
- The operational processes described with BPMN (Figure 2.) allowed to identify some lacks: considering all the calls, including those not delivered (phoning system doesn't plug with ERP); filtering, orientation of the calls, managing the queue (phoning system doesn't link with organization); traceability of customer contacts Electronic Documents Management System is not interfaced with other Informational Systems); exploitable data for statistics and improvement; insufficient productivity, reduction of the processing times; minimizing the data acquisition errors (Information exchanges are not efficient). These underline the integration and interoperability problems and its consequences on customer's satisfaction.
- From our analysis, we can notice that there are no indicators and then we cannot measure the performance of the processes. In addition, processes are badly de-

fined, the organisation is product-oriented and not customer-oriented; so some calls are lost and the tracking is not total.

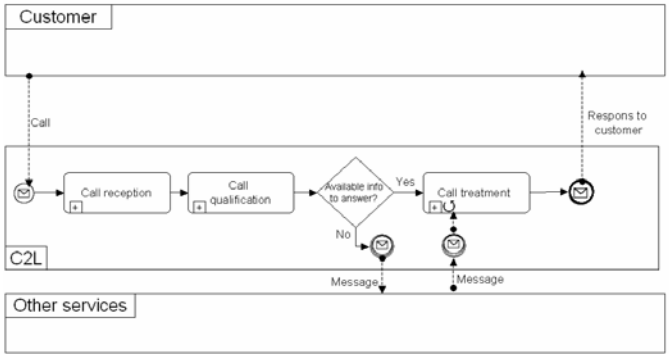


Fig. 2: an operational process with BPMN

We must now finish the description of all the processes, define their performance by a system of Performance Indicators and qualify the problem of integration. Then improvements will be suggested.

References

Colin, J.; Paché, G. (1999): La recherche en logistique : les questions d'hier, d'aujourd'hui et demain, in: Conférence/débat : La logistique - un pari pour/ sur l'avenir : Université de méditerranée, 1999.

Croxton, K.L.; Garcia-Dastugue, S.J.; Lambert, D.M. (2001): The supply chain management processes, in: The International Journal of Logistics Management, Vol. 12, No.2, 2001, pp. 13-36.

Day; Van Den Bulte (2002): Superiority in customer relationship management: consequences for competitive advantage and performance, in: the wharton school, university of Pennsylvania, pp. 1-49

Ducq, Y., B. Vallespir and G. Doumeingts (2001): Coherence analysis methods for production systems by performance aggregation. In: *International Journal of Production Economics*, No 69, 23-37.

Freeland, J.G. (2001): Defying the limits: setting a course for CRM success, in Montgomery Research Inc, 2001.

Konstantas, D.; Bourrières, J.P.; Léonard, M.; Boudjlida, N.(2006): Interoperability of enterprise software and applications, Edition Springer Verlag, 2006.

Kuglin, F.A. (1998): Customer-Centred Supply Chain Management, in: AMACOM-American Management Association, 1998.

Lauras, M.; Dupont, L. (2006): Diagnostic des processus de logistique commerciale: la problématique de l'intégration, in: MOSIM'06, April 2006, Rabat, Maroc.

Lin, F.R.; Shaw, M.J. (1998): Reengineering the order fulfilment process in a supply chain networks, in: International Journal of Flexible Manufacturing Systems, Vol. 10, No. 3, 1998, pp.197-229.

La Londe, B.J.; Martha, C.; Cooper, C.; Noordewier, T.G. (1998): Customer service: A management perspective, in: Oak Brook Council of Logistics Management, 1998.

Lauré, B.; Lebascle, J.L. (1998): Le processus de prévision au cœur de l'optimisation globale des enterprises, in : Stratégie Logistique, No. 5.

Risch, D.; Schubert, P. (2005): Customer Profiles, Personalization and Privacy, in: Proceedings of CollECTeR Europe 2005, June 2005, S. 1-12.

Stadtler, H.; Kilger, C. (2000): Supply Chain Management and Advanced Planning. Edition Springer Verlag.

Vernadat, F.B. (1996), Enterprise Modelling and Integration: Principles and Applications, Chapman & Hall, London

Five Finnish innovations in Mobile Government and their root factors

Reima Suomi

Turku School of Economics
reima.suomi@tse.fi

Abstract

Finland is known for its advances is mobile computing, not least because it is the country Nokia is from. The success of Finland and Nokia is however relative, and in many fields the country has returned to the group of average nations. First, this article will review the state-of-the-art of mobile communications, especially that of Mobile Commerce and Government, in Finland in the light of statistics. As in other countries, the current status of the information society is a result of long-term developments. This article reviews some of main historical trends that have led to the current situation. We call the first one the "Empire heritage". This name refers to the time of Finnish autonomy when Finland was part of the Russian empire, which is a period when the foundations of modern electronic telecommunication were laid. We call the second one the "Lutheran heritage". Here we report on the working cultures and habits that have developed in Finland because of our united religion, and discuss how they have contributed to the current Finnish information society. The third part addresses the "Nordic heritage", in which we report how Nordic cooperation and culture have affected the Finnish information society. Working mobile solutions have been slow to emerge, even in Finland; however, during recent years some gems amongst the applications have become classics. This article will report on five on them. Our conclusion is that innovations in Mobile Government are not easy to transfer from one country to another. An integral part of them is social innovation, which must always be developed anew.

1 Introduction

Finland is known for its advances is mobile computing, not least because it is the country Nokia is from. However, having a good grasp of the phone devices and networks does not mean that everything is perfect on the application side. On the contrary, some statistics show that Finland is lagging behind in many application areas. One specific line of Finnish networking discussion is that many researchers say that too much concept and product development is focused on mobile applications, and the more classical Internet-based applications are neglected and underrepresented in work. In Febru-

ary 2005 Finnish Prime Minister Matti Vanhanen heavily criticized Finnish teleoperators for not investing enough in product development and research.

The public sector is very big in Finland, as in all the Nordic countries. Similarly, taxes are very high. Industry sectors dominated by public authorities and companies include traffic, insurance, health care and, to a certain extent, banking. In many sectors the state-owned companies have been sold off. Under these circumstances it is clear that the general interest in developing public sector effectiveness is very high.

Several things make mobile applications both attractive and unattractive. The huge geographical area of Finland makes mobile applications attractive, especially since all of the country is populated and covered by a mobile GSM (Global System Mobile) network. For example, mobile messages can save hundreds of kilometres of driving in terms of traffic. On the other hand, some applications have been slow to emerge. For example, digital map material for use in vehicles with GPS (Global Positioning System) support was very slow to emerge the Finnish environment: some 2-4 years after becoming widely available in the German landscape, for instance.

This article unfolds as follows. The next section defines the concepts of electronic and mobile government. Section 3 reviews some statistics that place Finland among the top performers in most information and telecommunication activities in the world. Section 4 discusses the roots of Finnish success in the field of information and telecommunication application. Section 5 studies five Finnish pioneering applications in mobile operations in more detail. Finally, we draw some conclusions in section 6.

2 Digital end mobile Government

Digital Government and eGovernment can be considered synonyms. Mobile government means digital government services that can be delivered through mobile user interfaces, or in some instances special mobile services, such as location-based services, provided by the government. (Kushchu & Kuscu, 2003, page 254) define mobile Government as follows: "…*a strategy and its implementation involving the utilization of all kinds of wireless and mobile technology, services, applications and devices for improving benefits to the parties involved in e-government including citizens, businesses and all governmental units."*

eGovernment is usually presented as using IT to (Grönlund, 2002):

- Provide easy access to government information and service for citizens and business
- Increase the quality of services, through increased speed, completeness, process efficiency and other means
- Give citizens opportunities to participate in the democratic process

Silcock (Silcock, 2001) defines eGovernment as follows: "*…the use of technology to enhance the access to delivery of government services to benefit citizens, business partners and employees."*

Better quality services, especially when it comes to speed and reduced cost, are also a key ingredient of eGovernment according to the (European Commission, 2000): Transaction services, such as electronic forms, are perceived as being the future of electronic government.

The focus is typically on external services, but another important idea is to use new technologies to make government-internal operations more efficient. One important point is to see government as a customer-oriented organization. The idea in many eGovernment projects is to make it possible for citizens to do their governmental transactions via the Internet.

Banarjee & Chau (Banerjee & Chau, 2004) provide the following illustration of the fast development of eGovernment: In 1996, less than 50 official government websites could be found on the World Wide Web worldwide. In 2001, it was estimated that there were well over 50,000 official government websites globally. Of the 190 UN Member States, 169 were providing some degree of information and services on-line.

In the US, the state eGovernment strategy delivers the following summary of proceedings in the field: "*Federal information technology spending in the United States will exceed $48 billion in 2002 and $52 billion in 2003… a good portion of current federal IT spending is devoted to Internet Initiatives, yielding over 35 million web pages online at over 22,000 web sites."*

A Capgemini report sees the following advantages to be gained through eGovernment (Capgemini, 2004):

- Improved quality of information and information supply
- Reduction of process time
- Reduction of administrative burdens
- Cost reduction
- Improved service level
- Increased efficiency
- Increased customer satisfaction

It is not at all clear that the national government can always take the lead in eGovernment. As (Jarvenpaa, Tiller, & Simons, 2003) put it: *"The role of government varies, and at times it reverses from its typical stance in public choice as a supplier of regulation to being a customer of regulation."*

In its eGovernment strategy, the US Government has defined four areas of eGovernment (Forman, 2002):

Government to Citizen (G2C)

> Build easy to find, easy to use, one-stop points-of-service that make it easy for citizens to access high-quality government services.

Government to Business (G2B)

> Reduce government's burden on businesses by eliminating redundant collection of data and better leveraging E-business technologies for communication.

Intergovernmental (G2G)

> Make it easier for states and localities to meet reporting requirements and participate as full partners with the federal government in citizen services, while enabling better performance measurement, especially for grants. Other levels of government will see significant administrative savings and will be able to im-

prove program delivery because more accurate data is available in a timely fashion.

Intra-governmental (IEE, Internal Efficiency and Effectiveness)

Make better use of modern technology to reduce costs and improve the quality of federal government agency administration, by using industry best practices in areas such as supply-chain management, financial management and knowledge management. Agencies will be able to improve effectiveness and efficiency, eliminating delays in processing and improving employee satisfaction and retention.

The US vision of eGovernment is guided by three principles (Forman, 2002):

- Citizen-centered, not bureaucracy-centered
- Results-oriented
- Market-based, active promotion of innovation

A current EU report sees following obstacles blocking the way of eGovernment in Europe:

- Regulations and decisions made, for instance, with regards to security
- The tendency towards decentralization of political and administrative tasks in favor of strengthening of regional administrations
- The present lack of a country-wide coordinated policy
- The state moving from its traditional role as a direct provider of public services towards ones as a regulator of the way others must deal with providing them
- The development of other channels, service integration, ´form pull to push´ service delivery systems
- The economy of scale for smaller countries.

Different processes lead to good eGovernment. Deloitte and Touche report the following typical transition path (Wong, 2000):

- Information dissemination via websites
- Two-way transaction via an Internet connectivity
- Multipurpose portals
- Portal personalization
- Clustering of common services
- Full integration and enterprise transformation

A current EU report sees the eGovernment services growing in the following way (Wauters & Van Durme, 2005):

- Information
- One-way interaction
- Two-way interaction

- Full electronic case handling

According to (Daviddrajuh, 2004), the Sri Lankan government has seen the following path for developing eGovernment in Sri Lanka:

- Building implementation capacity
- Building information infrastructure
- Developing ICT human resources
- Delivering citizen services through eGovernment
- Economic and social development

It is apparent that eGovernment cannot be established from nothing. As documented in the list by Daviddrajuh, even the most basic resources have to be built in many cases. However, it would be wrong to consider eGovernment just as some kind of extension of e-commerce, as some authors do (Turban, 2000): *"Electronic government means an extension of e-commerce to government procurement.* eGovernment is a phenomenon in its own right and has many issues that go beyond the topics met in electronic commerce.

3 Finland as a Mobile Society

World Economic Forum takes a macro perspective on the information society readiness of different nations. In Table 1 we see the top 10 performers in the World Economic Forum's Network Readiness Index for 2003. Finland is the top performer in Europe, and the first non-English speaking country on the list. As can be seen, all the Nordic countries are well represented in the list.

Rank	Country
1.	United States
2.	Singapore
3.	Finland
4.	Sweden
5.	Denmark
6.	Canada
7.	Switzerland
8.	Norway
9	Australia
10.	Iceland

Table 1. World Economic Forum's Network Readiness Index (Soumitra & Amit, 2004)

In Finland, telecommunication revenue as a percentage of GDP is 3.51, which is slightly more than the OECD average of 3.35. The Finnish figure is exactly the same as that in the USA. Mobile communications constitute 42% of this. Cellular mobile telecommunication revenue per cellular mobile subscriber is 430 USD (2001). There were

79 cellular mobile subscribers per 100 inhabitants in 2001 (all data from (OECD, 2003)).

Several statistical data sets are available from Communications Outlook 2003 (OECD, 2003). Most of them place Finland in the top 10 performers group, but few on the very top. Some statistics gathered on Finland's position among different nations in the statistics:

Public telecommunication revenue per access path 2001	9th
Public telecommunication revenue per capita 2001	7th
Cellular mobile telecommunication revenue per cellular mobile subscriber 2001	7th
Share of mobile revenue in public telecommunication revenue 2001	9th
Access channels per 100 inhabitants	10th
Cellular mobile subscribers per 100 inhabitants 2001	8th
Telecommunication access paths per 100 inhabitants 2001	8th
Fixed Internet subscribers 2001	14th
Broadband access per 100 inhabitants 2002	12th
Web sites per 100 inhabitants 2002	14th
Secure servers per 100,000 inhabitants 2002	10th
Growth in domain name registrations 2000-2002	10th

Finland does quite well in terms of telecommunication prices. Some price basket positions of Finland (cheapest countries)((OECD, 2003)):

OECD residential tariff basket 2002	11th
OECD composite basket of residential telephone charges 2002	12th
OECD business tariff basket 2002	11th
OECD composite basket of business telephone charges 2002	9th.

In Finland, telecommunication is developed through private initiative and investment. Public telecommunication investment in Finland in 2001 was just 130 USD per capita, putting Finland in 16th place among the OECD countries. Even in comparison to Sweden, the difference is big: in Sweden the government has subsidized many forms of telecommunication, and the government of Sweden retains a firm grip on the former national PTT Telia, subsequently merged with the Finnish Sonera, forming the TeliaSonera operator. The Finnish government has given up almost all of its shares in TeliaSonera.

(West, 2001) identified Finland as the number 10 eGovernment country after USA, Taiwan, Australia, Canada, Great Britain, Ireland, Israel, Singapore and Germany. Finland got 40.2 points out of a possible 100 points for eGovernment.

In terms of mobile government, Accenture (Accenture, 2001) places Finland in the group of visionary followers with Norway, Australia, the Netherlands and the United

Kingdom. The top countries under the title “Innovative leaders” are Canada, Singapore and the USA.

4 Roots of the Finnish Mobile Society

There has been a lot of discussion about information societies, and this is also the case in Finland. Here we address six factors that may be discussed to a lesser extent but are very deeply rooted in the Finnish society and have a profound impact on many things, including on the possibilities to build new information systems such as mobile applications. These factors are:

- Freedom from corruption
- The empire heritage
- The Lutheran heritage
- The Nordic heritage
- Oligopoly industrial structure
- Homogenous and small cultural and population area

Freedom from corruption

Corruption has never been a problem for Finland. Finland has for a long time been considered the world’s least corrupted country, as documented in Table 2. Being able to trust your customers, suppliers and business partners, to say nothing of the government authorities, is an important perquisite for an innovative business environment. If you have to continuously question the actions of others, there is little chance for positive joint work towards new innovations.

Rank	Country	CPI Score
1.	Finland	9.7
2.	New Zealand	9.6
3.	Denmark	9.5
	Iceland	9.5
5.	Singapore	9.3
6.	Sweden	9.2
7.	Switzerland	9.1

Table 2: Countries with a score of 9.0 or more in the Transparency International Corruption Perceptions Index (Transparency International, 2005). CPI relates to perceptions of the degree of corruption as seen by business people and country analysts and ranges between 10 (highly clean) and 0 (highly corrupt).

The empire heritage

Figure 1 shows the Eckerö post office. It has very little direct connection with mobile eGovernment but is a mighty symbol of Russian power in Finland. Eckerö is the first island as you come from Sweden to Finland. The mighty post office building, which has

never served more than a few thousand citizens, served as a symbol of the might of the Russian empire to the west. A lot of telecommunication was built in a similar fashion.

The Swedes that governed Finland before the Russians already worked in the telecommunication field. Starting in 1796, the Swedish nobleman Abraham Niclas Edelcrantz built the Swedish optical telegraph network that ran from Stockholm via Finland to Russia (Holzmann & Pehrson, 1995). One of the world's first electrical telegraph lines was built between Helsinki and St. Petersburg.

The period of Finnish autonomy under the Russian regime is a story in itself. As the Finnish senate had a lot of autonomy, it decided to decentralize many things in Finland in order to make it harder for the Russians to exert control. Phone companies were one function that was decentralized. This led to a situation where there were over 800 telephone companies in Finland at one time, which provided a fertile field for competition and innovation development – issues that have partly carried Finland to today's position. The many telephone companies were demanding customers for Nokia, thus allowing it to develop its capabilities through these good national customers.

Figure 1 The Eckerö post office

The Lutheran heritage

The Nordic countries and parts of northern Germany and Netherlands belong to the so-called Lutheran Plateau that follows the Lutheran Christian religion named after Martin Luther (1483–1546). Two central values affecting work life come from the religion: an egalitarian way of living, which is also visible in the low hierarchical structures of working life, and respect – even desire – for hard work. The whole Lutheran church is a stripped-down version of the Catholic style of confessing: less ceremony and less external symbols of confession. This kind of attitude is visible in Nordic communication patterns: little ceremony, but direct and efficient communication. This is a principle that can also be implemented in mobile governmental applications.

The low hierarchical structure of the society is visible in the public services as well. Decision-making power has been allocated to the customer service level, and few decisions are made high up in the hierarchy. This "distributed power structure" makes it easy to start developing electronic public services. Sometimes, however, an excess of distribution of activities can slow development. For the reasons given above, for tele-

phone companies Finland has some 440 municipalities for telephone companies today. Developing solutions in such a large network of independent actors can be difficult.

The Nordic heritage

Finland was part of the Swedish empire until 1809. Some six percent of Finns still speak Swedish as their mother tongue, and the cooperation between the two countries is rich (even though the languages are very different). In terms of mobile communication, the Nordic Mobile Telephone (NMT) network is the most important part of the Nordic heritage. This analogous mobile communication network was established at the beginning of 1980s and was one of the pioneering mobile networks in the whole world. It gave companies like Nokia and Ericsson a competitive advantage, and many of the principles of the NMT network were later extended to the current GSM network prevalent in Europe.

A strong part of the Nordic culture involves catering to citizen rights. The term “ombudsman” is of Swedish origin and it has spread all over the world. The ombudsman takes care of citizen rights and ensures that the public administration works efficiently and with customer/citizen interests in mind. This kind of tradition has also been extended to the mobile services field.

Oligopoly industrial structure

Finnish and Nordic markets form a small segment on the world, or even European, level. Few international companies have been interested in entering the market with a high presence. On the contrary, the market has been dominated by a relatively small number of domestic players. Markets often form an oligopoly. This is true for sectors like banking, insurance and grocery detailing.

Oligopoly can often be a fruitful basis for cooperation. However, there is still some competitive pressure, but various industry level arrangements such as communication networks are easier to establish than in very fragmented industries. For example, homogenous banking ATM machine networks entered the world market in Finland first.

Heavy regulation has also been a factor in success factor, and public regulation has taken an active role in many industries. For example, the insurance business has a long tradition of regulator-coerced co-operation that has slowly extended towards a more intrinsic type of cooperation (Suomi, 1990). Nowadays insurance companies in Finland communicate with each other very efficiently through different insurance line – specific applications.

Homogenous and small cultural and population area

Finland has a population of just 5.2 million inhabitants, nearly all of whom speak the same language, 85% of whom follow just one religion (Evangelical Lutheran Church in Finland, 2005) and who have a very homogenous population structure (according to 2001 statistics, the number of foreigners in Finland has increased to 99,000, with Russians being the largest group with about 20% of the total, followed by persons with Estonian, Swedish or Somali citizenship (Peltonen, 2002)). The figure of 99,000 persons represents just under two percent of the total population.

It is clear that it is easy to deliver services to such a homogenous group of citizens. However, the Swedish language holds a very strong position in Finland by law and in reality, and everything published by public authorities in Finnish should also be in

Swedish, although this does not always occur. In any case, maintaining two languages in services is a tedious task.

5 Five applications: short introductions

In this section, we present five popular and successful Finnish mobile commerce/government applications in Finland.

5.1 Tram and metro ticket payment by mobile phone

This application won the 2004 Finnish Prime Minister's Award for a Finnish information society application. The roots of the success of this innovation are in its reasonable pricing and easy-to-use user interface and application.

The mobile payment for single tram and metro tickets was introduced in Helsinki in autumn 2001. Since then, the service has been extended to local train and ferry traffic as well. Bus services are still outside the scope of the system. In early 2005, the percentage of mobile tickets among all tickets was 12 percent, and over the years more than four million mobile tickets have been sold. Over 50 percent of users buy at least one ticket per week and about 1/3 buy a ticket once monthly. Two-thirds of the tickets are bought for tram travel (HKL, 2004).

A big part of the success is the reasonable pricing structure. For any mode of transport, a normal single ticket costs EUR 2, whereas the mobile ticket costs EUR 1.90 (prices in February 2005). However, even cheaper single tickets are available for the tram. Payment is easy as no cash is needed.

With the system, the traveller sends an SMS-message to a predefined number, and in return receives identification data for the paid travel ticket including the period of validity for the ticket. To eliminate abuse, the system deliberately has a certain lag time, so that ticket purchase can not be initiated when a ticket inspector is arriving. The ticket can be obtained in Finnish or Swedish.

The system is used in transportation modes where not every passenger is regularly checked for payment. In buses, where every customer is checked for a paid ticket, checking every passenger ticket through different user-interfaces on the multitudes of phones that customers carry might be too time-consuming.

User surveys have shown that the system has eliminated a lot of stowaway travelling with unpaid tickets, especially with young people.

Despite the visible success, other cities in Finland have not yet launched similar systems. The exact reasons for this are not discussed in public, but one reason might be that the City of Helsinki has been able to negotiate extraordinarily favourable conditions for SMS traffic with teleoperators in the spirit of a pilot application.

5.2 Rescheduling of dentist appointments

The City of Lahti has implemented a mobile application in health care with very good results. The municipal dental care clinic uses GSM-based SMS messages to sends information on cancelled dentist appointments to four potential customers. The first one to respond with a simple "Yes" will get the dental appointment.

When managing the reservations by GSM, the dental clinic informs clients on the waiting list by mobile phone about the cancelled appointment time. The GSM-based reservation in this application applies to cancelled appointment times that are reallocated within the same day (2-8 hours). For the GSM reservation, appointments recorded manually on paper are transferred to a database, i.e. a waiting list file. In the database, the clients may be grouped into either one waiting list or several, depending on the grouping principle. The basis for the grouping may be, for example, the treatment unit, medical priority, waiting time, or local area. Clients can be added or removed from the waiting list according to need. The opportunity for GSM reservation is presented to clients who wish to accept cancelled appointment times by mobile phone.

A receptionist or dental assistant sends the cancelled, available appointment time with one press of a button to five clients simultaneously. On the computer screen, he/he enters only the free appointment time. The first of the five clients to reply to the text message can reserve the free appointment time. The other four clients are informed that the appointment has been filled, and they return to the top of the list to wait for the next available time. This electronic invitation, which may be either free to the client or subject to a charge, costs the service provider the price of one text message.

GSM appointment reservation can be used as a method of invitation either for urgent emergency clients or for reallocation of cancelled times to non-urgent clients. An emergency client will be informed by GSM text message of the time when his/her treatment will begin. In this way, the emergency client can move around freely and does not need to sit in the waiting room. The non-urgent appointment times are intended for those clients who do not have symptoms but who have been confirmed as needing treatment.

A so-called ”express waiting list” has been tried out in an endeavour to solve the problem of cancelled appointment times. This ”express list” applies to cancelled appointment times for which clinic staff try to contact clients quickly by using GSM text messages. Clients are selected for the express list - that is, the GSM list - from those on the non-urgent waiting list who have waited the longest to see a dentist. The number of clients on the GSM (express) list totalled 400 in this trial. After the clients on the GSM list had been given a cancelled appointment time, the next 400 clients from the non-urgent waiting list were transferred to the GSM list, and so on. The GSM list should not be ”too long”, otherwise the clients would become tired of waiting for text messages. On the other hand, it should not be ”too short”, otherwise some of the cancelled appointments would remain unfilled. During the pilot experiment, an optimal length was sought for the express list of clients selected for GSM-based reservation; here, in a situation where there are 18 small dental clinics, this was found to be about 300 clients at a time.

The GSM appointment reservation system has resulted in some changes to reservation procedures. The changes have concerned client service, the reception process and also, to a greater degree, forms of waiting list management. As a new tool in client service, GSM reservation makes the everyday routines of the receptionists easier to some extent. However, bigger changes are possible when they all combine and centralize their appointment reservations. Appointment reservation by phone is then concentrated in one contact centre, from which the appointment times, including cancelled appointments handled by GSM, are filled for all the dental clinics.

GSM appointment reservation is based on maintenance of the waiting list database. The waiting list is visible at each of the dental clinics in real time, and each branch can make additions and deletions. In this way, the clients' positions on the waiting list can

also be monitored in real time. In the pilot experiment, the person's name and GSM phone number have become key data items for identification. However, the waiting list database is separate from the electronic client history, and so the clients' data privacy can be ensured. According to staff, the waiting list database has made it easier to distribute the appointments and to monitor the waiting list.

In terms of making contacts to reallocate cancelled appointments, there has been a shift from telephone calls to text messages during the course of the pilot experiment. The receptionists use text message invitations in the first place, and telephone calls in the second place. According to interviewees, the ready-structured text messages are easy to send in between other tasks. GSM appointment reservation increases the receptionists' and dental assistants' mobility in their own work to some extent, as well as its ease of management. The reallocation of cancelled appointments is also successful at the small dental clinics staffed only by a dental assistant and a dentist.

Different selection criteria can be taken into account in GSM appointment reservation. It is possible to select from the waiting list database those clients who, from the dental point of view, have the most urgent need for treatment. Invitations for the reallocation of cancelled appointments can be directed to clients in order of priority.

5.3 Mobile banking

Mobile banking is not a traditional application of mGovernment, but a working banking infrastructure is the cornerstone for all mobile applications, including those of mGovernment. In addition, even in Finland, the State is an active player in the banking field, although it no longer participates directly in retail banking. This is why we feel we can and should discuss this issue here.

GSN/WAP–based banking has been a cornerstone of Finnish Mobile phone applications for a long time. Even though the majority of users in most application situations opt for richer Internet-based user interfaces, mobile interfaces and services have found their own niche in simple transactions. According to data from the Finnish Banker’s Association (Finnish_Banker's_Association, 2005) one percent of respondents in a national survey identified the phone as the primary method of payment. Similarly, one percent of the respondents in a national survey identified the phone as the secondary method of payment. However, this does not provide a complete picture of the coverage of mobile banking. Information type services, such as checking balances and the latest banking transactions are much more popular. They are easy to perform and contain no possibility of mistakes by the customer because of the clumsy user interface of the phone. Considering the volume of banking applications in total, even a small share of the total makes mobile banking the most common mobile application in Finland, as is the case in many other countries too.

Mobile payments are one further development path of mobile services in Finland. The first pioneering attempts were made in 1997, and the tram ticket application in Helsinki (presented as case 1) is currently a killer application. Many of the first trials have been destroyed by overly expensive operator charges. In the worst cases, the operator fee has been up to five times the price of the service or product to be purchased. Since 2002, it has been typical to integrate credit card accounts with payments made through SMS messages.

5.4 Vehicle information

Inquiries about vehicles can be made with a single GSM/SMS message. Once again, an easy user interface and reasonable pricing have made this application a working solution. The Finnish Vehicle Administration AKE provides this service. After sending the registration or product number of a vehicle as an SMS message to a certain number, the following data is delivered as a return message:

- Vehicle brand name
- Vehicle type
- Vehicle owner name and municipality of residence/business
- Vehicle holder name and municipality of residence/business

An even richer set of mostly technical data can be obtained from another number:

- Motor volume of the vehicle
- Power output of the vehicle motor
- First day of usage for the vehicle
- The last vehicle inspection date
- Possible unpaid duties on the vehicle

This service also delivers the same basic data as the first service.

The services cost EUR 1.30 and EUR 1.70 and cover all cars and motorcycles in Finland. One can easily see that such services are useful for police officers. As the necessary question paths to the databases were programmed, it was just an easy decision to deliver the same information to the public. This kind of commercial development has been made possible by the orientation of AKE to be an independent authority with autonomous financing collected from its own services. Vehicle information is not considered private or sensitive in Finland.

In 2004 the services were used a total of 1.37 million times.

5.5 RFID-based library system

In the Kauhajoki library, all material is equipped with RFID (***r**adio **f**requency **id**entification*) tags that are very helpful in the processing of material. In addition, this procedure almost completely eliminates the loss of property. In addition, an easy solution is available to add RFID tags to material, which are only being used in about 100 libraries in the whole world so far.

The system helps mainly in two respects: identifying material and eliminating theft. Identification of material is especially helpful in the phases of lending and returning the material. The new system makes self-service in lending and returning material possible. The RFID code contains a theft control part that can be activated and deactivated in the process of lending and returning, even in self-service. Using the self-service system means that the customer's library cards must also be changed.

The system also makes it possible to identify material that has come to a wrong place. As the system is based on radio waves information exchange, no visible contact with the material is actually needed.

Since the library material is already contained in a database and each material is identifiable through a barcode, adding the RFID tag is not a time-demanding task. By summer 2005 the system should cover six municipalities in total. (Pieski, 2004)

6 Conclusions

Finland is a well-networked nation, but no longer at the very top as was the case in the period around 1995. The public sector is well situated in its progress towards an information society, even though this fact has not received very much attention. One reason may be that Finnish-language services are difficult for foreigners to understand and assess because of the marginal language.

Finland enjoys a rich heritage from various periods in the country's history. Specific characteristics from each historical period have been adopted by the Finnish public administration and the Finnish way of life. Some of these characteristics have also paved the Finnish way towards the information society. Our article identifies the heritage lines of empire, Nordic and Lutheran tradition, the Finnish oligopoly industry structure in many industries, and the small and homogenous national structure as Finnish success factors for Internet-based and mobile innovations in public administration.

Some very developed applications of Mobile Government can be found in Finland. Many of them have remained islands of automation (Riempp & Nastansky, 1997) and never attained very wide coverage. In our examples, mobile banking and the distribution of information on vehicles through mobile means are nation-wide applications, while the others are still local arrangements or experiments that are not yet an integral part of every Finn's life.

Should other countries also copy the Finnish innovations? Yes and no. Sometimes the technical solutions can be developed into transferable products, but very often the successful application of the technologies also requires social innovation, as is well documented in (Arnbrak, 1988). Social innovation cannot be imported or exported, but is developed again and again from almost nothing in every adapting country and domain. This is especially true for the public administration domain, which is heavily regulated, and in various part of the world that have very different traditions.

References

Accenture. (2001). Governments Closing Gap Between Political Rhetoric and eGovernment Reality. Retrieved 2.2.2005, from http://www.accenture.com/xd/xd.asp?it=enWeb&xd=Industries%5CGovernment%5Cgove_study.xml

Arnbrak, J. (1988). Trans-Border Communications Networks: Technology-Driven or Social Innovation? European Management Journal(4), 330-337.

Banerjee, P., & Chau, P. Y. K. (2004). An evaluative framework for analysing e-government convergence capability in developing countries. Electronic Government, 1(1), 29-48.

Capgemini. (2004). Does e-government pay off? : Capgemini.

Daviddrajuh, R. (2004). Planning e-government start-up: a case sudy on e-Sri Lanka. Electronic Government, 1(1), 62-106.

European Commission. (2000). Public Sector Information: a Key Resource for Europe. Green paper on Public Sectorr Information in the Information Society: European Commission.

Evangelical Lutheran Church in Finland. (2005). Churches and religions in Finland. Retrieved 2.2.2005, 2005, from http://www.evl.fi/english/e1.html

Finnish_Banker's_Association. (2005). Statistics on typical payment methods in Finland. In R. Suomi (Ed.): Ulla Halonen / Finnish Banker's Association.

Forman, M. (2002). E-government strategy, from http://www.whitehouse.gov/omb/inforeg/egovstrategy.pdf

Grönlund, Å. (2002). Electronic Government - Efficiency, Service Quality, and Democracy. In Å. Grönlund (Ed.), Electronic Government: Design, Applications and Management (pp. 62). Hershey, PA, USA: Idea Group Publishing.

HKL. (2004). HKL:n kännykkälipulle pääpalkinto Pääministerin parhaat käytännöt - kilpailusta. Retrieved 1.2.2005, from www.hkl.fi

Holzmann, G. J., & Pehrson, B. (1995). The Early History of Data Networks: IEEE Computer Society Press.

Jarvenpaa, S., Tiller, E. H., & Simons, R. (2003). Regulation and the Internet: Public Choice Insights for Business Organizations. California Management Review, 46(1), 72-85.

Kushchu, I., & Kuscu, M. H. (2003). From e-Government to m-Government: Facing the Inevitable. Paper presented at the The 3rd European Conference on e-Government.

OECD. (2003). OECD Communications Outlook 2003. Paris, France: OECD publications service.

Peltonen, A. (2002). Population in Finland. Retrieved 2.2.2005, from http://virtual.finland.fi/netcomm/news/showarticle.asp?intNWSAID=25785

Pieski, P. (2004). Kauhajoen kirjastosta Suomen ensimmäinen radiotaajuuskirjasto. Kirjastolehti.

Riempp, G., & Nastansky, L. (1997). From Islands to Flexible Business Process Networks - Enabling the Interaction of Distributed Workfiow Management Systems. Paper presented at the Proceedings of the Fifth European Conference on Information Systems, Cork.

Silcock, R. (2001). What is e-government. Parliamentary affairs, 54, 88-91.

Soumitra, D., & Amit, J. (2004). The Global Information Technology Report 2003–2004: World Economic Forum.

Suomi, R. (1990). Assessing the feasibility of an inter-organizational information system on the basis of the transaction cost approach.

Transparency International. (2005). Corruption Perceptions Index 2004, from http://www.transparency.org/cpi/2004/cpi2004.en.html#cpi2004

Turban, E. (2000). Electronic commerce: a managerial perspective. Upper Saddle River, NJ: Prentice Hall.

Wauters, P., & Van Durme, P. (2005). Online availability of public services: How is Europe Progressing? Brussels: Gapgemini

European Commission Directorate General for Information Society and Media.

West, D. M. (2001). WMRC Global E-Government Survey, October, 2001, from http://www.insidepolitics.org/egovt01int.html

Wong, W. Y. (2000). At the Dawn of E-government. New York: Deloitte Research, Deloitte and Touche.

Towards Citizen Centric Mobile Government Services: A Roadmap

Shadi Al-khamayseh and Elaine Lawrence

Faculty of Information Technology,
University of Technology, Sydney
Shadi;elaine@{it.uts.edu.au}

Abstract

This paper reports on an ongoing investigation into the success factors for the development of mobile or M-Government. The critical success factors have been compared with E-Government applications to identify any issues or synergies that might substantiate the use of enabling wireless technologies and devices. The authors have conducted an online web-based survey of experts in the field and use qualitative replies to illustrate their findings. Based on the above, the researchers have drawn up an initial classification of factors behind successful mobile government services and present a preliminary roadmap for governments seeking to implement mobile government services.

1 Introduction

One of Electronic government's (e-government) main goals is transforming government-to-citizen (G2C) centered digital administration (European Communities 2006; The Working Group on E-Government in the Developing World 2002) to deliver digital services to constituents over the available communication channels. The most robust channel available at the time of digital administration's emergence was the World Wide Web (WWW). However, wireless mobile communication infrastructure advances are pushing governments to think seriously about utilizing this technology to better deliver its services and provide more constituent satisfaction. Governments that utilize these advances effectively are the prime movers of the next stage of e-government adding benefits to those governments (such as cost reductions and greater work efficiency and effectiveness), and to their constituents (such as faster access to public services anytime, anywhere). Thus Mobile government (M-Government) may be defined as the use of mobile and wireless communication technology within the government administration and in its delivery of services and information to citizens and firms (Östberg 2003). Mobile communications and Internet technologies are enabling access to new eGovernment services at anytime and from anywhere.

In this paper the authors analyse the success factors of mobile government initiatives and devise a preliminary roadmap for governments seeking to implement mobile pro-

grams. The next section gives an outline of mobile or m-Government services and provides a brief overview of the literature and M-Government examples examined. It sets out the technologies that make mobile government possible. It reports on the opinions of eGovernment and M-Government experts who have been surveyed. Section three contains the methodology whilst in section four the authors recommend a generic roadmap for implementing m-government. Section five contains the conclusion and points the way to future research.

2 Background

High speed wireless data networks and the arrival of multi-purpose mobile devices such as 3G phones and Personal Digital Assistants (PDAs) that are in effect mobile personal computers are revolutionizing the way companies do business and increase their efficiency (IDC 2005). These new technological solutions have put pressures on governments to work efficiently, deliver better services and to compete in the global marketplace, for example, in their trade links with other governments. Globally governments have responded to these pressures, by adopting new ICT technologies, and passing legislation to enforce paper elimination. In the United .States of America the Paper Elimination Act 1998 is used to ensure digital measures will be dominant in the governmental daily processes (Relyea & Hogue 2004). Adopting such ICT solutions have helped the emergence of electronic government (e-government).

There are many drivers that contribute to the genesis of mobile government, but (Carroll 2005) refers to the wireless technology evolution and the need for more effectiveness and efficiency in government service delivery as the two main drivers. The number of mobile phones is escalating swiftly (Sandy & McMillan 2005) making mobile phones the most common communication devices on earth (Oakland County 2005); and according to Wireless Intelligence (2005) there are more than 2 billion mobile connections in the world today.

> …*The trend towards m-government has been facilitated by growing capabilities of mobile technologies and their associated infrastructures, devices and systems and their acceptance in both developed and developing countries. There is broad governmental support for m-government in the European Union, USA and Asia Pacific regions (Carroll 2005)"*

Country wide wireless coverage is another factor contributing in higher mobile than land-line penetration even in rural and remote areas (Patel & White 2005) especially in developing countries that suffer from insufficient telecommunication infrastructure (Kushchu & Kuscu 2003). A country like Bangladesh suffers annual natural disasters such as cyclones and floods which claims the lives of thousands and causes billions of dollars worth of damage (Hossan, Chowdhury & Kushchu 2005). The lack of electronic services in Bangladesh is pronounced, as only 30% of Bangladeshis has access to electricity and a lesser percentage has access to TV or radio, while mobile phones are widely spread and *always on* so citizens can receive information 24x7X365. Since M-Government delivers information and services through the wireless infrastructure, Kushchu & Kuscu (2003) argue that M-Government could be the solution for reaching citizens and exchanging information especially in remote areas. Hossan, Chowdhury & Kushchu (2005) define four major life saving uses of M-government applications in

Bangladesh through disseminating pre-disaster and post-disaster warning SMS, and through exchanging SMS with citizens to enable them request relief assistance, and government-to- citizens interaction to exchange information about health hazards.

Governments need to capitalize on these new technologies to improve work effectiveness and efficiency and to better serve citizens and business. The enthusiasm to integrate the wireless channel with the wired has caused mobile government (m-government) services to become a reality in many countries in particular Dubai in UAE, Malta, Canada and the states of California and Virginia in the USA. An IDC study (2005) shows that about 30% of Australian companies either have implemented or were in the process of implementing an enterprise mobility solution. Further, their study found that government and education organizations were at the forefront of the mobile enterprise movement.

3 Methodology

This research has being approached in several phases. First, a literature review has been undertaken to understand and draw out the critical success factors associated with mobile government applications. The critical success factors have been compared with E-Government applications to identify any issues or synergies that might substantiate the use of enabling wireless technologies and devices. The literature review enabled the authors to identify mobile governments experts, from both academia and government departments globally. Academic experts were defined as those who had written a minimum of two papers at international peer reviewed conferences and journals. Industry experts were sourced from communication companies, mobile phone suppliers, Internet Service providers, application developers and consultants. The second stage of the research involved the setting up of a web based survey to which the experts were invited to respond. These experts could either answer anonymously or provide their contacts for further elaboration. This survey is ongoing and currently 31 usable surveys have been received and will be further analysed and reported on in another paper. In this paper we have drawn on the results of the literature survey and a number of survey respondents' answers to devise a Mobile Government Services Roadmap to assist governments to implement mobile government services. Respondents were from only replies to the following questions are used in this paper:

a.) What are the most common Standards and Protocols used in M-Government projects?

b.) What is missing nowadays that hinders achieving successful M-Government?

Thus far, the respondents included 25 from European countries, 3 from Asia, 2 from North America and one from New Zealand.

4 Towards a Mobile Government Roadmap

After conducting the extensive literature reviews, and after analyzing the results of the surveys received so far, the authors classified success factors into three categories, namely technological, human and socioeconomic, and business factors as outlined in table 1. The results of this classification system are discussed in the following section.

4.1 Technology Factors

As can be seen in Figure 1 there has been an explosion of wireless technologies that are proving an impetus for the implementation of mobile services for M-Governments. As one particular example, Near Field Communication (NFC) is already starting to revolutionise the way people use their mobile phones. NFC uses a short range wireless chip that can be placed into mobile phones to enable them to transfer all sorts of data (including credit card details and bus timetables) once the user touches his phone to a NFC paypoint (Flynn Vencat 2006).This is just one technology that is attractive to government officials – for example citizens could pay their parking fees and click through to pay for train tickets, at NFC paypoints, both of which are often controlled by government authorities. In fact industry pundits are predicting the mobile will replace the wallet by 2010 (Flynn Vencat 2006).

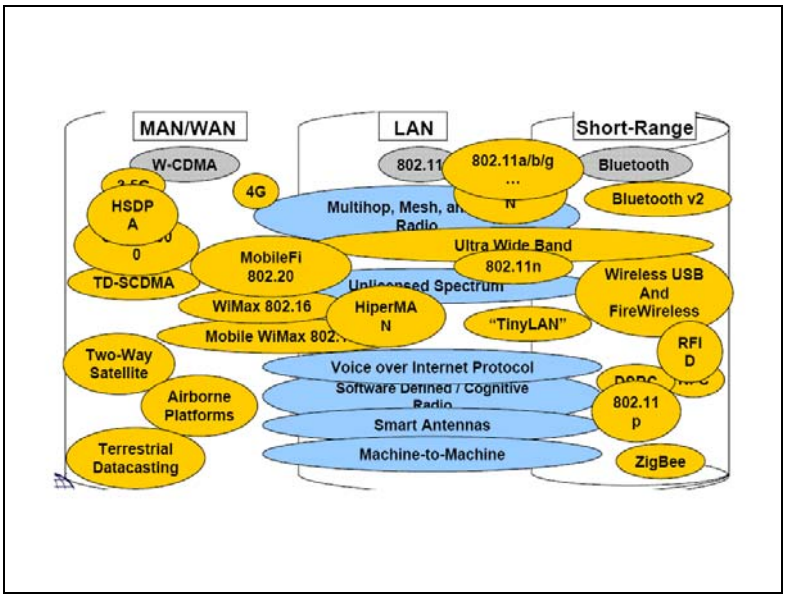


Figure 1: Explosion of wireless technologies driving mobile government adoption

According to IDC (2005) government can “mix and match technologies to custom-create a mobile solution that matches” its needs. Thus the government does not have to rely on and lock-in with a specific solution manufacturer. According to IDC (2005) the technology components of mobile government are identified below:

1. Dedicated m-government gateway G/W (Kim et al. 2004)
2. Wireless and wired sections integration through mobile internet services availability in both wired and wireless spaces (Kim et al. 2004)
3. Wired and Wireless IT infrastructure
4. Network Equipment
5. Enterprise Applications
6. Wireless Networks
7. Mobile Devices

Our respondents had the following comments to make on technology factors that seem to be hindering the uptake of mobile government:

Decent interfaces on mobile technology. The lack of intuitive, simple input devices limit the complexity of the applications pushed towards mobile devices.

Other technical issues that must be taken into account include *Backend integration Truly / natively mobile apps Missing data.voice integration Security issues Hot spot roaming not mature.*

4.2 The Human and Socio Economic factors

The Human and Socio Economic factors will become increasingly important over time as a result of the impact of the next generation of humans who have been termed 'Digital Natives. This description was coined by Prensky (2001) for young people who became acquainted with digital technology from birth and for whom computers, mobile phones, I-pods and video technology are a normal part of life. For example, the twenty-first century student is part of the "e-generation whose best friend is a mobile phone"(Williams 2006). Studies from Flinders University in South Australia and Queensland's University of Technology confirm the importance of mobile phones to young people 'Young people consider a mobile phone the most important item of all – it is more important than access to the Internet or even television' (Williams 2006). In developing countries such as China and India mobiles are considered symbols of upward mobility and Professor Katz, director of the Centre for Mobile Communication Studies at Rutgers University in the United States of America found that children in lower socio-economic groups in the US are more likely to have a mobile phone than their richer peers (Williams 2006) Governments who wish to engage these young people in the community and politics will need to utilize these mobile devices.

Technological Factor	Technology	Examples
	RADIO BASED	• Two way radio
	CELLULAR PHONE BASED	• Mobile voice • Short Message Service SMS • Wireless Application Protocol WAP • General Packet Radio Service GPRS • Universal Mobile Telephone Services (3G) UMTS • CDMA (Code Division Multiple Access • EDGE (Enhanced Data for GSM) • CDMA2000 1xEV (Evolution) • I-mode
	MOBILE DEVICE BASED	• Notebook Computer • Tablet Computer • Personal Digital Assistant

		• Bluetooth • Global Positioning System GPS • Pager
	NETWORK BASED	• Wireless LAN • WiFi • Voice over IP • Satellite • Wireless Sensor Networks (MOTES)
Human and Socio-economic factor	1. Traveling citizens and mobile workers. 2. Many citizens cannot afford to buy computers and subscribe with an Internet service providers ISP to access the internet, while majority can afford to own a mobile device. 3. Number of wireless internet users around the globe is exceeding the number of wired internet users. 4. Young generation prefer to do everything with the wireless mobile device 5. Demands for efficiency, reduced cost, increased revenue, improved mobile services and better delivery of government services	
Organization Factors	**Organization Type**	**Reasons**
	Business	1. Improve business productivity and workforce efficiency. 2. Instant access to critical information for decision making. 3. Cost cutting. 4. Enhance citizen relationship and satisfaction. 5. Lessen corruption in government
	Government	

Table 1: Factors contributing to the spread of Mobile Government (Goldstuck 2003)

Some of the experts in the survey commented that important success factors must include *citizen centric service* or *what is useful for citizens*. Another stated that *Acceptance and user needs do not capture the complex social process, upon which the success or failure of a technology-related endeavor hinge. Many of the factors are intertwined and interact that a factor analysis may not lead to much understanding of the dynamics at work here*. Yet another respondent felt that the uptake of mobile government was being hindered by lack of *Partnerships with the private sectors; illiteracy of the elder generation in the use of mobile devices*; Bad *user interface design;* and finally *Restricted capabilities of mobile devices.* Two other respondents noted that what was currently hindering the uptake of mobile government included:

public takeup of M-Government and *Citizen take-up of government services on mobile devices*. Yet another felt that lack of *commitment from service owners and resistance to change by operators* were hindering the advancement of mobile government. In terms of human and socio-economic factors the main actors will play a crucial part in the set up of a mobile enterprises and governments as are explained in Table 2.

Actor	Description
End User	Targets for every service
Service Provider	Provides services via software application using content
Content Provider	Collecting, aggregating and distribution of data and information
Mobile Network Operator	Network owner,
Device Manufacturer	Provides platform through which users access value added wireless services
Equipment Manufacturer	Provides tools for delivering wireless or mobile services
Software Manufacturer	Provides operating systems and other applications such as micro browsers
Regulation Authorities, Government Standardisation Groups and Special Consumer Groups	Will have impact on some decisions n market development
Others	Virtual operators, wireless application providers, multi-access portals and wireless infrastructure service providers

Table 2: Mobile Market Place Actors, source: (Wohltorf & Albayrak 2003)

4.3 Organization factors

To implement mobile government services, the stakeholders must have a project plan that starts with a vision, which should encompass the citizens' concerns. Accordingly, governments should survey their constituents concerns and prioritize them. The key players should be identified (See Table 1) and will include the following stakeholders (IDC 2005):

1. Government agency willing to implement m-government services.
2. Wireless carriers, robust mobile operators
3. IT infrastructure manufacturers
4. Business application developers

The government workforce needs a good understanding of wireless mobile technologies in order to successfully implement mobile government services (Chang & Kannan 2002). Some of the comments made by our respondents concerning organisational issues that are hampering the uptake of mobile government include the following:

Fieldworker commitment Organizational readiness Basic understanding of the mobile potential Business process adjustments Workplace/task improvement Cost/benefit ratio (including non-financial cost)

Governments should create robust strategies and prepare multi-year plans based on accurate analysis of return on investment models, cost and benefits. Mobile governments may be able to reduce cost and increase revenue. Chang & Kannan (2002) maintain that the existence of e-government is a prerequisite for mobile government and states that "government websites in the United States attract more visitors than commercial websites "If commercial organizations are able to use government websites to advertise and market themselves, then government agencies could gain added revenue for their operations.

4.4 Challenges for the mobile government

Some of the challenges for the mobile government organizations include the following:

Lack of mobile technology standards (IDC 2005), which makes each government agency invest in different mobile systems according to their needs to achieve their own purpose (Kim et al. 2004) and that certainly leads to management and integration problems. Spending more money on fixing such problems contradicts the cost reducing advantage of m-government. Lack of security standards allows security breaches to occur even with the existence of many encryption technologies(Chang & Kannan 2002). Our survey question on "What are the most common Standards and Protocols used in M-Government projects?" illustrated that there is indeed confusion in this area. Some of the comments include:

There are no special standards in the m-gov area. There should not be if one wants broad acceptance of m-gov applications and *GovML Governmental Markup Language NISS" Network and Information Security Standardisation*. Others mentioned included: *Data standards WAP 2.0 XML User-interface design guidelines.*

Security and Privacy are the biggest issues that concern m-government constituents and affect their behavior in accepting or refusing its adoption (Chang & Kannan 2002). Overall secure m-government means secure networks, software applications, and devices (Chang & Kannan 2002). According to Kim et al,(2004) m-government is exposed to security breaches because an important component of m-government is the private wireless carrier. Such partnerships are a potential threat to the success of m-government. So appropriate policies and regulations must govern these relationships. Other security risks that must be considered include hacking for example on-the-air security breaches, and device loss or theft (Chang & Kannan 2002). Destroying the data on the device and blocking it immediately is a solution for device loss or theft. Dedicating an m-government gateway helps to keep the service secure (Kim et al. 2004)

Initial and on-going solution costs (IDC 2005), must be studied thoroughly before starting the project. According to Al-khamayseh and Lawrence (2005) allocating and raising sufficient funds for the project is one of the important steps in the planning phase towards a successful m-government strategy**.** " reports that "industry players have recognized these challenges and have been working to address them, providing increasingly standard-based, affordable and secure mobile solutions" Foghlú (2005) recommends utilization of private mobile operators' infrastructure through partnership and avoidance of deployment in more than one mobile operator.

4.5 Towards developing a mobile Government Roadmap

Taking the above into account the authors have devised version1 of a mobile Government roadmap (Figure 2) aimed at assisting governments to plan for a successful mobile government service implementation. It is envisaged that this roadmap will go through several iterations during the course of our ongoing investigation of mobile government implementations and as further results from the survey come to hand. As the technology and functionality of mobile devices improves and with the accelerated deployments of the various wireless networks, more people will adopt the technologies and demand further services from them. This creates a pressure on content developers and software architects to satisfy this need and businesses start to see the advantages that are to be had by having mobile workers. Further pressure is then placed on the wireless and business sector to develop compelling business applications. This becomes an iterative process which in turn leads to governments realizing that they too could follow the example of business and develop and adopt mobile services to interact with their citizens. As mentioned earlier this is particularly compelling in the case of communicating with younger constituents and should lead to an accelerated adoption of mobile government. We recommend that governments utilize the private sector's infrastructure rather than building a standalone m-government infrastructure as the private sector already provides extensive network coverage in many countries.

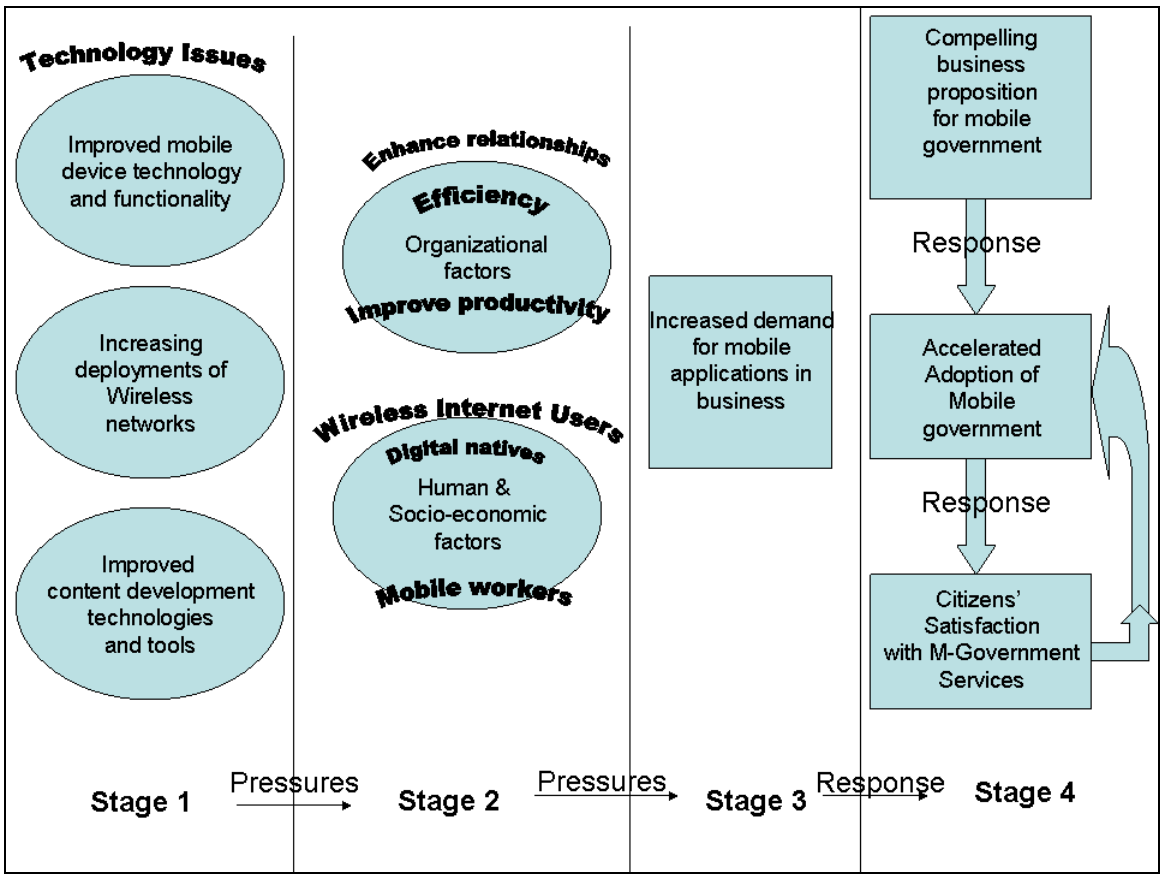


Fig. 2: Pressures leading to Mobile Government – a preliminary roadmap

5 Conclusion

The authors have described the results of literature reviews covering both eGovernment and M-Government success factors and have devised a preliminary categorization of these factors under the headings of technology, human and socio-economic, and organizational factors. Next they have analyzed the comments of 31 experts and aligned these comments to the component categories to ascertain if their categorization was realistic. Preliminary results confirmed their classifications but ongoing surveys may force further refinement. Finally they have presented a preliminary roadmap showing how pressures are leading to increased demand for mobile applications in businesses which in turn are spearheading compelling business propositions for mobile government which should lead to accelerated adoption of mobile government services.

6 Future research

M-government is still in its early stages and requires further analysis of its *strengths*, *weaknesses*, *threats* and *opportunities* especially concerning privacy and security, mobile payments, best ways of displaying content on variety of mobile devices and successful transition and/or integration between e-government and m-government.

References

Al-khamayseh, S. & Lawrence, E. 2005, 'MOBILE GOVERNMENT – CONVERGING TECHNOLOGIES AND TRANSITION STRATEGIES', DEXA 2005, Copenhagen, Denmark, pp. 358-365.

Carroll, J. 2005, 'Risky Business: Will Citizens Accept M-government in the Long Term?' EURO mGOV 2005, Brighton, UK, pp. 77-87.

Chang, A.-M. & Kannan, P.K. 2002, Preparing for Wireless and Mobile Technolgies in Government.

European Communities 2006, DE: Europe's biggest PPP publishes 'eGov' roadmap, viewed 24 April 2006 <http://europa.eu.int/idabc/en/document/5532/194>.

Flynn Vencat 2006, 'Toss the wallet and Grab the Mobile', The Technologist, 10-17 April, p. 14.

Foghlú, M.Ó. 2005, 'Infrastructures for Mobile Government Services', EURO mGOV 2005, Brighton, UK, pp. 192-199.

Goldstuck, A. 2003, Government Unplugged - Mobile and wireless technologies in the public sector, Centre of Public Service Innovation, Tshwane, South Africa.

Hossan, G.C., Chowdhury, M. & Kushchu, I. 2005, 'Prospects of Using m-Technologies for Disster Informaoin Management in Bangladesh and other LDCs', EURO mGOV 2005, Brighton, UK, pp. 243-253.

IDC 2005, Enterprise Mobility In Black and White.

Kim, Y., Yoon, J., Park, S. & Han, J. 2004, 'Architecture for Implementing the Mobile Government Services in Korea', pp. 601-612.

Kushchu, I. & Kuscu, M.H. 2003, From E-government to M-government: Facing the Inevitable, mGovlab, <http://www.mgovlab.org/library/mgovlab/mgovlab_ikhk.pdf>.

Oakland County 2005, eGovernment Goals and Objectives, viewed 24 October 2005 <http://www.co.oakland.mi.us/egov/initiatives/goals_objectives.html>.

Östberg, O. 2003, 'A Swedish View on 'Mobile Government'', International Symposium on E & M-Government, Seoul, Korea, <http://www.statskontoret.se/upload/Publikationer/2003/2003128.pdf>.

Patel, I. & White, G. 2005, 'M-government: South African Approaches and Experiences', EURO mGOV 2005, Brighton, UK, pp. 313-323.

Prensky, M. 2001, Digital Natives, Digital Immigrants, viewed 03 April 2006 <http://www.marcprensky.com/blog/archives/000030.html>.

Relyea, H.C. & Hogue, H.B. 2004, 'A Brief History of the Emergence of Digital Government in the United States', in A. Pavlicheve & G.D. Garson (eds), Digital Government: Principles and Best Practices, Idea Group Publishing, Hershey, pp. 16-33.

Sandy, G.A. & McMillan, S. 2005, 'A Success Factors Model For M-Government', EURO mGOV 2005, Brighton, UK, pp. 349-358.

The Working Group on E-Government in the Developing World 2002, ROADMAP FOR E-GOVERNMENT IN THE DEVELOPING WORLD.

Williams, L. 2006, 'Insight: Don't Call us', The Sydney Morning herald, March 20, p. 12.

Wireless Intelligence 2005, Cellular reaches 2 billion connections, viewed 10-10 2005 <https://www.wirelessintelligence.com/index.aspx>.

Wohltorf, J. & Albayrak, S. 2003, 'Decision Cockpit for Mobile Services'.

Towards Ambient Business: Value-added Services through an Open Object Information Infrastructure

Christian Schmitt, Kai Fischbach, and Detlef Schoder

University of Cologne
{schmitt | fischbach | schoder}@wim.uni-koeln.de

Abstract

Internet-based information sharing among different partners of the value chain enables collaborative business. Beyond, applying ambient technologies provides new opportunities for gathering information ubiquitously from various sources including physical objects, e.g. the movement of goods or cars, and virtual objects, i.e. the information trails created through customer interactions. Granting public access to this wealth of ubiquitously gathered information favors an unprecedented climate of innovation fostering the collaborative development of new value-added services by external developers and even customers. We call this Ambient Business. In this context, the paper reveals empirical evidence and an appraisal of the emergent trend towards Ambient Business. Further more we at hand point out how to ensure arbitrary access to information about physical products and virtual objects by introducing the concept of the Open Object Information Infrastructure (OOII). As result new and innovative knowledge intensive products and services will be conceivable by deploying this OOII as a publicly accessible database.

1 From Collaborative Business to Ambient Business

The diffusion of Internet technology creates new opportunities for the realization of collaborative business among different partners of the value chain. Among others the development of new forms of Customer Relationship Management (CRM) named Customer Integration can be observed in recent years [Reichwald/Piller 2006]. Customer Integrations aims at bringing customers' knowledge, ideas, and preferences into the value creation process of a company. Customer Integration may take place at different stages in the value chain that is from R&D up to sales and distribution. For instance, Internet-based configurators facilitate customer to participate in designing and developing of products choosing individual settings out of standard modules. Thereby configurators enable vendors to acquire customer's preferences directly out of their actions [von Hippel 1998]. One example of these new products is an individualized printed newspaper. When evoking a customized newspaper, one might instantly think of an online version where readers often already nowadays have the opportunity to select only articles which they are particularly interested in. However, reading a printed news-

paper is often preferred instead of reading it on the screen. New manufacturing as well as information and communication technologies make it possible that readers (on an individual basis) can choose the topics relevant for them the day before they receive the printed newspaper at their homes. A simple phone-call or a query via the Internet is enough[14].

Being on the road from Electronic Business to Ambient Business[15], further opportunities for developing new forms of CRM emerge while gathering information directly from customer interactions [Gershman/Fano 2006]. Especially the connection of the real with the virtual world by embedding computers or smallest processors, memory chips and sensors into the environment and into physical objects [Gershenfeld 1999], as well as using natural, multimodal customer interaction [van Dam 2001] influences future business services to a large extend [Fano/Gershman 2002, Mattern 2005, Roussos 2006, Fleisch/Tellkamp 2006]. In particular, the possibility of assigning unique IDs to physical objects by embedding sensors enables customer to identifying real objects. Furthermore, these unique IDs can be used as a primary key to access virtual data objects that provide specific information about the related real object (e.g. product qualities or the current whereabouts). Connecting everyday objects to stored information in this way results in building a so called „Internet of Things" [Gershenfeld et al. 2004, Fleisch/Mattern 2005]. First steps to implement this scenario are ongoing in projects like Semapedia [Rondeau/Wiechers 2005] and commercial standardization initiatives like the EPCGlobal Network [Engels et al. 2001]. The goal of the EPCGlobal network is to provide information related to products while tracking them automatically on their ways through the value chain using small inexpensive RFID-sensors and readers. In addition, the information is stored decentralized and can be shared securely among partners of the value chain applying the Internet and services for discovering significant product details. Nevertheless, the EPCGlobal Network is limited to selective partners of the value chain and does not incorporate prospects of Customer Integration as shown by Amazon.com [Roush 2005a] or Google.com [Roush 2005b]. Hence, in order to enable and benefit from new paradigms like Open Innovation [Chesbrough 2003] we propose the concept of publicly accessible object information. We assert that this consistently open approach favors an unprecedented climate of innovation fostering the collaborative development of new and innovative Ambient Business services by external developers and even end-users.

2 Value-added Services through Publicly Accessible Object Information

Thinking of Ambient Business means granting access to information gathered by mobile smart objects and local ambient environments hosted by different service providers. To ensure arbitrary access to corresponding filed object information enabling the development of Ambient Business services we introduce the framework of the Open Object Information Infrastructure (OOII) in the following (see Fig. 1).

---

[14] For details on the individualized printed newspaper see http://www.medieninnovation.info/.

[15] The newly-introduced term Ambient Business refers to a stronger reflection of considerations concerning economics in comparison with the well-established Ubiquitous Computing [Weiser 1991], Pervasive Computing [Hansmann et al. 2003] or Ambient Intelligence [Aarts et al. 2001] that mainly reflect considerations concerning technology (for details on Ambient Business see www.ambient-business.eu).

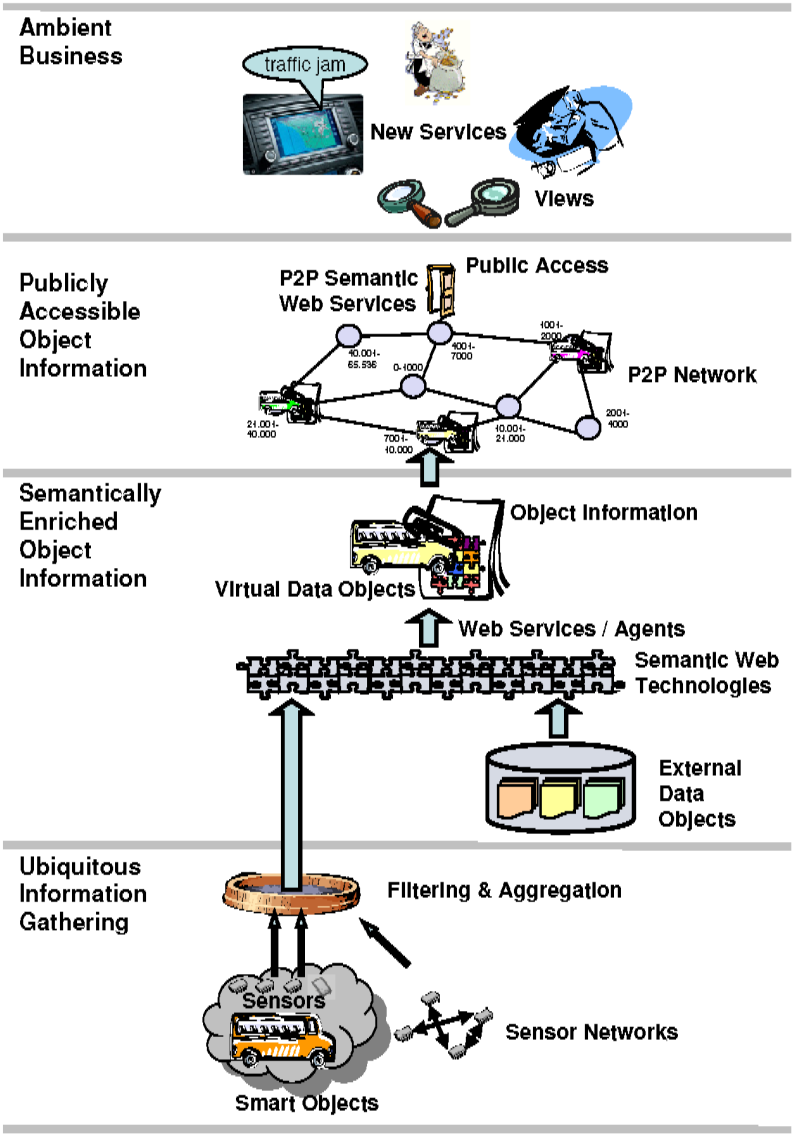


Fig. 1: The OOII Framework

2.1 Ubiquitous Information Gathering

Connecting the real with the virtual world means embedding of computers or smallest processors, memory chips and sensors into physical objects, named “Smart Objects”. For instance, with the assistance of Radio Frequency Identification (RFID) objects can be identified automatically without line of sight by transponders which are attached to them [Finkenzeller 2003]. Other examples are sensor networks: Smallest sensors, which are implemented into the environment, forming ad-hoc networks in order to recognize e.g. the whereabouts, the speed, size and form of objects and to observe them over a period of time [Culler et al. 2004]. In order to develop applications these sensed single data has to be formed into usable incidents and statements by appropriate filter and aggregation procedures. Therefore numerous projects for the development of middleware for ambient environments have already started (see for an overview of selected projects [Hill et al. 2004, Schoch 2005]). Researchers have developed novel applications e.g. wearable systems with sensors that can continuously monitor the user's vital signs, motor activity, social interactions, sleep patterns, and other health indicators

activation throughout the entire day resulting in a truly personal medical record [Pentland 2004]. Most applications, however, ignore the further use of information in another context as the one it was gathered. Hence we propose to extend existing middleware technologies with mechanisms for the semantic markup of the sensor data as described in the following.

2.2 Semantically Enriched Object Information

Thinking about mobile smart objects and local ambient environments hosted by different service providers, a common understanding of the semantics of the information gathered in someone's context is essential to their recombination in new business contexts. Corresponding the way companies exchange businesses messages and conduct trading relationships in common terms (e.g. using ebXML) sensor data or even corresponding events have to be enriched by semantic annotations. Therefore Semantic Web [Berners-Lee et al. 2001] standards like Topic Maps [Pepper/Moore 2001, Garshol/Moore 2005, Durusau et al. 2006] or RDF(S)/OWL [Brickley/Guha 2004, McGuinness/van Harmelen 2004] can be employed. Furthermore it has to be taken into account that sensor data should be integrated with additional available semantically enriched information from external resources to develop innovative Ambient Business services. By now a number of semantic web services [Fensel 2002, Alesso/Smith 2004] and "Smart Agents" [Lee 2005, Konnerth et al. 2006] are developing that could be adapted to integrate semantically annotated resources to so-called object information. For instance customer feedback about a bought product can be obtained by Semantic Blogging[16] [Cayzer 2004] in order to enhance CRM.

2.3 Publicly Accessible Object Information

In order to build ambient services the gathered object information must be accessible even if no continuous connection can be ensured for smart objects due to their mobility. In addition both the great amount of smart objects and the existing energy and capacity limitations of the embedded computers and sensors have to be taken into account. These prerequisites suggest the implementation of peer-to-peer (P2P) networks to save accompanying virtual data objects and to process information on additional network nodes, which have sufficient memory capacity and computer power. P2P networks offer a better scalability, a self-organized and decentralized coordination of unused or limited resources, a higher fault tolerance as well as a better support of spontaneous networking of entities in comparison with the alternative client/server architecture [Barkai 2001, Oram 2001, Milojicic et al. 2002, Schoder et al 2005]. Existing P2P projects like Freenet [Clarke et al. 2000] and Free Haven [Dingledine et al. 2000] have demonstrated how an anonymous and censor-free information access can be made possible. In contrast, the Napster Case has revealed that central approaches rather facilitate to limit access to the offered information or to even deny it completely.

Using P2P networks for storing semantically enriched object information requires their extension with semantic retrieval services. On the one hand, scientific research pursues scheme based approaches and, on the other hand, ontologies or P2P Semantic

[16] Blogging is a new emerging way to provide commentary and opinions through a self-published "personal Web site". For a brief description of the evolution of Blogging see [Blood 2004]

Web Services are applied (see for an overview of selected projects [Staab/Stuckenschmodt 2006]). Thereof starting, it is necessary to further evaluate a suitable approach.

2.4 Ambient Business atop Open Object Information

Granting arbitrary access to stored semantically enriched object information enables various developers with different perceptions to search relevant object information, combine those freely and hence create innovative, ambient services. For instance, the low speed of vehicles in proximity might hint a traffic jam, and this information could then be provided for others in form of a traffic service. New logistics concepts which lead to a changed creation of value would also be conceivable. If a package is announced to arrive beyond the regular office hours, a taxi-driver waiting for customers could decide to collect and deliver this package directly to earn a promised bonus for fast delivery. These are only some examples of a variety of possible innovations based on an OOII which is necessary to realize in the further project course now.

3 Further Steps

To proof the technical feasibility of our design, a first prototype of an OOII will be realized by rebuilding our office rooms into a kind of ambient environment. Bookshelves and doors will be equipped with RFID readers and books will be tagged with RFID labels in order to sense the presence of books ubiquitously. Semantic markups will be annotated to the sensor data. This semantically enriched information will be stored in form of virtual data objects in a P2P network. By offering arbitrary access to these objects and integrating services like Amazon's Web Service as well as semantically annotated external resources an innovative, federative library can be developed. The Federative Library represents a library without a pool of books hosted at a centralized location. The books are distributed in the participants' offices. You can borrow a book by fetching it right from our colleague's shelf and taking it to your own office. If you want to return a book you just have to put it back to your own bookshelf.

Additionally, other value-added services will be conceivable as well. While monitoring the movements of the books it is possible to create social networks [Cross/Parker 2004]. Based on communities of practice that can be detected while analyzing these resulting networks, collaborative filter services can propose colleagues as expert related to certain topics derived from the books they borrow.

References

Aarts, E., Harwig, R., Schuurmans, M. (2001): Ambient Intelligence. in: Dennin, P. (ed.): The invisible future - the seamless integration of technology in everyday life. McGraw-Hill, 2001, pp. 235 – 250.

Alesso, H., Smith, C. (2004): Developing Semantic Web Services. A.K. Peters, Wellesey, MA, 2004.

Barkai, D. (2001): Peer-to-Peer Computing. Technologies for Sharing and Collaboration on the Net. Intel Press, Hillsboro, 2001.

Berners-Lee, T., Hendler, J., Lassila, O. (2001): The Semantic Web. Scientific American, Vol. 284, 2001, pp. 34 – 43.

Blood, R. (2004): How Blogging Reshapes the Online Community. Communications of the ACM, 47 (12), 2004, pp. 53 – 55.

Brickley, D., Guha, R.V. (2004): RDF Vocabulary Description Language 1.0: RDF Schema, 2004, available at: http://www.w3.org/TR/rdf-schema/.

Cayzer, S. (2004): Semantic Blogging and Decentralized Knowledge Management. Communications of the ACM, 47 (12), 2004.

Chesbrough, H. (2003): Open Innovation – The New Imperative For Creating And Profiting From Technology. Harvard Business School Press, 2003.

Clarke, I., Sandberg, O., Wiley, B., Hong, T. (2000): Freenet: A Distributed Anonymous Information Storage and Retrieval System. in: Proc. of the ICSI Workshop on Design Issues in Anonymity and Unobservability. Berkeley, CA, 2000.

Cross, R.; Parker, A. (2004): The Hidden Power of Social Networks, Harvard Business School Press, Boston, 2004.

Culler, D., Estrin, D., Srivastava, M. (2004): Overview of Sensor Networks. Computer 37(8), 2004, pp. 41 – 49.

van Dam, A. (2001): User Interfaces: Disappearing, Dissolving, and Evolving. Communications of the ACM, 44 (3), 2001, pp. 50 – 52.

Dingledine, R., Freedman, M., Molnar, D. (2000): The Free Haven Project: Distributed Anonymous Storage Service. in: Proceedings of the Workshop on Design Issues in Anonymity and Unobservability, (LNCS 2009), 2000.

Durusau, P., Newcomb, S., Barta, R. (2006): Topic Maps Reference Model, 13250-5, 2006, available at: http://www.isotopicmaps.org/TMRM/TMRM-6.0/TMRM-6.0.pdf.

Engels, D., Foley, J., Waldrop, J., Sarma, S., Brock D. (2001): The Networked Physical World: An Automated Identification Architecture. Second IEEE Workshop on Internet Applications, 2001.

Fano, A., Gershman, A. (2002): The Future of Business Services in the Age of Ubiquitous Computing. Communication of the ACM, 45 (12), 2002, pp. 83 – 87.

Fensel, D. (2002): „Semantic web enabled web services", in: Proceedings of the International Semantic Web Conference, 2002.

Finkenzeller, K. (2003): RFID-Handbook. 2nd edition, Wiley & Sons LTD, 2003.

Fleisch, E., Mattern, F. (eds.) (2005): Das Internet der Dinge – Ubiquitous Computing und RFID in der Praxis. Springer, 2005.

Fleisch, E., Tellkamp, C. (2006): The Business Value of Ubiquitous Computing Technologies. in: Roussos, G. (ed.): Ubiquitous and Pervasive Computing New Frontiers for Electronic Business. Springer, 2006.

Garshol, L.M., Moore, G. (2005): Topic Maps - Data Model, 2005, available at: http://www.isotopicmaps.org/sam/sam-model/.

Gershenfeld, N. (1999): When Things Start to Think. Henry Holt & Company, 1999.

Gershenfeld, N., Krikorian, R., Cohen, D. (2004): The Internet of Things. Scientific American 291(4), 2004, pp. 76 – 81.

Gershman, A., Fano, A. (2006): Ubiquitous Services: Extending Customer Relationship Management. In: Roussos, G. (ed.): Ubiquitous and Pervasive Computing New Frontiers for Electronic Business. Springer, 2006.

Hansmann, U., Merk, M., Nicklous M., Stober, R. (2003): Pervasive Computing Handbook. 2nd edition, Springer, 2003.

Hill, J., Horton, M., Kling, R., Krishnamurthy, L. (2004): The platforms enabling wireless sensor networks. Communications of the ACM, 47 (6), 2004, pp. 41 – 46.

von Hippel, E. (1998): Economics of Product Development by Users. in: Management Science, Volume. 44, Nr. 5, 1998, pp. 629-644.

Konnerth, T., Hirsch, B., Albayrak, S.(2006): JADL: An Agent Description Language for Smart Agents. in: Proceedings of Declarative Agent Languages and Technologies (DALT06), 2006.

Lee, W. (2005): An Intelligent Agent for RFID-Based Home Network System. in: Yang, L.T. et al. (eds.): EUC 2005., LNCS 3824, 2005, pp. 499 – 508.

Mattern, F. (2005): Ubiquitous Computing: Scenarios from an informatised world. in: Axel Zerdick, A., Picot, A. Schrape, K., Burgelman, J., Silverstone, R., Feldmann, V., Wernick, C., Wolff, C. (eds.): E-Merging Media - Communication and the Media Economy of the Future. Springer, 2005, pp. 145 – 163.

McGuinness, D.L., van Harmelen, F. (eds. (2004): OWL Web Ontology Language Overview. W3C Recommendation, 2004, available at: http://www.w3.org/TR/owl-features/.

Milojicic, D., Kalogeraki, V., Lukose, R., Nagaraja, K., Pruyne, J., Richard, B., Rollins, S., Xu, Z. (2002): Peer-to-Peer Computing. Technischer Report. HP Laboratories Palo Alto, 2002.

Oram, A. (ed.) (2001): Peer-to-Peer: Harnessing the Benefits of a Disruptive Technology. O'Reilly, Sebastopol, 2001.

Pentland, A. (2004): Healthwear: Medical Technology Becomes Wearable. Computer 37(5), 2004, pp. 42 – 49.

Pepper, S., Moore, G (eds.) (2001): XML Topic Maps (XTM) 1.0., 2001.

Reichwald, R., Piller, F. (2006): Interaktive Wertschöpfung. Gabler, 2006.

Rondeau, A., Wiechers, S. (2005): Semapedia - The Physical Wikipedia, 2005, available at: http://www.semapedia.org/semapedia_article19092005.pdf.

Roush, W. (2005a): Amazon: Giving Away the Store. Technology Review, 108 (1), 2005, pp. 28– 30.

Roush, W. (2005b): Killer Maps. Technology Review, 108 (10), 2005, pp. 54 – 60.

Roussos, G. (2006): Ubiquitous Computing for Electronic Business. in: Roussos, G. (ed.): Ubiquitous and Pervasive Computing New Frontiers for Electronic Business. Springer, 2006.

Schoch, T. (2005): Middleware für Ubiquitous-Computing-Anwendungen. in: Fleisch, E., Mattern, F. (eds.): Das Internet der Dinge – Ubiquitous Computing und RFID in der Praxis. Springer, 2005.

Schoder, D., Fischbach, K., Schmitt, C. (2005): Driving Resource Management with Peer-to-Peer Network., in: Subramanian, R., Goodman, B. (eds.): P2P Computing: The Evolution of a Disruptive Technology. Idea Group Inc, Hershey, 2005.

Staab, S. Stuckenschmodt, H. (eds.) (2006): Semantic Web and Peer-to-Peer. Springer, 2006.

Weiser, M. (1991): The Computer of the 21st Century. Scientific American 265(3), 1991, pp. 94 – 104.

Community2Go: support for online communities

Wolfgang Gräther[1], Simone Braun[2] and Susanne Krause[2]
[1]Fraunhofer FIT
Schloss Birlinghoven
53754 Sankt Augustin
wolfgang.graether@fit.fraunhofer.de

[2]Bauhaus-Universität Weimar (until autumn 2005)

Abstract

In this paper Community2Go, a community portal for mobile devices with small displays is presented. Community2Go offers relevant functions for the access to online communities set up by the FIT community toolbar. We present design, functionality and evaluation of Community2Go.

1 Introduction

There exist plenty of online communities with different intended and shared purposes. Among them are, for example, online communities which support customers [ciao 2006], support eating disorders self-help groups [healthyplace 2006], help in finding friends [metropolis 2006] or create a Web encyclopedia [wikipedia 2006].

In online communities, the social interaction of people is mediated and supported by community support systems, which also facilitate a sense of togetherness [Preece 2000]. Community support systems provide a virtual meeting point, e.g. bulletin boards, chat rooms, discussion forums or the Web, and means for communication and interaction like email, chat, audio and video links. In addition, community support systems use knowledge about the composition of the group and the ongoing activity to visualize relations between community members, i.e. matchmaking, and to visualize presence and activity of others, i.e. provide “awareness” [Koch 2001].

Access to online communities with mobile phones or PDAs is rare but could often result in delivery of important and just-in-time information. In contrast, in the area of games, so-called “mobile communities” can be found where interaction with the community takes place via small devices.

In the following we will briefly describe the FIT community toolbar, which is the basis for Community2Go. Then we present design and functionality of Community2Go. Next we show results of our evaluation and finally we end with a conclusion.

2 FIT Community Toolbar

The community toolbar is a browser integrated portal solution for online communities, which provides its services directly in the web browser and therefore becomes a companion for the World Wide Web. In other words, the community toolbar provides new ways for online communities to create and share information, to structure and rate the relevant aspects of shared information and to be aware of ongoing activities in communities. For example, the community toolbar checks if the currently displayed web page is contained in the information collection of the online community where the user is a member. If this is the case, then the following information is presented:

- Identification of the community
- Presence and accessibility of other members
- News in the community
- Collaborative rating of and comments for the currently visited web page
- Shared glossary

If the currently visited web page or web site is not already in a community but seems to be relevant for a certain community, then users are able to add this web page immediately to a community and to rate its relevance. Additionally, the community toolbar provides direct access to a discussion forum and a collection of documents. Comments can be immediately added and direct response to actions of other community members is possible via different communication channels. Furthermore, the community toolbar offers services for the administration of community membership.

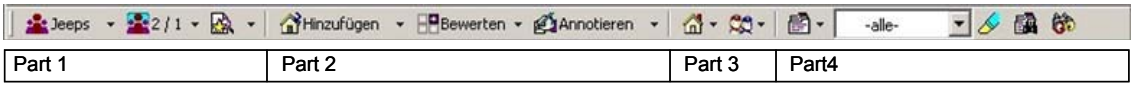


Fig. 1: The 4 parts of the community toolbar

The community toolbar is divided into 4 functional parts (see Figure 1). The first part contains the identification of the community, shows the presence of other members and indicates if there are news. Part 2 offers functions related to the currently visited web page: adding, rating and commenting. Access to the information spaces and membership management is accessible via the corresponding buttons of part 3. In part 4 all the functions referring to the glossary including highlighting and searching are located; more details can be found in [Kolvenbach et al. 2005], a predecessor of the community toolbar is the Social Web Cockpit [Gräther/Prinz 2001].

BSCW is the underlying cooperation platform [Appelt 1999] for the community toolbar, which is itself implemented using .net technology. The community server provides the data which is to be presented in the community toolbar and communicates via XML-RPC with BSCW. The event and notification infrastructure ENI [Prinz et al. 2004] is used to capture presence and actions of community members and to distribute the corresponding events according to access rights of the community members. All functions of the community server and ENI are accessible via HTTP requests and thus allow implementation of other interfaces easily, which is achieved by Community2Go.

3 Design

Support for creation and sharing of information as well as being aware of ongoing activities in online communities set up by the community toolbar are the main tasks of Community2Go. According to the design considerations for information appliances mentioned in [Mohageg/Wagner 2000] we pose three questions:

1. How can information be clearly arranged on a small screen?
2. Which functions are useful and necessary for mobile users?
3. Are there technical means for the implementation of the selected functions?

These questions will be answered in the following sections.

3.1 Screen layout and navigation

The screen of the PDA is limited to 229x245 pixels. The presented information should be visible without horizontal scrolling, which is circumstantial and avoids, for example, easy readability of text. Consequently, the presented information has to be classified according to its importance. Important information should be presented in the upper screen area, so that even vertical scrolling is often prevented.

Furthermore, we decided to arrange the information to be presented in separate parts, which are “piled up” and each part has a link to the top of the window. On the other hand, there are links from top of the window to the respective parts. Figure 2 shows the ‘Home’ window with the parts ‘News’, ‘Add Link’ and ‘Communities’ as well as the link structure within the window. Tool tips above the icons are used to clarify their meaning.

The entire functionality of Community2Go is organized in two different windows: ‘Communities’ and ‘Members’. An additional window ‘Home’ provides direct access to main functions of the other two windows. This decision was made because it is easier to scroll vertically than to navigate (and remember) in large window hierarchies.

3.2 Selected functions

After designing screen layout and navigation it was quite clear that nearly all functions offered by the community toolbar are reasonable and desirable for mobile users. For example, even the invitation of people as members in a certain community was considered useful. Disinviting of members seemed absolutely necessary.

A few additional functions were designed and implemented for Community2Go. For example, there are functions available to send group mails and SMS messages.

In contrast, the creation of new communities seemed dispensable, because after the creation, more operations like inviting a large number of members, collecting a lot of web pages, etc. would have to be carried out, which is in fact too much work on a small display and better offloaded to the desktop.

Toolbar communities have direct access to a discussion forum in their community context. We decided not to re-implement the corresponding tool but rely on BSCW's mobile solution. The integration of a mobile chat tool is possible, but was left open and was postponed.

3.3 Implementation of the selected functions

There were no restrictions according to the chosen design to implement all selected functions. Consistency with the data of the already existing communities is given, i.e. the presented information on a PDA is the same as on a desktop computer for a community member.

One main strength and distinctive feature of the community toolbar is the provision of additional information in the context of web pages. For example, comments of community members to web pages are directly visible as overlays (highlighted and tool tips) in the visited web page. Imagine a customer community, where customers can directly comment on certain features of a product. This situative and context-based interaction technique would have required extending the browser software on the PDA. According to the restricted developing time for Community2Go, we decided to present comments (annotations) to web pages as a separate part in the corresponding 'Community' window of Community2Go.

4 Community2Go

Community2Go is completely realized as a web interface for PDAs based on Windows Mobile 2003 (Windows CE) platform. We were using HTML, CSS and Javascript to implement it; cookies are used to store the settings locally. Because of these 'standard languages', we expect a good portability to other comparable platforms for Community2Go. The underlying groupware BSCW offers an API to access all functionality via an XML-RPC interface. XML-RPC calls can either be implemented using JAVA or Python, we used the latter language.

The following sections describe in detail the functionality provided by Community2Go. Firstly, we present the access to Community2Go, configuration functions and the integrated help mechanisms. In the second section we describe the functions for membership management, communication, and presence awareness. The third section focuses on the description of functions for web pages like adding, rating and commenting, functions supporting management of a community glossary, and task awareness.

4.1 Access to Community2Go, settings and help

Connecting with Community2Go brings up the first window, where users can choose between three different interface languages: German, French and English. Next the 'login' window is displayed; members have to authenticate to get access to community information (see left part of Figure 3). After successful login, the 'Home' window is displayed (see Figure 2).

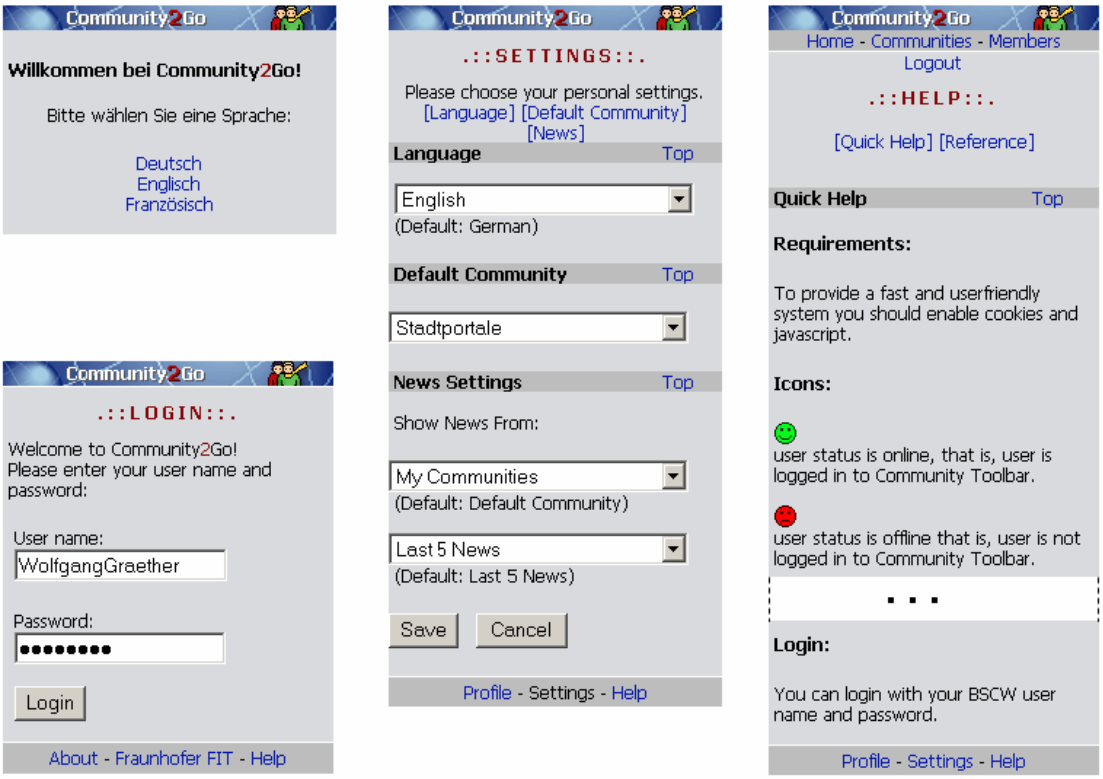


Fig. 3: Welcome, login, settings, and help window

Normally, when using Community2Go for the first time, community members want to specify their defaults. The corresponding information is entered in the ‘Settings’ window (see center part of Figure 3). Again, the language can be chosen and a default community, one out of all communities, where the user is a member, can be specified. The third part of the ‘Settings’ window concerns the news setting. Members can adjust if they want to have presented the news of all communities they have access to or only the news of the default community. The second pull down menu offers 3 choices of how many news items should be presented: no, the last 5 items or the last 10 items. The news is displayed in the ‘Home’ and ‘Communities’ window but not in the ‘Members’ window.

Community2Go offers a small online manual containing a quick help as well as a reference (see right part of Figure 3).

4.2 Membership management, presence awareness and communication

The ‘Members’ window provides a complete overview of all members and their online status of all communities the user has access to. Also all ‘Active Users’ are listed, i.e. users of Community2Go and the community toolbar. The online status of a community member is coded using emoticons. Other icons are used to invite and disinvite (open or closed door) people to communities, to get information about members, and to mail to a single member or all members (see left part of Figure 4).

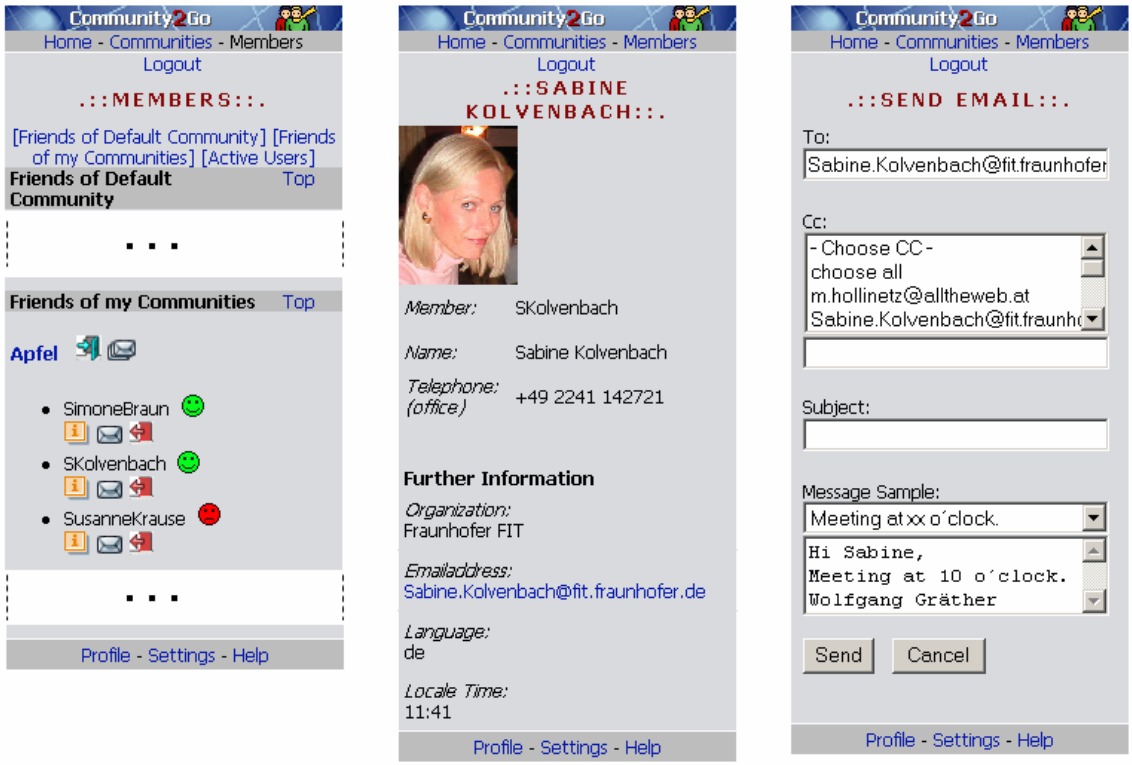


Fig. 4: Members, member information, and email window

If a user wants to disinvite a member, then a mouse click on the ‘closed door’ icon beneath the member name is sufficient. A mouse click on the ‘open door’ icon brings up a window containing a list of people from the user’s address book. New members can be selected or email addresses can be entered. The right part of Figure 4 shows the email window. The ‘To’ text field and the potential candidates for the ‘Cc’ field are automatically provided. Community2Go offers also several standard text messages.

4.3 Functions for web pages, community glossary and task awareness

The ‘Communities’ window is divided into 5 parts. The topmost part (‘News’) in the window lists the activities that took place in this community. For example, the addition of a web page to the information space of the community, rating, the annotation of a web page, or invitation of a person to the community (see left part of Figure 5).

The ‘Link Collection’ part presents all the web pages in the information space of the community in a scrollable selection list. If a web page is selected, then URL, title, creator, and rating are listed. It is possible to directly rate this web page by mouse click on one of the corresponding 5 icons ranging from poor until excellent. Annotations to web pages can be directly entered. If there are already annotations for this web page, then a mouse click on the link ‘Show Annotations’ pops up the ‘Annotations’ window with more details and the possibility to delete annotations (see center part of Figure 5).

Web pages are added by means of the elements in the window part ‘Add Link’. The glossary can be displayed (see right part of Figure 5) and new keywords can be easily added. Furthermore, details for keywords like the name of its creator can be displayed. The fifth window part – right at the bottom – is named ‘Friends’ and lists all members of this community and their online status in the same manner as in the ‘Members’ window.

Fig. 5: News, link collection, add link, glossary parts of the 'Communities' window

5 Evaluation

We conducted an evaluation of Community2Go with 16 participants in the research division 'CSCW' of Fraunhofer FIT. 87.5% of the participants had experiences with the community toolbar and 25% of them used the community toolbar at least once a day.

The participants attended a short training to learn Community2Go usage. In this training the specified task 'Finding the best online Advent calendar' was presented and at the end a questionnaire was distributed to the participants. The questionnaire comprised questions referring to the provided functionalities of Community2Go, the design of the user interface and questions that focused on the comparison of Community2Go with the FIT community toolbar.

Some details of the results: None of the functions provided by Community2Go was rated unimportant! 10 participants rated the functions 'Community List' and 'Link Collection' as very important. All 16 participants rated 'Annotate' as important or very important. 14 participants found the function for rating of web pages important or very important.

The function 'Glossary' was rated by 8 participants as neutral. This could be due to the fact that Community2Go offers no means to highlight keywords of the glossary in the web pages of the community. The 'Help' functionality was rated nearly equally distributed as less important, neutral and important.

The wish list for an improved Community2Go contained functions for: news list with items since last login, list of members should be sortable according to online status, configurability of the interface according to levels basic, standard and extended, and a more compact member list.

The overall rating of the technical performance of Community2Go has the median good, the overall rating of Community2Go is good (8 participants) and very good (5 participants).

6 Conclusion

This paper illustrates how online communities can be supported in their need to interact, communicate, and cooperate and to stay informed about community activities of other members through services that are provided on mobile devices with small interfaces.

References

Appelt, W. (1999): WWW Based Collaboration with the BSCW System. In: Proceedings of 26th Annual Conference on Current Trends in Theory and Practice of Informatics (SOFSEM'99). Milovy (Czech Republic): Springer Verlag, S. 66-78

Gräther, W.; Prinz, W. (2001): The Social Web Cockpit: Support for Virtual Communities, in Proceedings of GROUP'01 International ACM SIGGROUP Conference on Supporting Group Work. ACM Press, 2001, pp. 252-259.

Koch, M. (2001): Community-Support-Systeme, in: Schwabe, Streitz, Unland (eds.), CSCW-Kompendium, pp. 286.296, Berlin: Springer, 2001.

Kolvenbach, S.; Gräther, W.; Klöckner, K. (2005): A Toolbar for Efficient Interaction in Online Communities, in Proceedings of 31th Euromicro Conference on Software Engineering and Advanced Applications. IEEE Computer Society, Los Alamitos, CA, 2005, pp. 483-490.

Mohageg, M.; Wagner, A. (2000): Design Considerations for Information Appliances, in E. Bergman (ed.), Information Appliances and Beyond, San Francisco: Morgan Kaufmann Publishers, 2000, pp. 27-52.

Preece, J. (2000): Online Communities; Designing Usability and Supporting Socialbilty, John Wiley & Sons, Inc. New York, NY, USA, 2000.

Prinz, W.; Pankoke-Babatz, U.; Gräther, W.; Gross, T.; Kolvenbach, S.; Schäfer, L. (2004): Presenting Activity Information in an Inhabited Information Space, in D. Snowdon, E. Churchill, E. Frécon (eds.), Inhabited Information Spaces: Living with your Data, London: Springer, 2004, pp. 181-208.

ciao (accessed 04/21/2006): http://ciao.com/

healthyplace (accessed 04/21/2006): http://www.healthyplace.com/Communities/Eating_Disorders/self_help.asp

metropolis (accessed 04/21/2006): http://www.metropolis.de/

wikipedia (accessed 04/21/2006): http://en.wikipedia.org/wiki/Main_Page

Skills and motivation in ad-hoc-collaboration

Dirk Frohberg[1] and Gerhard Schwabe[2]

[1] University of Zurich
frohberg@ifi.unizh.ch

[2] University of Zurich
schwabe@ifi.unizh.ch

Abstract

Mobile technologies offer the opportunity to collaborate spontaneously any time and any place. While researchers have begun to understand the skills and motivational consequences of distributed office meetings, we are only beginning to understand them for ad-hoc collaboration. This paper reports on an analysis of two exploratory experiments dating from 2004 and 2005. Ad-hoc collaboration requires specific skills for process facilitation, communication, planning, media usage, multi-tasking, as well as specific social skills. Those skills need to be different in their characteristic than those skills necessary for traditional face-to-face and distributed meetings. A fast action and reaction cycle leads to raised excitement and motivation despite the difficulties the group has in organizing their work.

1 Introduction

When a Nokia customer service agent travels to visit a new customer, he can use their SMS community to ask fellow customer service agents how to deal with the new customer. Typically, they can access important customer data as well as gather input on how to sell to the customer[17]. This SMS community is widely accepted because it allows customer service agents to exchange ideas, sometimes required on an ad hoc basis, over a familiar medium. This approach symbolises a radical change in providing support for collaboration. Prior approaches bound collaboration to given technological settings such as meeting rooms or workplaces. Mobile technology provides support when the need arises. The support relies less on systematic analysis of data than on creative and informal ad-hoc input. This is an opportunity but also a challenge to the designers of mobile systems: “Last, but not least, we believe that the successful adoption of these [mobile[18]] solutions will depend on their capability to act as connecting tools: connecting people, ideas, and contexts. This capability of connecting also re-

[17] Interview with Riitta Vänskä (Nokia representative) during a regular MOBIlearn meeting in 2004.

[18] Addition by the author

quires a switch from short term to long term creative thinking, with a better integration of the creative process into everyday life" [Shibata and Hori 2002].

An increase in mobile collaboration may also reduce well known difficulties in localising and organising people for face-to-face meetings. [Lundin&Magnusson 2003, Bellotti & Bly, 1996; Nardi & Whittaker, 2002] These difficulties are a major obstacle for the opportunistic meetings required by unplanned creativity, unexpected problems, opportunities and incidents [Whittaker et al., 1994].

When people most need creative input from others, they are unable to make contact with sufficient speed. The diffusion of mobile technologies has opened communication channels allowing to share ideas whenever and wherever they appear. We are currently moving to a situation where it is more likely that a person has a mobile phone available than a pen and paper. Thus, mobile phones may be an ideal device to support creativity and informal collaboration.

The triumphal procession of mobile phones during the recent years has already significantly changed the coordination and planning behaviour towards informal 'lazy planning' in every day's life, especially among youngsters: They just agree roughly after school to undertake something in the evening and trust for detailed and spontaneous coordination on the modern communication media as messenger, mail, but particularly their mobile phone and SMS [Sacher et al., 2002]. Thus mobile technology raises the individual degree of freedom. After mobile communication and mobile coordination, the next step on the ladder of complexity would be mobile collaboration. Mobile collaboration integrates communication and coordination, but adds the shared work with material, i.e. the processing of information to formal output. The challenge in mobile ad-hoc collaboration is its unstructured process. We found in our experiments that people are nowadays quite unable to deal properly with the low formality of mobile collaboration. They do not naturally have the necessary skills to collaborate without a clearly designated moderator and when lacking a thoroughly prepared process. This incapability was known from common collaboration in large groups, while smaller groups have a good intuition for informal collaboration. But in mobile settings even small groups fail to collaborate effectively. Just like the capability of lazy planning has evolved in mobile coordination, mobile collaboration will only be successful, if an appropriate set of skills is developed and spread. What is this skill-set and how is it different from the skill-set of established collaboration? As there is surprisingly little knowledge about this, we ran a series of exploratory experiments studying the developing skill-sets of successful participants. Astonishingly, mobile collaboration does not only pose particular challenges on the participants, but also has a motivational effect on them. We therefore decided to include this motivational effect in our study.

In the following chapter 2, we will first define and characterise the nature of ad-hoc-tasks and discuss prior research on skills for distributed and ad-hoc-collaboration. Chapter 3 will report on the research approach and the data collection in experiments. In chapter 4 we present the most interesting preliminary findings from the first series of experiments. Chapter 5 will summarize the lessons learned.

2 Literature and research questions

2.1 Ad-hoc-collaboration collaboration

Research in the area of computer supported collaboration of distributed groups aims towards bridging distribution in time and space as efficiently as possible. Systems usually trust on prepared locations with powerful desktop computers. CSCW researchers have expended a considerable amount of effort trying to emulate physical collocation using advanced techniques in audio and video communication (e.g. [Ishii& Kobayashi 1992]), sharing document repositories [Bentley et al. 1997] and creating a sense of awareness of the activities of the others [Prinz 2001]. Newer research on collaboration detected mobile technology to shift the limitation of space further and support groups with members being mobile. Systems like Placememo, SoundPrayer [Esbjörnsson et al., 2002], MenuMe, CallKiosk, or Netman [Chang, 2003] allow people to deliver material or information into a database, that can be searched and used, by other people. Such systems basically work as market to match offer and demand. Other systems like Hocman [Esbjörnsson et al., 2002], IPAD, Hummingbird, ProxyLady, AIDA [Wang et al., 2005], Smart-Its YCab, MagicLounge [Chang, 2003], or ActiveCampus [Griswold et al., 2004] heavily support mobile communication and awareness, which are basic prerequisites for mobile collaboration. A whole strand of research about computer-supported collaboration serves loosely coupled groups to cooperate in an opportunistic way and is excellently covered in a doctoral thesis of Pinelle [2004]. All systems have in common to interpret distributed locations as obstacle and restriction, which must be overcome. Furthermore all systems provide a clear idea how the group members are supposed to act in order to ensure maximum efficiency.

This paper introduces mobile, spontaneous, collaborative tasks (called 'ad-hoc-tasks') being different in two aspects. Firstly distribution is not seen as obstacle, but purposely established as challenge. Secondly the proposed setting is not suggesting an optimal process to the group but challenges the group to find the optimal process on their own. Acting in highly informal, dynamic and complex collaborative situations drives the group to their limits of collaboration abilities.

We are defining the following characteristics for an ad-hoc task.

1. The point in time the task is given is unknown and unpredictable
2. The task is unknown beforehand
3. There is no socialised standard procedure how to deal with the concrete task
4. The task has a 'high enough' priority not to be ignored
5. The available time to solve the task is 'critical enough' not to be shifted until conditions for collaboration have improved
6. The task requires to be solved collaboratively. The need for collaboration can be manifold:

- The necessary information to solve the task is spread among several people
- The task is too complex and resource taking to be solved by one or two persons
- The task requires people to contribute from dedicated locations
- The addressees of the task are equal in rank and have different interests. Individual decisions without group consultation will not be accepted.

- The task is ambiguous and needs the creative power of many brains

Here are some examples for ad-hoc tasks as they may occur in business or private life:

- A proposal for a huge bidding must be sent and the deadline is close. The team heard of it in the very last minute.
- The client asks very urgently for a status report of the project. He comes over for a visit in the afternoon and asks for a 30 minute presentation.
- Some friends decide to meet in the evening, have dinner together and watch a video. They want to coordinate who brings which dishes and what film to get from the video store.
- In case of a disaster (e.g. flooding), the endangered people need to collaborate and coordinate activities until and beyond professional units can take responsibility.

2.2 Skills for successful distributed and ad-hoc collaboration

Most humans have acquired first basis skills and competencies for collaborating in small, face-to-face groups through their socialisation in their family. The acquisition continues throughout school, secondary education and business life, as face-to-face small group collaboration is widely used there. This socialising begins early and happens so intensively that the acquired behaviour appears “natural” and “intuitive” to most humans. Unfortunately, this set of behaviours does not scale to larger groups, as larger groups have different problems than smaller groups (e.g. sharing airtime or different group dynamics) [Schwabe 2004, Nunamaker et al. 1991, Löber et al. 2006]. Research on Group Support Systems recommends using a skilled facilitator to design and manage the group collaboration process [Schwabe 1995]. Similarly, the “naturally” acquired skills may not be applicable to distributed groups[19]. An analysis of best practice for distributed collaboration by McQuaid et al. [2000] leads to the following particular skills:

- process facilitation skills: enhanced process control, especially in convergent phases
- planning skills: more explicit pre-planning
- communication skills: explicit communication of status information, e.g. progress, reduce ambiguity of target and source of communication by making the source explicit, organize channel choice
- social skills: Organize social breaks (which are obvious in co-located meetings)
- awareness skills: create a feeling of co-presence; remind participants of co-presence.

These skills were deduced from running formal, pre-planned Group Support Systems meetings. Some are by definition not easily applicable to distributed ad-hoc-collaboration (e.g. planning skills). Furthermore the additional benefits (e.g. the possibility for immediate situated action [Schwabe et al. 2004, Luff&Heath 1998]) and challenges of mobile ad-hoc-collaboration (e.g. time pressure) are not covered by the prior

[19] The only exception is 1:1 collaboration over the telephone, which is currently widely practiced today.

literature. Thus, we were interested to find out what skills lead to successful ad-hoc collaboration resulting in research question 1.

Research question 1: What are the particular skills required for participating in successful ad-hoc-collaboration?

While the skill set of a facilitator responsible for running the mobile collaboration is discussed in another publication [Schwabe&Frohberg 2006], this paper focuses on the skills of ad-hoc collaboration that typically do not have a predetermined facilitator available.

A particular challenge of distributed collaboration is the motivation of the participants. Many of the challenges reported by McQuaid et al. [2000] deal with motivational problems: Tasks may be postponed as they easily can be moved out of sight. It is easier for free riders to hide and distributed meetings lack “natural” mechanisms of feedback on open issues and successful task completion. Again, those challenges may not be as relevant to ad-hoc-tasks. Time pressure and tight, frequent interaction may add to motivation as well as the enhanced freedom of mobile participants. The contribution of mobility may be ambiguous: “Interestingly, users of mobile devices experienced a simultaneous sense of freedom from being bound to their desks with a tethered device, yet, at the same time, a sense of captivity owing to the compulsiveness of responding to communication initiated by others at any or every time.” [Sarker&Wells 2003]. Thus, we took a special look at how ad-hoc-collaboration raises motivation, which is leading to research question 2.

Research question 2: What are the motivational effects of ad-hoc-collaboration?

3 Research approach and data collection

The idea of a mobile ad-hoc-task was born during the last phase of the EU-project MOBIlearn[20]. We are reporting on two experiments within MOBIlearn with ad-hoc-tasks in November 2004 and February 2005. A third series of experiments is currently running. Originally the whole setting was only thought to demonstrate and evaluate the readiness of the MOBIlearn system, which was aimed at supporting mobile cooperation. There we learned how overstrained even skilful people are when being confronted with mobile informal cooperation. So we decided to derive skills required for ad-hoc-collaboration both from successful and unsuccessful user behaviour. As research on ad-hoc-collaboration is still in its infancy, we chose an exploratory approach, striving for a deep understanding rather than for statistical significance. As there are no natural groups available for study, we designed a set of experiments which emulates natural group behaviour as closely as possible. A particular challenge was the design of the ad-hoc-task. As in the current stage the design of an appropriate experimental task is a contribution of its own, we will describe them in more detail.

The basic idea of an ad-hoc-task is as follows: "A small team is aware of the fact that they will be confronted with a suddenly appearing task which must be accomplished under high time pressure. The countdown to hand in the result is only about 4-6 hours after sending out the trigger. The task will surprise the team starting at any time during

[20] "MOBIlearn is a worldwide European-led research and development project exploring context-sensitive approaches to informal, problem-based and workplace learning by using key advances in mobile technologies." (http://www.mobilearn.org)

a given week. By the starting time the team members will most probably be busy with other tasks and have not scheduled this extra task. The group must organize itself on the fly and integrate the task in the context and activities that are currently running. These circumstances create a realistic and authentic ground for mobile collaboration." [Taylor et al., 2005]

3.1 Experiment 1: Ad-Hoc-Task as part of a formal exercise

The first experiment was part of a collaborative homework being integrated in a course about computer supported collaborative work (CSCW). Thus the participating students can be seen as semi-experts for collaboration. The course itself was a cooperation between University of Zurich (Switzerland) and University of Konstanz (Germany) with 24 students from Zurich and 10 from Konstanz. The ad-hoc-task was a voluntary and additional task awarded with some pocket money for each successful participant and cinema tickets for the best performing team. The purpose was to have the students experience very intensely the challenges of collaboration in mobile settings. The 34 participating students were distributed in ten teams. Each team except one had at least one member from Konstanz. All teams were given a trigger to run the task but could reject participation without consequences. 13 of 34 students (four of ten teams) decided to participate actively. The other teams signalised as well interest in participation and rejected for reasons like illness, important other obligations or non-availability of some group member. One exceptional and hindering factor was a low private accoutrement of computers by the students from Konstanz who were mostly exchange students. Accounting the general resistance for extra work among students, the high percentage of more than one third of voluntary participation is amazing and an indication for the attractiveness of such an ad-hoc-task. We will further analyse the factors of attractiveness in chapter 4.2.

Each team had some established technical setting of devices (exceptions mentioned above) and collaborative software. The software consisted of a defined bundle of synchronous and asynchronous tools for communication, coordination, and collaboration. It was in particular Skype, SmartIdeas, Netmeeting, Groove, ICQ, BSCW, and K3. At that time we were not aware of any useful, free and available mobile software, so the mobile support for the ad-hoc-task was basically limited to a mobile phone with SMS and laptops with wLAN-card, to be used within the wLAN-network at the University of Zurich. The teams were not provided with specific training how to deal with mobile ad-hoc-tasks.

Because moderation was complex each team got its own ad-hoc-task at an individual time. To avoid one team learning from another about the task, the experimenter provided individual tasks, but with similar components to ensure an equal level of complexity. The ad-hoc-task was tightly related to the obligatory homework featuring "collaboration between two universities", which each team had to work on simultaneously. When the ad-hoc-task started, the experimenter sent a mail with process-related information and an SMS, saying "Ad-hoc-task starts now for you. Check your mail". In the mail each team member found the information that he needs to phone the experimenter in order to get a piece of information about the task. Only the composition of all pieces of information would allow the team to solve the task completely. This had two reasons One was to simulate the situation of distributed non-written information among team members. The second reason was the experimenter would keep control and be able to monitor, if the team would overcome the first hurdles.

Below there is exemplary one of the ad-hoc-tasks, split in the three pieces of information as the participants got it via phone. The tasks for the others were very similar in structure and complexity: "1: The university's television unit offers you to make a 4-minute film clip about the collaboration project between the universities of Zurich and Konstanz. But they need in advance a concrete multimedia story board with pictures and text to plan the film clip. 2: There must be the same number of pictures in the story board from both universities. Your two professors need to be interviewed in the film. Prepare an interview text. Search for some music to underlay the story board with it. Estimate the resources needed to make the film (time for camera man, people needed, time to machine finishing etc.). 3: Use Powerpoint. One slide represents 10 seconds of film time. Give explanations in the annotation frame,of the content of each slide. The background music can be in any format or quality. Record the original interview or (if not possible) put yourself in the role of the professors". The students had about 6 hours time to solve the task.

For observation and evaluation purposes, the team members were asked to fill a structured diary form (see figure 1), keeping notes for each single activity. This helped the experimenter to get a full picture of what happened in each group. The participants were asked to fill in a short questionnaire which contained questions about the technical and didactical setting which are of lower relevance for the paper at hand.

When? *Time/ Duration*	*What?* *Activity*	*With whom?* *Partner*	*Why?* *Purpose*	*How?* *Medium or tool*	*With what?* *Device*	*With what?* *Mean*	*Where exactly?* *Own location*	*Context*	*Remarks (Technical problems, argument in the group, misunderstandings etc.)*
10.00 (CET)	***Received SMS from Dirk for start of trial***	***Dirk***	***passive event***	***SMS***	***mobile phone***	***NokiaONE***	***cafeteria***	***eating breakfast with colleaques***	***A nice conversation with my colleaques was interrupted :-(***

Figure 1: Diary form with exemplary entry

3.2 Experiment 2: The MOBIlearn Ad-Hoc-Task Experiment

In the second experiment there were 12+1[21] volunteers from ten MOBIlearn partners spread over 6 countries. The whole experiment consisted of three tasks with increasing complexity. The general design of the experiment and the nature of the tasks were similar to those from the first experiment. In difference to the students from the first experiment, the employees of MOBIlearn partners were much better equipped with standard and mobile technology. All participants must be seen as experts in the domain of mobile learning and mobile technology. All participants were already under heavy workload and none could have blamed them for not participating. Obviously the announcement and idea of an ad-hoc-task sounds attractive to people.

The participants possessed and used their private devices (PDAs, laptops etc.) and some got a sponsored mobile phone. Additionally two software systems were given as

[21] One participant was unavailable during the first two tasks.

support. One was sponsored by Nokia and supported synchronous, asynchronous and scheduled group-SMS with web access. The other one was the web-based mobile learning system from MOBIlearn with tools like an agenda, brainstorming, voting, messaging, chat, forum and the like. Data for evaluation has been captured in various forms as direct monitoring, logfiles, questionnaire, diary from participants and sporadic, informal discussions with individual participants. The core findings of this paper are based on the second experiment.

After technical tests with the MOBIlearn system, a training session via phone-conference had been organised to explain how to use the system. All other administrative and organisational issues during preparation had been managed via mail. Many thoughts had been put in how to compose the teams. In each team of three members there was at least one participant with some technical background to help the team members. Furthermore all team members came from different partner organisations to avoid simplification of solving a task. Two teams were consciously built with members from the core of MOBIlearn who knew and liked each other. In the third team people knew each other not very well. The people in the fourth team did not know each other at all. The first three teams were given an identity by finding a common attribute for all team members. There was the girls-team, the university-team, and the industry-team. The fourth team was purposely not given any identification. All teams were told to be in competition with the other teams collecting points for good performance. The winning team members would each get a mobile phone as reward The teams were free to use any device or software they liked to solve tasks, but extra points would be given to those who would use mobile devices and the suggested systems.

During the experiments the participants were confronted with the phenomenon of 'creeping commitment'. The tasks became by far more labour-intensive for all than promised and originally thought. This phenomenon was not planned but happened, because we underestimated by far the effort an ad-hoc-task would demand from participants.

The first task sounded as simple as "Hello all. First simple task: Message me and your group [via the MOBIlearn system[22]], in what context you currently are and what you do in general over there. Reply fast to get points". This message was sent through the MOBIlearn system and none became aware of it. So after some time a group SMS was sent to all participants to call attention to the task, but without information about the task. If all participants would have sat in front of a desktop PC at that time, it would have been a matter of a few minutes to solve the task for all. But instead, many were at lunch, at home with a flue or simply away from office. Those without internet connection first needed to find out from team members what the task actually was. Then some agreed to send their information via SMS to their team colleagues, who would post the information into the MOBIlearn system. SMS answers were not accepted. It took 10 of 12 participants about 1.5 hours after the notifying SMS and 40 internal messages to solve this task. One participant became aware of the task one day later (team 3) and one failed completely to reply (team 4).

To the surprise of all participants the second task was started on a Saturday morning (8 a.m. in Spain and UK, 10 a.m. in Finland and Greece). The basic task was as simple as doing a PowerPoint portrait of the group. There were a number of restrictions like

[22] This was a hidden restriction to be found out by the teams.

there should be a picture of each team member with the today's newspaper and sky must be seen. As another pitfall the task was described in a PowerPoint file sent through the MOBIlearn system. Only one randomly chosen person from each team got the file and needed to alarm the others. Again, if all participants would have been scheduled the time and were sitting in front of a desktop PC, it would have been a matter of at best one hour to fulfil the task. Most time would have been spent to organise a digital camera (attached to many mobile phones) for the demanded picture and buy a current newspaper. There was a high probability that both would be available without much extra effort. In fact it took the fastest group the whole Saturday and the slowest group until Monday 12 a.m. (deadline) to finish the task. Each and every collaborative step and activity turned out to become complex and a challenge under mobile conditions. The author monitored altogether incredible 107 SMSs (71 SMSs by the winning team) and 88 messages (forum, agenda, chat, messaging) through the MOBIlearn system. Furthermore one team used phone conferences and there were of course normal phone calls and mails as well. The participants reported that the task had interfered strongly with their privacy as they had been together with friends, family, or had had other obligations. Of course the ad-hoc-task did not have a high priority but was solved as side activity, being interwoven in every day's life. Even as the participants complained moderately about this interference, they found it as well very exciting and amazing how it was possible to work collaboratively in such a manner. The most active teams stayed in close touch all the time during the task and enjoyed it. As in the first task, the fastest and best solutions came from the teams 1 and 2 which were familiar with each other. Team 3 presented an equally good and team 4 an acceptable solution on Monday morning. This second task was rated best by all participants. We think it was the one with the most adequate and motivating level of complexity under the given circumstances.

Before the third task was given, some teams started frequent communication about how to be better prepared. One team agreed on a cycle for checking the MOBIlearn system frequently for the new task in case there was no SMS trigger this time. This sign of being over-motivated was taken by the author to intervene and promise, there would be an SMS trigger. Anyway, this incident showed the amazingly deep level of commitment, intensity and identification ad-hoc-tasks can create. The group-building function of the ad-hoc-task was highly assented by the participants.

The third task was by far more complex than the first ones, but the teams were trained now and thus able to deal with more complexity. Because of the complexity, the author could not moderate all teams in parallel any more, so each team got a different task at a different time, which contained a number of common elements. Each team member had to phone the experimenter individually to get a personal piece of oral information. Only the composition of all information pieces resulted in a complete picture of the ad-hoc-task. All teams were supposed to do a brainstorming and agree on the best idea by a formal voting. They all needed to produce some collaboratively written text, a presentation and additionally some short (from 30 seconds to 3 minutes) multimedia output as audio records or photomontages. Each team had once the opportunity to agree on a rejection of the start of the ad-hoc-task and receive it at another (again unspecified) time instead. Each team had four hours time to solve the task. After three hours the teams were informed they optionally got 2 additional hours, but points would be subtracted for it. Even though most participants started complaining about the heavy workload of the experiment and other urgent pending obligations, all teams took the additional two hours. They did not realize or ignored the fact that the heavy reduction of

team-performance-points for the additional time would never be compensated by the rising quality of their work. This can be seen as another indication for the high motivation created by an ad-hoc-task. After the experiences from the first two tasks, it was obvious from begin on, that the third task would mean a heavy workload. The experimenter actually expected the teams to mutiny or at least relax and decide for an acceptable minimum effort to solve the task fragmentary. Only team 4 did not even try to solve the task, because they saw no chance at all to finish it. At the end the output from the three remaining teams were fascinating considering the difficult circumstances of dealing with the task while working on other issues.

Again in this experiment we asked the participants to fill a diary with all their activities, as already been done in the first experiment. Furthermore the participants of the MOBIlearn experiment were kindly asked to answer a questionnaire of 91 rating questions with a Likert scale from 0 to 4 and 24 open questions. For those rating questions with relevance for useful skills and motivation, the average and variance have been calculated and interpreted. The comments from the open questions have as well been checked systematically for relevance. The most significant comments have been chosen to be presented in this paper as statements. Furthermore all system activities had been logged for further investigation. The performance of the teams has been rated by the experimenter, who deduced it from the quality of the final material, which was handed in by the teams as output of the tasks.

4 Results

4.1 Research Question 1: Skills for Ad-Hoc-Collaboration

In this chapter we will analyse to what degree the proposed skills suggested in 2.2 are useful to perform ad-hoc-tasks successfully.

Process facilitation skills: A major challenge for ad-hoc-collaboration lies in the spontaneous and situational arrangement and coordination of the process. In contrast to professionally trained teams for certain types of ad-hoc-tasks as firemen, medics, soldiers etc, in our case there are no established 'prior socialisations' [Pinelle 2004]. Even if roles like facilitator, time manager, caretaker for material etc. might be distributed among the team members, they cannot be fixed due to their non-permanent availability. Team members need dynamically switch roles and take over from others, so work can go on. One participant of the MOBIlearn experiment stated: "Balance of task to time is very important in a mobile situation (would apply to any distance situation) especially where the people involved are not allocated 100% of time to the activity." The central role of the facilitator must likely be distributed among team members [Bostrom 1991, Bostrom 1993], which is especially critical. Thus process facilitation skills must be available among all team members. Each team member needs furthermore to feel responsible for the process. Each must get an emphatic feeling of who is currently facilitating, when it is time to take over control and when to subordinate. A participant noted: "Time flew by - especially when waiting for contribution from others in group. Needed a group leader to take control in these cases to move things on. We fell down here - we were being too democratic".

Communication skills: Communication in mobile settings is another challenge. There are various channels available to communicate. Due to situational restrictions a compromise has to be found between the efficient and the available channel. SMS for in-

stance was a highly available but not very rich channel. Lacking sufficient tools and structure, the communication means were used for a number of functions such as socialisation, coordination, collaboration, giving mutual awareness, and facilitation. The mix of various channels not being clearly related to functions caused a lot of confusion. One participant said: "Having several channels to communicate was more awkward than expected." It turned out that it is useful and necessary to separate or highlight at least the facilitating communication from other communication.

Awareness skills: Awareness about who is where, and does what until when, was experienced as being extremely important for the orientation of all participants. Due to lacking awareness the group members were very likely to lose orientation, act uncoordinated, fall into stress and chaos. Therefore the teams needed to spend much energy in providing awareness to each other. Awareness was seen as very important (average of 3.5 on a scale from 0 to 4) and awareness services of any kind were heavily demanded. One participant stated: "I would have needed some kind of context awareness about the members of my group, concerning the exact status of the other users (what activity, where exactly in the system, for how long etc). " Another one mentioned: "I could have done with some form of availability service - possibly associated with whether a mobile phone is on or off. To perform the trial I was not that interested in where the team members were - just what their current capabilities were."

Social skills: To our observation a crucial factor of successful ad-hoc-collaboration is the social dimension, i.e. how well the team members knew each other before. In the MOBIlearn trial the acquainted teams performed much better and were by far more motivated than the non-acquainted teams (see 4.2). A member from one of the acquainted teams stated: "We were all committed to what we had to do to succeed and willing to cooperate regardless of the time we may have needed to spend on each task." Other statements were similar. In contrary a member from the non-acquainted team 4 stated: "No member of our group had sufficient time, we did not know each other before the tasks began, and we did not have the time to get to know each other during the trial. In other words, we were not really a group." Obviously, a lack of familiarisation cannot be healed before or during the task. All teams were given sufficient time to get to know each other via distance-media, but neither team 4 nor any other team took this chance. The number of tested teams is yet too small to prove the statements above empirically, so further research should focus this issue.

Planning skills: The main attribute of an ad-hoc-task is that it cannot be pre-planned in detail. One planning issue was the challenges of collective time management. The common and 'natural' approach observed in the experiments was just to start, keep running and deliver what is finished by the deadline by increasing the stress level the closer the deadline comes. No communication of any explicit time management was detected in the log files. In fact all participants underestimated by far the time that would be needed to solve the tasks. One participant formulated this insight as such: "Mobile collaboration needs much more time than classical office communication by phone and mail". Anyway the teams reflected that they could have prepared better and would certainly do in case of repeating the experiment. They would generally have a "clear choice of tools" and agreement on the way to use those tools, e.g. make spontaneously a shared agenda. One participant noted: "More time on the organising and planning in advance. Agreeing procedures and creating templates for agenda items etc. But I think we might spend less time overall as we know now some of the pitfalls." Thus some form of 'prior socialisation' [Pinelle 2004] seems to be feasible for ad-hoc-

tasks. Participants stated that they had not been able to solve the complex third task, without having done the two simpler tasks in advance. So teams are obviously getting routine in planning their process and planning skills can be trained. One participant put it as: "Really it was practice. Also in our group we really did not know how to use the different features best. But we have learnt more since we started the trials. Doing for real makes the difference."

At least two additional skills were found important analysing the experiments' data. Competency in using mobile media: This is not yet naturally given to everyone. Participants faced a lot of problems like how to send mail via mobile phone, how to transfer a picture taken with the mobile phone's camera or how to attach a PDA via Bluetooth to the mobile phone. Unfortunately, a lot of mobile technology still needs expert knowledge to be used and is often not at all intuitive.

Multi-tasking skills: In ad-hoc-experiments the participants need to embed the suddenly appearing and unplanned task in their intended routine of the day and coordinate it quickly with other obligations. Almost all participants made explicit comments about the high stress level during the task arising from the time restriction of the ad-hoc-task itself competing with simultaneous obligations, but even more from the need to restructure all intended activities. Several participants reported stress, especially because of social duties as the following two anecdotes demonstrate: "Just realized that there was a meeting with two friends for today and the meeting time should be scheduled to be in line with the task. One friend is just coming from abroad only for the weekend." and "I was multitasking the rest of the evening. I was sitting in front of the pc and talking with my friends, who really were nice the first hours, they said that they do understand this special task. My friends had a good time together. Sometimes after 10 pm, some of my friends said that they like to go home because the host has something else to do. Some friends stayed until I finish the task and then we had a glass of wine and some peaceful talking." Another one formulated it more generally with: "I had not expected the level of intrusion into my normal activities."

4.2 Research Question 2: Motivational Power of Ad-Hoc-Tasks

The most surprising and obvious impact of ad-hoc-tasks is the motivational power. Already explaining and announcing the idea of an ad-hoc-task fascinated our participants. Even already being under heavy workload, they agreed voluntarily to participate, simply because it sounded fun and meaningful. There is not much explicit data about the motivational power derived from the first experiment, because we were not aware of this impact. We were completely overwhelmed by the activism and commitment of the students who worked on the task simultaneously to their lectures or even skipped lectures and private arrangements (entries from diverse diaries). The task was actually designed to be too complex to be solved in the given time. We wanted to make sure that not only one of the team would just do all the work. We actually expected the teams to agree on limiting their effort by solving the main parts of the task in just an acceptable and non-embarrassing way. We were wrong. The students took the task with its time restriction as challenge, accepted an extremely stressful time and delivered impressing results. In the open fields of the questionnaire most of the students stated explicitly that they had much fun and found the experiment very exciting.

Given this experience we gave the issue of motivation explicit attention in our second experiment. There we found exactly the same phenomenon of very motivated and partly even over-motivated participants once they started working on the tasks. Some

seniors of the participants saw a need to intervene and ordered them to spend less time and energy in the ad-hoc-task. Even the participants themselves were surprised about "the enthusiasm of some people" and "the very very high team motivation". This observation is even more astonishing as there were a number of fun killing conditions as slow and buggy software, very heavy workload, parallel note taking for evaluation, intruding leisure time and private sphere.

In a questionnaire, we asked the participants "How much fun was it for you to participate?" On a Lickert scale from 0 to 4 the average was 2.8, which seems moderate, but actually is amazing considering the contrarious conditions. Data gives clear evidence that team 1 and 2 (acquainted teams) were by far more motivated than team 3 (less acquainted) and 4 (not acquainted). The participants of team 1 and 2 rated the question of how much fun they had in average with 3.3. We suppose, the degree of acquaintance before the ad-hoc-task is critical for the performance (both teams were considered as winners) and the motivation. The questionnaire contained further questions about how much various factors contributed to fun. The highest rating got the answer "Working with your group members" (3.4[23]/3.6[24]), followed by "The tasks themselves" (3.0/3.1) and "Experiencing the nature of a typical ad-hoc-task" (2.8/3.3). The participants liked the game-like design of the task (2.5/3.0), but did not grade it as joyful as the factors mentioned before. The "competition with the other teams" as factor of fun was even rated lower (2.3/2.9), which does not perfectly reflect the observation of the communication among team members. Especially among the teams 1 and 2 the will to win the competition was mentioned several times. The least contribution to motivation was given by the usage of mobile technology (2.2/2.9). In the last question there was a high variance of people, who liked very much dealing with mobile technology and others, who did not enjoy it at all. One participant confirmed explicitly the suggestion of [Sarker&Wells 2003] that the higher level of freedom was motivating. He stated about other factors that had increased fun: "The possibility to work freely depending on how much time I could spend on the task."

Another part of the questionnaire was about motivation[25]. We asked, "How motivated were you initially to participate?" which was rated quite high (3.0/3.3). Next we asked how much various factors contributed to motivation. The two highest ratings dealt with the group dynamics in the ad-hoc-task. Highest (3.4/3.4) was "the social pressure, not to let the group down". Second highest (2.9/3.7) was "the level of motivation of your group members". At first view both ratings are not astonishing, because we know about the motivational power of teamwork. But those teams were spread among countries and were supposed to have little awareness of each other. Normally they would not be able to infect each other with motivation. In the ad-hoc-task with mobile support, they obviously did and even to a very high degree. Especially within team 1 and 2 there was a very frequent exchange and a good awareness of the others' situation. The importance of mutual awareness was affirmed by all participants (3.2/3.4) with a very low variance (0.7). Other factors for motivation were rated lower as there were "Contributing to make the success of MOBIlearn visible" (2.7/3.3), "The competition" (2.2/2.9),

[23] First value in brackets reflects the average rating for all participants

[24] Second value in brackets reflects the average of teams 1 and 2 only, because they are even more significant than the average of all teams.

[25] The participants were not given a clear distinction between fun and motivation, so the answers may as well not be distinct.

"Excitement about the tasks" (2.0/2.4), "The phones as prize for the winners" (0.8/1.1), and "Extrinsic motivation (e.g. order from your boss)" (0.6/0.4).

5 Lessons Learned

As conclusion we suggest to see ad-hoc-tasks in first place as an extremely motivating setting to evaluate (assessment) and train (education) a vast variety of methodical and social skills. Observing the trends towards more team work, higher mobility, convergence of work and leisure time and higher flexibility [Webster 1992], we assume that in future there will be a rising need for technological solutions and personal skills to deal with ad-hoc-tasks efficiently. Ad-hoc-tasks interfere heavily with every day's routine and thus cause a high stress level. Simple ad-hoc-tasks can today be scraped through by small, distributed, and acquainted teams which are provided with some minimum mobile technology. More complex tasks need more potent tools, devices, and networks. Anyway, naive estimation of effort needed is usually highly mistaken. The lack of natural intuition for distributed, mobile tasks paired with a lack of any coordinated process rises the complexity of an ad-hoc-task by factors. But teams can improve their general ad-hoc-task-performance by training them. With training, acquainted teams start to establish prior socialisation and thus reduce complexity. The prior level of familiarity between team members is crucial for the team's performance in solving ad-hoc-tasks and getting trained. We do not know yet about the critical factors for large groups solving ad-hoc-tasks.

References

Belotti, Bly (1996): Walking Away from the Desktop Computer: Distributed Collaboration and Mobility in a Product Design Team, CSCW 96.

Bentley, R.; Appelt, W.; Busbach, U.; Hinrichs, E.; Kerr, D; Sikkel, K.; Trevor, J.; Woetzel, G. (1997): Basic Support for Cooperative Work on the World Wide Web, in: International Journal of Human Computer Studies: Special issue on Novel Applications of the WWW, Academic Press, Cambridge.

Bostrom, Robert; Clawson, Vikki; Anson, Robert (1991): Training people to facilitate electronic environments. Working paper, Department of Management, University of Georgia, Athens, Hershey, PA, USA.

Bostrom, Robert; Anson, Robert; Clawson, Vikki (1993): Group facilitation and group support systems, in: Macmillan, editor, Group Support Systems: New Perspectives, pp. 146–148, Jessup, L. M.; Valacich J. S., New York.

Chang, Michelle (2003): Introducing Mobile Ad hoc Collaboration In Restaurants, Working paper. Available at http://www.csdl.tamu.edu/~mchang/cscw.html.

Esbjörnsson, M.; Östergren, M. (2002): Issues of Spontaneous Collaboration and Mobility, in: Spontanetiy'02, workshop proceedings on Supporting Spontaneous Interaction in Ubiquitous Computing Settings, at UBICOMP'02.

Griswold, William G. ; Shanahan, Patricia ; Brown, Steven W. ; Boyer, Robert S. ; Ratto, Matt ; Shapiro, Benjamin R. ; Truong, Tan M. (2004): Active-Campus: Experiments in Community-Oriented Ubiquitous Computing. In: IEEE Computer, Volume 37, Number 10, pp. 73-81,

Ishii, Hiroshi; Kobayashi, Minoru (1992): ClearBoard: A Seamless Medium for Shared Drawing and Conversation with Eye Contact, in: Proceedings of the CHI (May 3-7 1992), pp 525-532.

Löber, A.; Grimm, S.; Schwabe, G. (2006): Audio vs Chat: Can media speed explain the differences in Productivity? Submission to the European Conference of Information Systems 2006.

Löber, A.; Schwabe, G.; Grimm, S. (2006): Audio vs. Chat: The Effects of Task Type and Group Size on Media Choice. Submitted to CSCW 2006.

Luff, P.; Heath, C. (1998): Mobility in Collaboration, in: Proceedings of the 1998 ACM conference on Computer supported cooperative work, Seattle, 1998, pp. 305 - 314.

Lundin, J.; Magnusson, M. (2003): Collaborative learning in mobile work, in: Journal of Computer Assisted Learning Volume 19, Issue 3, pp. 273-283.

McQuaid, Michael J.; Briggs, Robert O.; Gillman, Duffy; Hauck, Rosie; Lin, Chienting; Mittleman, Daniel D.; Nunamaker, Jay F. Jr.; Ramsey, Marshall; Romano, Nicholas (2000): Tools for Distributed Facilitation, in: Proceedings of the 33rd Hawaii International Conference on System Sciences 2000

Nardi, B.; Whittaker, S. (2002): The role of face-to-face communication in distributed work, in: Hinds, P.; Kiesler, S.: Distributed Work, pp. 83–112. MIT Press, Cambridge, MA.

Nunamaker, J.F:, Dennis, A.R., Valacich, J.S., Vogel, D.R., George, J.F. (1991): Electronic meeting systems to support group work, in: Communications of the ACM, Volume 34, Number 7, pp. 40-61.

Pinelle, D. (2004): Improving Groupware Design for Loosely Coupled Groups, Doctoral thesis, Department of Computer Science, University of Saskatchewan.

Prinz, W. (2001): Awareness, in: Schwabe, G.; Streitz, N.; Unland, R. (Hrsg:): CSCW-Kompendium – Lehr- und Handbuch zur computerunterstützten Gruppenarbeit, Springer, Heidelberg et al.

Sacher, Heiko; Loudon, G. (2002): Uncovering the new wireless interaction paradigm, in: Interactions, Volume 9, Number 1, pp.17-23.

Sarker, S; Wells, J. (2003): Understanding mobile handheld device use and adoption, in: Communications of the ACM Volume 46, Number 12, pp. 35-40.

Schwabe, Gerhard (1995): Objekte der Gruppenarbeit - ein Konzept für das Computer Aided Team, Gabler, Wiesbaden 1995.

Schwabe, Gerhard (2004): Medienwahl. In: Haake, J., Schwabe, G.; Wessner, M.: CSCL-Kompendium, Oldenbourg, München et al.

Schwabe, Gerhard; Frohberg, Dirk (2004): Mlearning - Kooperatives Lernen im Kontext, in: WISU - das Wirtschaftsstudium, Volume 8-9, pp. 1071–1077.

Schwabe, Gerhard; Frohberg, Dirk (2006): Facilitating mobile groups - experiences and requirements, Accepted for Group Decision and Negotiation 2006.

Shibata, H.; Hori, K. (2002): A system to support long-term creative thinking in daily life and its evaluation in: Fourth conference on Creativity & Cognition, (Loughborough, UK), ACM Press, pp.142-149.

Taylor, J.; McAndrew, P.; Murelli, E.; Brugnoli, M.; Frohberg, D.; Clow, D.; Brasher, A.; Lonsdale, P. (2005): D11.2 - Evaluation of the MOBIlearn Final System MOBIlearn, Technical report of MOBIlearn IST-2001-37187.

Vänskä, Riitta (2004): Meeting with Nokia Representative during regular MOBIlearn meeting.

Wang, Alf Inge; Sørensen, Carl-Fredrik; Fossum, Thomas (2005): Mobile Peer-to-Peer Technology used to Promote Spontaneous Collaboration, in: The 2005 International Symposium on Collaborative Technologies and Systems (CTS 2005) in conjunction with ICSE'05, St Louis, Missouri, USA, May 15-19.

Webster, Jane (1992). Group spontaneity, in: SIGCPR '92: Proceedings of the 1992 ACM SIGCPR conference on Computer personnel research , pp. 259-267, ACM Press, New York, USA.

Whittaker, S.; Frohlich, D.; Daly-Jones, O. (1994): Informal Workplace Communication: What is it like and how might we support it? in: Proceedings of the CHI94 Conference, pp. 131–137. ACM Press, New York.

Classification of Collaborative Working Environments in Organizations

Katarina Stanoevska-Slabeva[1] and Roman Hoegg[2]

[1] University of St. Gallen, mcm institute
Katarina.Stanoevska@unisg.ch

[2] University of St. Gallen, mcm institute
Roman.Hoegg@unisg.ch

Abstract

This paper presents a taxonomy for collaborative working environments (CWEs). It describes a matrix consisting of two axes: "level of human interaction" and "collaboration context" of different CWEs. Based on twelve brief cases, it illustrates the different categories of CWEs and elaborates on potential implications.

1 Introduction

In the era of global connectivity and networked economy, organizations are transforming towards networked organizations [Easton 1992] [Hamel/Prahalad 1994], [Gulati/Nohria/Zaheer 2000] [Sydow 1992] [Alt and Oesterle 2004] with complex relationships to suppliers, customers and other stakeholders. As a result, there is a growing need for efficient support of collaboration and coordination of various collaborative work processes within and between companies. Companies are increasingly adopting and applying collaborative, networked environments (CWEs) to efficiently support cooperation, collaboration and "…*to tap into the knowledge and expertise of their employees, customers and business partners*" [Fontaine et al. 2004].

The development of support for collaboration has a long tradition and dates back to the 1980s when research areas as "Group Support Systems (GSS)" [Nunamaker et al. 1997] and "Computer Supported Collaborative Work (CSCW)" emerged. At the beginning research concentrated in developing various group-oriented communication systems as messaging and video conferencing with the aim to help cooperating actors to overcome physical distance [Schmidt 2000]. In a second step systems focusing on collaboration and coordination of tasks, sharing of common information spaces within collaborative organizational structures as teams and groups were developed [Bannon and Schmidt 1989]. Examples of systems resulting from the second phase are CSCW systems as the well-known "Basic Support for Collaborative Work (BSCW) system [Bentley et al. 1997], which provides online support for dislocated project teams. Another type of collaborative systems are workflow systems, which support more structured processes. The resulting great number of systems have been classified according to

the place/time classification structure [Roden 1988], [Bafoutsou and Metzas 2002] (c.f. 1):

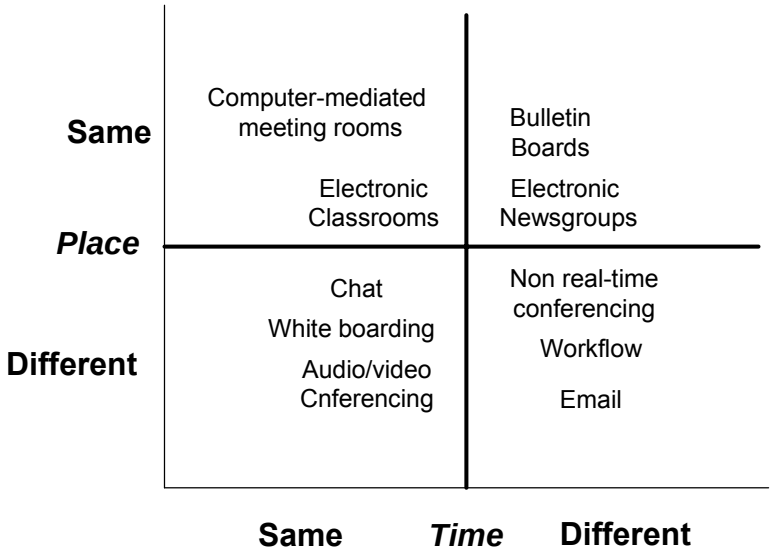


Figure 1: Time/Place classification of collaboration systems [Bfoutsou and Mentzas 2002].

The prevailing classification according to time and place has several limitations and is not sufficient for requirements engineering. It is on the one hand focused on already available information systems. On the other hand it does not reflect neither the diversity of emerging and established collaborative work settings nor the increasing number of different kind of participants in collaborative setting in networked organizations. It also ignores the manifest trend of increasing automation of work processes based on emerging technologies (for example based on Remote Frequency Identification (RFID) [Fleisch 2001]) and the extension and augmentation of work environments into more peripheral and stakeholder-oriented realms of an organization. In this paper a new classification structure is proposed, which tries to mirror the new collaborative settings and their requirements.

The classification structure was developed within the research Study "Sustainable Value Creation in Networked Working Environments (n4V)", supported by the European Commission. The aim of the study was to develop a roadmap for research in the area of Networked Working Environments based on a systematic classification of CWEs and the analysis of their actual and future impacts.

In this paper the proposed classification will be described in detail and illustrated with cases. The content of the paper is structured as follows: In section 2 the research approach is described and the stepwise creation and validation of the classification structure. In section 3 the classification structure is illustrated by cases of collaborative environments. Section 4 concludes the paper with a summary and outlook

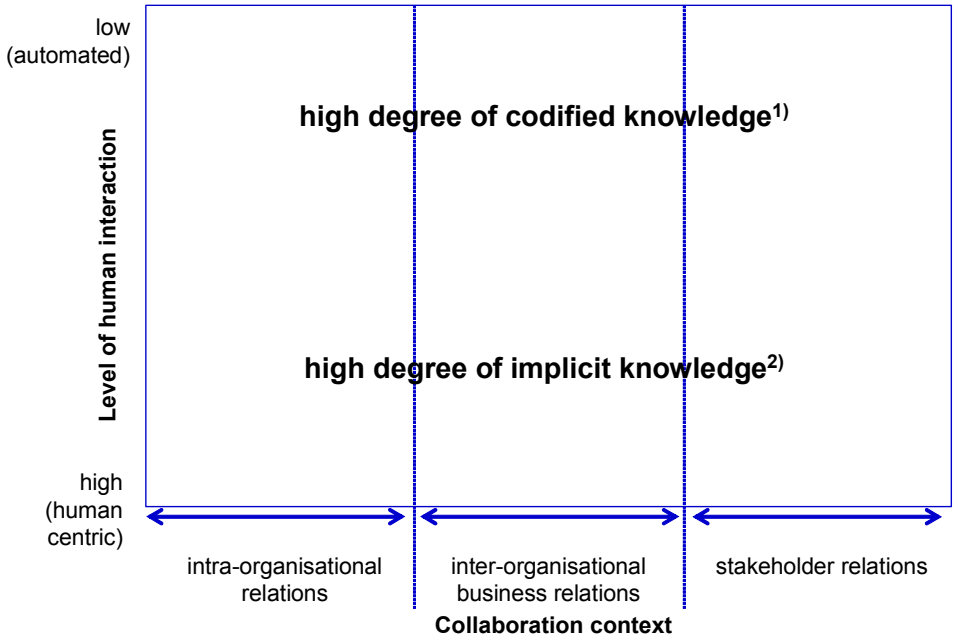
2 Research Approach

The classification was developed in two steps: The first step was based on two activities: an extensive literature study of collaborative working environments and published case studies of collaboration and cooperation support in organizations. In addition find-

ings of own case studies of collaborative working environments in particular mobile work have been analyzed and consolidated [Vartiainen 2005], [Schaffers at al. 2005].

The literature review revealed that collaborative working environments are considered from different perspectives. As already mentioned above one broad research area is related to information systems supporting collaborative work (GSS and CSCW) [Rodden 1988]. Another research direction considers the impact and changes in the work environments for employees [e.g. Jarvenpaa/Ives 1994; Davidow/Malone 1993]. Another research are considers eWork and mobile work environments [Reichwald et al. 2000]. The growing technological capabilities steered a discussion on further aspects of mobility, including virtual mobility [Vartiainen 2005], operational and interactional mobility [Kakihara/Sørensen 2004]. Consequently, the aspect of networking/collaboration grew more important [Luff/Heath 1998].

Furthermore, typical collaboration settings that have been researched are on the one hand knowledge-centered collaboration environments as for example in research and development [e.g. Arundel/Bordoy 2002; Birkinshaw 2002] and process-oriented collaboration settings, which are prevailing in the operational part of a company [Christopher 1998]. In addition, parallel to transformation of organizations to networked organizations increasingly collaboration settings that spread over the boundaries of companies have been considered (see for example [Fontaine at al. 2004]).



1) Knowledge that can be externalised from its source and stored as information, made available to thirds.
2) Highly complex knowledge tightly connected to its source.

Fig. 2: The initial classification of collaborative environments based on level of human interaction and collaboration context

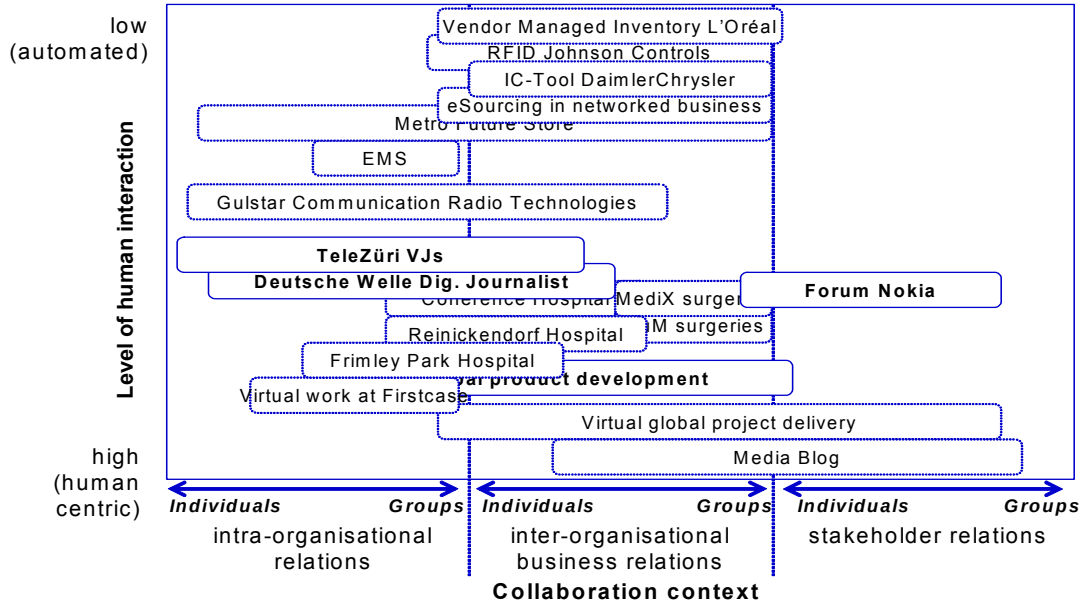
Based on the results of the research conducted in the first step, a new classification structure was developed, which considers on the one hand the knowledge and process oriented view and on the other hand the organizational context of collaboration. The taxonomy is depicted in figure 2. The matrix shows the level of human interaction on the y-axis and the collaboration context of CWEs on the x-axis.

The level of human interaction (y-axis) describes whether a CWE is human centric (i.e. displays high degrees of human interaction) and primarily deals with implicit knowledge or whether it is highly automated (i.e. displays low degrees of human interaction) and focuses on codified knowledge and work processes.

The collaboration context (x-axis) shows whether a CWE is placed within organizational boundaries or whether it goes beyond organizational boundaries, involving external partners and stakeholders and including them into the work process. Thus, the dimension is split into three segments: Intra-organizational relations, inter-organizational business relations and relations to stakeholder to whom no direct business relation exists. Examples of such stakeholders are government authorities, NGOs and similar.

In a next step in-depth case studies have been performed for specific collaborative environments identified in the taxonomy, in order to verify the proposed classification. The second step revealed that cooperation and communication support can be designed in order to enhance the coordination and cooperation abilities of an individual and of groups and teams. For example wearable computing [Nicolai et al. 2005] results in many systems enabling communication support of individuals and enables their participation in remote and networked formal or informal as well as physical or virtual cooperation.

Based on these results, the three organizational contexts of collaboration (x-axis of the framework) can be further classified according to the number of core participants in the networked environment. Each sub-context differentiates if a collaborative technology focuses on the support for collaboration of individuals or groups within organizations. Similar definitions have been used to describe e-Work settings [Huws/ O'Regan 2001; Hanhike/Gareis 2004]. For simplification purposes the differentiation is set between collaboration with an individual partner (company or actual individual person) and collaboration with a group (which can either be a closed circle or a completely public and open collaboration). The more detailed classification is presented in figure 3, which also provides an overview of analyzed cases of CWEs.



1) In-depth cases shown in blue-lined boxes – literature based cases shown in light blue-lined boxes.

Fig. 3: Detailed classification framework with representative cases.

In the next section each element of the proposed classification will be illustrated through one case.

3 Taxonomy of Collaborative Working Environments

This section introduces selected cases of networked working based on the study of extant literature. The taxonomy is then populated with the cases. For this purpose each case is numbered and the number is depicted in figure 4. We aim to show that the taxonomy allows for clusters to be built which describe typical instantiations of working environments and provide insights on CWE's implications for practitioners and researchers.

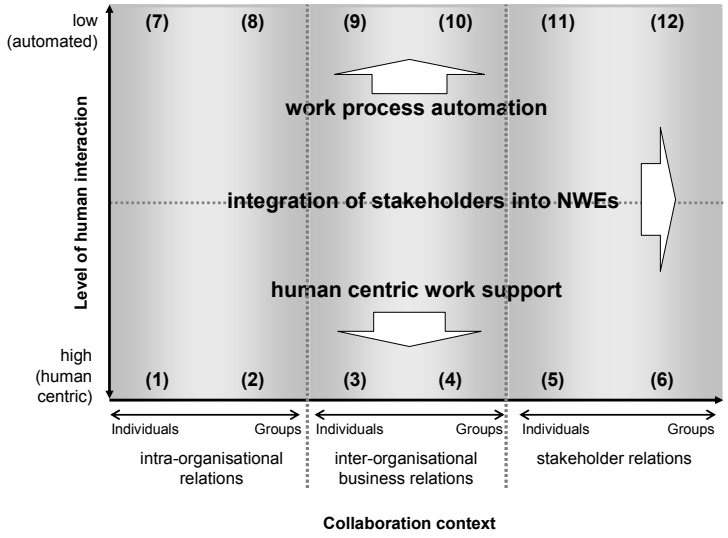


Figure 4: Selected cases

As demonstrated in the previous section, typical examples for all sectors of the taxonomy matrix can be identified.

3.1 Aerospace engineer supported by wearable computer systems (Case 1)

The term wearable computing describes a movement in hard- and software engineering towards a seamless integration of computing power and software applications into clothes and fashion accessories. In business contexts, the main objective is to support complex work processes without limiting a worker in its physical moves and actions. One case example is the use of wearable computing equipment for aerospace maintenance engineers. The engineers, while controlling and repairing airplanes need to use their hands for the repairs and for example need to be able to reach engines without being bound to a computer at a fixed location. As such, this case represents individual support in an intra-organizational setting. The work environment is networked in so far as the individual engineer is connected to a central database. The provisioning of knowledge at the right time and the right place and the reduction of physical limitations by computer equipment are in the foreground of the human centric work environment design. The level of human interaction is high and the work process is highly knowledge dependent [Nicolai et al. 2005].

3.2 Mobile sales force solutions (Case 2)

Mobile sales force solutions are used to support sales representatives in their daily routines of meeting customers, presenting products and closing deals as well as taking orders. The sales representatives usually use PDAs or tablet-PCs as a device. Wireless or fixed line connectivity is used to synchronize the devices with the central customer and product data base [Frost & Sullivan 2004]. The data-sets can be personalized to individuals or groups of sales people. Certain solutions provide the sales personnel with contextual data such as location-specific information about (potential) clients [refer to Schaffers et al. 2005]. Hence, mobile sales force support groups or individuals within one organization to conduct their business more efficiently. The level of human interaction is high in sales relationships and the work process is highly knowledge dependent.

3.3 Freelance graphic designer (Case 3)

Freelance graphic designers operate as self-employed businesses. They work for several clients at the same time or in tight sequence. Usually, they belong to a lose network of friendly designers, who might share common rooms for their work or help each other with contacts and knowledge sharing. Their work is strongly computer-based and deliverables can be 100% digitally delivered. The work environment of freelance designers changed in so far as ICT support them in operating their business from remote (cheap) locations and having strong remote interactions with clients which in certain cases leads to the fact that work is accomplished without any physical client meeting [refer to Kakihara/Sørensen 2004].

This work environment describes a case of individual inter-organizational collaboration which is highly knowledge driven, requiring high levels of human interactions.

3.4 Automotive CAD interface for product development (Case 4)

Product development processes (e.g. in the automotive industry) are highly complex in terms of the components to be developed, the engineering and design skills required and by the fact, that teams are often geographically dispersed. These determinants require a strong ICT-infrastructure to support collaboration and the exchange of complex information. Design and Computer Aided Engineering (CAE) solutions support intra- and inter-organizational teams and individuals in pursuing their tasks. Key components of a collaborative CAE-solution are (1) a common engineering database, (2) tools and environments for remote collaborative sessions regarding common examination of hypotheses and modifications and (3) the possibility to choose the best adequate environment (from the desktop to the virtual room) [Fernando et al. 2003]. The work environment is inter-organizational, integrates entire groups of participants and is highly knowledge centric.

3.5 Forum Nokia (Case 5)

Forum Nokia is - with more than two million individual developers - the world's largest application developer platform for mobile applications. It is separated the two levels "Forum Nokia", an open and free to the public forum and "Forum Nokia PRO", a fee-based membership developer community. By offering technical development guidelines as well as marketing and sales support, Nokia orchestrates the decentralized development activities to increase the number of mobile applications available in the market [Forum Nokia 2005].

3.6 Health expert circles (Case 6)

Health expert circles are platforms initiated by the pharma and healthcare industry to pool experts and their knowledge. Various companies have set up such platforms, e.g. Pfizer [Pfizer 2005], Sanofi [Sanofi 2005] or Wyeth [Wyeth 2005]. The key component of these circles is a web-platform used for information purposes, offering certain community features and a knowledge repository. The platform is initiated by a core organization which invites experts to participate in the platform. In a variation the wider public can be invited to either actively participate or consume the information generated on the platform.

The circle can be used for communication purposes (e.g. public relations, product promotion) or the stakeholder involvement can be used as a tool for idea generation for new products (co-creation strategies) [Sawnhey/Prandelli 2000]. As such, online communities are an extension of companies' core marketing and development activities and impact working environments like corporate communication specialists, product engineers and marketing planners. Online community managers can actually evolve as a new job description requiring an integrated set of skills. The work environment is stakeholder related, integrates entire groups of participants and is highly knowledge centric.

3.7 Self check-out (Case 7)

To test customer acceptance the supermarket chain Spar Austria installed two self-scanning check-outs in their store in Mattinghofen near Salzburg. Instead of having a cashier the customers take their purchases out of their trolleys, scan and pack them. Afterwards they pay for the goods at a machine either by cash or by card. The company states that there will remain human assistance at the check-out. However, it has to be stated that the traditional tasks of cashiers have been taken over by the machine. It is a working environment which focuses on a single employee, is intra-organizational and the check-out process was automated in a way that it was possible to have the customers to do it on their own [SPAR Österreich 2005].

3.8 eLearning (Case 8)

"envol" is the official eLearning teaching material for French at schools in several Swiss cantons. It uses computer technology to allow the students to do self-assessments as well as teaching correct pronunciations by playing recordings of native speakers. Teachers are still needed but with the advancements of eLearning their job profile may be transformed radically. Many repetitive tasks (such as training the correct pronunciation) are taken over by computer programs. The NWE (for the teachers) is intra-organizational, integrates entire groups of participants (students) and is highly automated [envol 2005].

3.9 Industry supply chains (Case 9)

DaimlerChrysler established the Internet-based Information Control Tool (IC-Tool) for the production of their cars. Each supplier knows the gross requirements, assets and capacities in the entire supply chain and can - in the ideal case - deliver his goods just in sequence of the assembly line. The work environment is inter-organizational and highly automated [Corsten/Gabriel 2002].

3.10 Public procurement (Case 10)

simap.ch (Système d'information sur les marchés publics en Suisse) is an association of nearly all Swiss cantons, many big cities as well as the federal government. Its ambition is to establish one single platform for the exchange of information on public procurement. The platform is to promote competition and transparency in the public procurement process, to grant access to all relevant information and to minimize administrative costs. It generates an inter-organizational working environment for groups, automates the processes and therefore reduces the need for human interaction [SIMAP.CH 2005].

3.11 Individualized information from a website (Case 11)

The Swiss federal railways SBB offer individualized time table information on their websites. Through a simple interface queries about travel routes, times and costs can be sent to the web server to be automatically processed. This NWE is highly automated and collaboration takes part with customers as well as non-business partners [SBB 2005].

3.12 Content feeds (Case 12)

DW-WORLD, the online-branch of Deutsche Welle in Germany, offers news feeds of its own content to other websites. Their feed system customizes the content to the individual profiles of their customers and automatically offers the news in different XML formats or HTML. Available topics are politics, business, culture, multimedia or sports. Apart from a webmaster who sets up the system, this service allows its customers to offer news without the need of an own editorial team. This CWE is highly automated and incorporates a potentially open group of stakeholders [Deutsche Welle 2005].

4 Conclusions and Further Research

Generally, three main trends become visible when analyzing the Cues based on the suggested taxonomy:

1. Increasing automation of Working Environments which are based on codified knowledge about processes
2. ICT as a context aware support technology for Working Environments that base on implicit knowledge support
3. Increasing active extension of corporate networks (and the respective work environments) to comprising various groups of stakeholders that are not in a business relation with the company. Examples of such stakeholders are NGOs, consumer organizations, regulatory authorities and similar.

From each of these trends we can identify critical implications for the design of CWEs: (1) CWEs with increased automation tend to a reduced need for human work for highly structured routine activities. On the other hand existing job profiles change profoundly. The tasks require different - typically more advanced - sets of skills as routine work is taken over by machines. (2) CWEs with a strongly human-centric dimension can be seen as augmented working environments as they allow for interactions that would never have been possible before. This allows for greater efficiency but also for new types of bundling of resources. With the advances of ICT and further codification of im-

plicit knowledge they may be automated over time too. (3) Networking technologies and activities allow the active inclusion of non-business partners.

The taxonomy presented in this paper was derived from a broad literature review of collaborative work environments and an analysis of collaborative work in different organizational settings. Afterwards it has been tested on a number of different cases. The cases proved the practicality of the framework to cluster and describe CWEs and their impacts. Further validation is part of ongoing research.

In a next step research will be conducted with respect to identification of critical success factors for the identified different types of collaborative working environments and with respect to development of guidelines for the successful implementation of specific collaborative working environments.

References

Alt R. and Österle H., Real-time Business, Spring, Berlin, Heidelberg, New York 2004.

Arundel A. and Bordoy C., In-House vs. Ex-House: The Sourcing of Knowledge for Innovation. In: Networks, Alliances and Partnerships in the Innovation Process, J. De la Mothe and A. Link (Eds.), Kluwer Academic Publishers, Dordrecht, 2002, pp. 67-90.

Bafoutsou G. and Mentzas G. Review and Functional Classification of Collaborative Systems. In: International Journal of Information Management. Vol. 22 (2002), pp. 281-305.

Bannon L.J. and Schmidt K., CSCW: Four Characters in Search of a Context. In: Proceedings of the First European Conference on Computer Supported Cooperative Work. Gatrwick, London, 13-15 September 1989, pp. 358-372.

Birkinshaw J., Managing Internal R&D Networks in Global Firms: What Sort of Knowledge is Involved? Long Range Planning, 35 (2002), pp. 245-267.

Schaffers, H.; Brodt T.; pallor M.; Prinz W. The Future Workspace - Perspectives on Mobile and Collaborative Writing, Published by Telematica Instituut, The Ntherlands, 2006.

Christopher M., Logistics and Supply Chain Management, London, 1998.

Corsten D. and Gabriel C., Supply Chain Management erfolgreich umsetzen, Springer, Berlin, 2002.

Davidow W. H. and Malone M.S., Das virtuelle Unternehmen. Campus, Frankfurt/Main, 1993.

Deutsche Welle, 2005, http://www.dw-world.de/dw/article/0,1564,306767,00.html

Easton G., Industrial Networks: A Review. In: Industrial Networks: A New View of Reality, B. Axelsson and G. Easton (Eds.), Routledge, London, 1992, pp. 3-27.

envol, 2005, http://www.envol.ch/

Fernando T. et al., A Strategic Roadmanp for Defining Distributed Engineering Workspaces of the Future, European Commission, Brussels, 2003.

Fleisch E., Betriebswirtschaftliche Perspektiven des Ubiquitous Computing, 2001.

Fontaine, M. Parise S.; and Miller D., Collaborative Environments: An Effective Tool for Transforming Business Processes. In: Ivey Business Journal - Improving the Practice of Management. May/June 2004.

Forum Nokia - Developer Resources, 2005, http://www.forum.nokia.com/

Frost & Sullivan, Mobile Sales Force Automation (SFA) Markets, Report # F114-65, Palo Alto,, 2004.

Gulati R., Nohria N. and Zaheer A., Strategic Networks. Strategic Management Journal, 21 (2000).

Hamel G. and Prahalad, C.K. Competing for the future. Harvard Business School Press, 1994.

Hanhike T. and Gareis K., Modelling eWork - Towards a Better Understanding of Information Technology's Impact on Workplaces and Work Locations, 22nd Annual International Labour Process Conference, Amsterdam, 2004.

Jarvenpaa S.L. and Ives B., The Global Network Organization of the Future: Information

Kakihara M. and Sørensen C., Practicing Mobile Professional Work: Tales of Locational, Operational, and Interactional Mobility. INFO: The Journal of Policy, Regulation and Strategy for Telecommunication, Information and Media, 6, 2004, pp. 180-187.

Kärkkäinen M. and Holmström J., Wireless product indentificaiton: enabler for handling efficiency, customisationand information sharing, in Supply Chain Management: An International Journal, 7(4), 2002.

Luff P. and Heath C., Mobility in Collaboration, Proceedings of CSCW'98, ACM Pre, Seattle, 1998.

Management Opportunities and Challenges. Journal of Management Information Systems,, 4, 1994, pp 25-47.

Nicolai T., Sindt T., Kenn H. and Witt H, Case Study of Wearable Computing for Aircraft Maintenance, Proceedings of IFAWC'05, Zürich, 2005, pp. 97-111.

Pfizer, 2005, www.der-gesunde-mann.de

Reichwald R., Möslein K. and Piller F., Taking Stock of Distributed Work: The Past, Present and Future of Telecooperation, Proceedings of the ASAC-IFSAM 2000 Conference, Montreal, 2000.

Rodden T. A Survey of CSCW Systems. In: interacting with Computers 3(3), 1988, pp. 319-353

Sanofi, 2005, www.schilddruese.de

Sawnhey M. and Prandelli E., Beyond Customer Knowledge Management: Customers as Knowledge Co-Creators. In: Knowledge Management and Virtual Organisations, Y. Malhorta (Ed.), Idea Group Publishing, Hershey, PA, USA, 2000, pp. 258-282.

SBB, 2005, http://www.sbb.ch

SIMAP.CH, 2005, http://www.simap.ch

SPAR Österreich, 2005, Premiere im österreichischen Lebensmittelhandel in Mattighofen: SPAR setzt auf Self-Check-Out (Pressrelease), http://www.spar.at

Sydow J., Strategische Netzwerke Evolution und Organisation. Gabler, 1992.

Vartiainen M., Mobile Virtual Work - Concept, Challenges and Scenarios. In: Mobile Virtual Work, J.H.E. Andriessen and M. Vartiainen (Eds.), Springer, London, 2005 (forthcoming).

Generic Community Management Functionality for the Cobricks Community Platform Toolkit

Michael Koch

Technische Universitaet München, Munich, Germany
kochm@in.tum.de

Work in Progress Paper

Abstract

Community management functionality is becoming more and more important in the still growing field of community support platforms. We present a conceptualization of "community management" and a first approach of how generic community management support can be provided in the community platform toolkit Cobricks.

1 Introduction

Community support is becoming more and more important in different application domains like the support of communities of practice for knowledge management or the support of customer communities in marketing. In contrast to the early days of community support in the Usenet these new applications have in common, that management of the communities is desirable or even needed to make the community (or more precisely the community platform) a success. While the discussion of general management issues has been the topic of several publications on community support [e.g. Hagel/Armstrong 1997, Figallo 1998], there has not been much work on how to (generically) support community management.

Cobricks is a toolkit for building (Web- and Web-Service based) community support platforms (see www.cobricks.org). In the context of the development of Cobricks we were faced with the question how generic community management functionality should look like. The first results of this quest are presented in this paper – a conceptualization of "community management" resulting in the identification of some generic areas how community management support functionality could be structured, and a first set of ideas of how this can be integrated in Cobricks.

2 Community Support Platforms and the Cobricks Toolkit

In general a community is a group of people who share some interest, identify with a common idea or more generally belong to a common context. Additionally, community

members usually are cooperating to help each other – by exchanging information, providing general resources etc. [Mynatt et al. 1997; Ishida 1998; Wenger 1998].

The use of networked computers to support communities can be traced back to the beginnings of the Internet. Starting with proprietary communication platforms like Usenet News, the last years have brought an explosion of public and restricted community support platforms that are usually based on Web technologies. Examples are different bulletin boards (forums) or knowledge management applications in companies. Additionally, the hype generated by Hagel and Armstrong [1997] resulted in many companies trying to establish platforms for supporting (and exploiting) customer communities.

The problem still remaining when building community support platforms is that usually the software is programmed particularly for the particular community. There is no generic toolkit for building community support platforms, and there is no interoperability among different community support platforms [Koch 2002].

With Cobricks we have started to address these issues: providing a generic toolkit for building community platforms that provides standard interfaces to other Cobricks platforms and other services for guaranteeing interoperability. Cobricks provides a clear architecture and basic data concepts for users, items and categories that can be extended using ontologies.

Cobricks has been developed for seven years and different (large-scale) community platforms have been built using the toolkit during this years. While some community management functionality can be built for each platform individually using low level functionality in Cobricks, there currently is no particular support for community management in the toolkit.

3 Community Management

Communities differ from teams in not having an organization attached, being mainly based on intrinsic motivation of the community members. This however does not say that communities do not have to be managed – in the contrary.

Reviewing existing work on building communities (like [Hagel/Armstrong 1997, Figallo 1998]) one has to conclude that building communities (community platforms) as technical systems only does not work. Communities involve people (social systems) and cannot be engineered like technical systems. So, everything about community building is about supporting or managing communities.

Management characterizes the process of leading and directing all or part of an organization, often a business, through the deployment and manipulation of resources. One can also think of management functionally, as the action of measuring a quantity on a regular basis and of adjusting some initial plan, and as the actions taken to reach one's intended goal. From this perspective, usually five management functions are identified: ***planning***, ***organizing***, ***leading***, ***coordinating*** and ***controlling***.

We have applied management theory to communities and have derived three basic community management functions that can and should be supported in community support systems [Ljepoja 2005]: ***monitoring, moderation, and motivation***

Monitoring: The main task of monitoring is to capture the basic structural variables of an (online) community to derive appropriate management actions.

Information gathered in monitoring can be interesting both for community administrators and for community members in general. In the latter case one usually talks about “community awareness” [Koch 2005]. Since community management is often implemented as at least partly self-management of the community, the usage of monitoring information to display to all community members cannot be overestimated.

Moderation: The task of a moderator is to keep the interaction in the community in balance with the norms and values of the community. As already mentioned, an important issue in community management is that communities have the potential to self-regulate themselves. Because of this, community platforms often do not need massive external interference - if the members have the tools for doing self-regulation.

The simplest case of moderation is that moderators (especially selected ones or all the members of the community) determine which content should be made available in the community – according to the norms and values or culture of the community. One can distinguish pre-moderation (a contribution has to be approved before it is published), post-moderation (after being published, a contribution can be canceled), both in a centralized or distributed way.

A very extensive example of moderation functionality can be found in the community platform Slashdot.org (see http://slashdot.org/faq/com-mod.shtml).

Motivation: There are various reasons to join a community and to contribute to it. Because of that, there is a wide range of online communities. Common to all of them is that the members have to get added value by joining and contributing to a community. However, this added value can be quite different for different members. Some people help because they received help in the past or they are hoping to receive help in the future (*added value, principle of reciprocity*). Others help because they like to be seen as experts (*appreciation*, see [Hall/Graham 2004, Ludford 2004]).

Visibility is the one thing that can help most for motivation: People who like being seen as experts are more motivated if this status is publicly visible to all members. This is supported by the Top-10-Contributor lists for example. People who hope for help are more likely to read or contribute when they see that the community is active (visualization of inflow and outflow, see (Glance et al. 1998) for an example). Providing awareness of the activity in the community is key to different forms of motivation. This is documented in different works, e.g. by Viegas and Donath who found that increasing social presence results in increasing contribution levels in online communities [Viegas/Donath 1999].

4 Community Management Functionality in Cobricks

Cobricks already provides very generic functionality for handling data that has been contributed by community members. Starting with the general conceptualization presented in the previous section we have extended this functionality to particularly support the different facets of community management.

Monitoring: Functionality for generating and distributing notifications about basic user activities is already available in Cobricks. Currently, this includes only activities on the generic data objects in the platform (generation and reading of items or user attributes). For supporting community management we added the possibility to generate events based on any user actions, and to aggregate events to new ones (for condensing/abstracting the information). This functionality is provided in a new Awareness

Component together with the possibility to store all events in a database. This information can be displayed in different views on the administrator user interface or on the user interface for the all community members.

Motivation: The Awareness Component presented above already provides several possibilities for supporting motivation (by making monitoring information available to all users). Additionally, we added a generic incentive system based on user status points. The system supports generic rules to define how users can earn status points, and provides mechanisms for displaying this information (*motivation by appreciation*) or for basing access permissions and group membership on the number of status points a user has earned (*motivation by added value*).

Moderation: The most generic way to contribute content to a Cobricks platform is the item. In the field of moderation we worked on making a generic hierarchical moderation system available for any kind of item – and therefore for all content classes used in particular instances of Cobricks. The moderation system supports all modes of moderation (pre-moderation, post-moderation, reactive moderation) by generically extending the meta information of items via so called additional moderation items and moderation categories.

Moderators are defined by their membership to the moderation categories, which makes all possibilities of Cobricks to define membership available for defining moderators, including the definition of membership based on user status points.

5 Summary and Outlook

In the past sections we have briefly described our approach to think of and build a generic functionality for community management for the community toolkit Cobricks. We have found that the classification of community management in the three categories monitoring, motivation and moderation helps to think about the domain, and helps to come up with generic functionality for the task.

The functionality presented in the previous section is designed to enable community platform builders to mimic all existing forms of community management and to extend them to their own ones. We are currently making the new functionality available on some of the Cobricks live platforms to get feedback for further development of the conceptualization and of the functionality.

References

Figallo, C. (1998): Hosting Web Communities - Building Relationships, Increasing Customer Loyalty, and Maintaining a Competitive Edge. New York, Wiley.

Glance, N., D. Arregui, and M. Dardenne (1998): Knowledge Pump: Supporting the Flow and Use of Knowledge in Networked Organizations, in Information Technology for Knowledge Management, U.M. Borghoff, R. Pareschi, (eds). 1998, Springer: Berlin.

Hagel, J.; Armstrong, A. (1997): net gain - expanding markets through virtual communities, Harvard Business School Press.

Hall, H.; Graham, D. (2004): Creation and recreating: motivating collaboration to generate knowledge capital in online communities. Intl. Journal of Information Management 24(3): pp. 235-246.

Ishida, T. (1998): Community Computing. John Wiley and Sons.

Koch, M. (2005): Supporting Community Awareness with Public Shared Displays. Proc. Bled Intl. Conf. on Electronic Commerce, Bled, Slowenien, Jun. 2005.

Koch, M. (2002): Requirements for Community Support Systems - Modularization, Integration and Ubiquitous User Interfaces. Journal of Behaviour and Information Technology, 21(5), pp. 327 – 332.

Ljepoja, B. (2005): Community-Management in Cobricks-2. Diploma thesis, Department of Informatics, Technische Universität München, Munich, Germany

Ludford, P. J.; Cosley, D.; Frankowski, D. und Terveen, L. (2004): Think Different: Increasing Online Community Participation Using Uniqueness and Group Dissimilarity. Proc. Conf. on Human Factors in Computing Systems (CHI), Vienna, Austria, ACM Press. pp. 631-638.

Mynatt, E. D.; Adler, A.; Ito, M.; Oday, V. L. (1997): Design for Network Communities. In: Proc. ACM SIGCHI Conf. on Human Factors in Compting Systems.

Viegas, F. B.; Donath, J. (1999): Chat circles. Proc. Conf. on Human Factors in Computing Systems (CHI), ACM Press. pp. 9-16.

Wenger, E.: Communities of Practice: Learning, Meaning and Identity. Cambridge University Press, 1998

Social Adoption Innovation System: an alternative conceptual model for visualising DOI

Grace Ng-Kruelle[1], Paul A. Swatman[1], J. Felix Hampe[2] and Douglas S. Rebne[3]

[1] University of South Australia
graceng-kruelle@web.de, paul.swatman@unisa.edu.au

[2] University of Koblenz-Landau, Germany
hampe@uni-koblenz.de

[2] New York University, USA
dr73@nyu.edu

Abstract

Literature has identified the need to study socially pervasive ICT "in context" in order to understand how user acceptability of innovation varies according to different inputs. This paper contributes to the existing body of knowledge on innovation studies and proposes a methodology – a conceptual model for representing dynamic contextual changes in longitudinal studies. The main purpose of the paper is to enhance confidence in the conceptual model: PoC - Social Innovation Adoption System (part 3 of the paper) and its generality of application through a thorough exploration of the methodological issues associated with the development of the model (part 2 of the paper).

1 Introduction

Users' perceptions of, and intentions to adopt, a ubiquitous information and communication technological (ICT) innovation and the rate of diffusion and penetration of ICT (mainly within and across organisations) are two main focuses of contemporary IS research (Han, 2003). The theoretical models employed to study adoption of ICT innovations have been diverse. They include: the Theory of Reasoned Action (e.g., (Fishbein and Ajzen, 1975), the Technology Acceptance Model (e.g., (Davis, 1989), the Theory of Planned Behavior (e.g., (Ajzen, 1991), the Decomposed Theory of Planned Behaviour (e.g., Taylor and Todd 1995) and, perhaps most importantly, Diffusion of Innovation Theory (e.g., Rogers 1995). These models were applied primarily to explain user (individual) adoption and usage of technologies in limited contexts – i.e. at a specific time, in single usage pattern, or in respect of a well developed product such as the PC. Little emphasis has been placed on understanding the changing context within which users decide to adopt socially pervasive computing technologies such as mobile products and services – for personal and/or professional purposes. In the main, existing re-

search focuses on understanding user adoption of IS by applying the abovementioned theories.

Our project contributes to the existing body of knowledge on innovation studies and proposes a methodology – a conceptual model, for representing dynamic contextual changes in longitudinal studies. The foundation for this methodology is the "Price of Convenience" (PoC) Model (Ng-Kruelle, Swatman, Rebne and Hampe, 2002). As a theory development project, it deals with two related studies of socially pervasive ICT implementation: (1) voluntary adoption of innovations and (2) acceptance of new socially-pervasive and ubiquitous ICT innovations.

This paper, presented as a consolidated report of all POC-related studies, is organised as follow:

- The first section briefly introduces our research focus,
- The second section presents the research methodology adopted. It is based on the principles of grounded theory (Glaser and Strauss, 1967, Orlikowski, 1993). The first phase of the research involved intensive literature review, reflections and discussions, whereas the second phase were more closely directed toward the emerging concepts and themes. The method of an iterative grounded theory, is used in which cycles of researches are created between "theory" and "data" to produce knowledge that enriches the cycle after (Carroll and Swatman, 2000, Ng-Kruelle, Swatman, Rebne and Hampe, 2003).
- The third section briefly summarises the outcome of the POC, the finalised conceptual model: *PoC – Social Innovation Adoption System*, which was first published in (Ng-Kruelle, Swatman, Hampe and Rebne, 2005b) and discussed in (Ng-Kruelle, Swatman, Hampe and Rebne, 2005a).
- Finally in section four, we conclude with a discussion reflecting on the contribution of the research approach taken in the PoC programme to the robustness, generality of applicability and implications of this model.

2 Research Focus

Diffusion of socially pervasive, ubiquitous ICT innovations is very difficult to model and predict due to complexity of the interactions between the innovation and society. The interaction between the object (service or product innovation) and the subject (adopting individual, community or society) may result both in re-conceptualisations of the essential nature of the innovation itself and, indeed, in significant changes in society – which, itself, becomes an agent of change which redefines the birth of new innovations or forces the evolutions of exiting ones. Two examples to illustrate this point are presented below. The first is a classical example of how technology changes Society in terms of learning. It reflects the changes that have already occurred within the society, thus allowing us to observe the ongoing implications. The second reflects an evolving change with no clear implications as yet on the end-user in particular and the society as a whole.

Example 1: The emergence of the Internet and implications on the society - Education

Before the emergence of the Internet, education systems worldwide have been very much focused on the training of students according to fields and subjects that are thought to be useful for their future. This "conservative" approach represents a "just-in-

case" approach to education, offering rather limited flexibility for change. When the Internet began penetrating lives worldwide, it's implications for how individuals and society-at-large study, work and play have been enormous. Today, "just-in-time" learning (often associated with eLearning strategies) is at the core of many education systems. For example, instead of static assignments, students now receive active learner assignments and enrichment materials over the web and to which they respond electronically. These responses become immediate feedback to the instructors concerning the state of the class' progress which offers a real time opportunity for the instructors to adjust the classroom activities to suit the students' needs (Novak and Patterson, 1998). In the professional field, just-in-time learning systems deliver training to workers as to when and where they need it. Rather than sitting through hours of traditional classroom training, users can tap into Web-based tutorials, interactive CD-ROMs and other tools to zero in on just the information they need to solve problems, perform specific tasks or quickly update their skills. Before the WWW, learning systems were structured and information was fed to the participants. With just-in-time and eLearning, information retrieval and the learning process becomes partly the responsibility of the learner. Ironically, the role of instructors becomes even more important. The implementation of just-in-time learning has to be constantly monitored and revised to ensure long-term effectiveness and success.

Example 2: The evolution of mobile services - ePayment

The development and evolution of electronic payment systems (ePayment) since the beginning of the 1990s has been volatile and not very successful. When it was first introduced failures were attributed to the lack of convenience and usability of these systems. Later it proceeded to make use of the interfaces of a mobile phone. However, acceptance among end-users, the financial institutions and the merchants have been low and non-promising (Rader and Riehm, 2000). What appears today to be a possible solution is that the merging of RFID chips with mobile phones, to ease mobile application especially in information retrieval and payment simply by holding their own device close to another one. It was predicted by the ABI Research that within 5 years, 50% of cell phones will include RFID chips to use Near Field Communication (NFC), a two-way technology spearheaded by Nokia, Sony and Philips (Swedberg, 2004). This is sample scenario: While walking down the street, you come across a poster for a movie you want to see. By pointing your phone at the poster, you will be connected to a website, buy the ticket and be charged through the credit card information stored in your smart phone. These transactions can be done without user configuration. In other words, the RFID tag inside the device will automatically connect, via the cellular connection or through NFC-enabled Wi-Fi or Bluetooth to the appropriate Web site so you can learn about the product or service, transfer content such as audio or video files, or carry out a commercial transaction. The first NFC-equipped handsets are expected to hit the market in 2005. The questions remain: is this finally going to be the breakthrough for mobile commerce? Will it play out like SMS, underestimated but later adopted widely in all societies in spite of its application simplicity or will be another flop like ePayment?

Implementing any innovation can be met with varying reactions – a mixture of predictable and unpredictable – from the adopting population. It can be influenced by the channel of communication (e.g. learning and experience), characteristics of the end-user (e.g. culture and demographics), characteristics of the innovation itself (e.g. ease of use, and trialability), and the environment of which the innovation is deployed and implemented (Rogers, 1995). When an innovation is enforced, such as electronic visa,

electronic Passports or smartcard-like devices for enhancing organisational security, even when justified on the basis of more effective management of individual authentication and movement (i.e. immigration), implementation can be a very provocative and emotional issue (Gallivan, 2001). When adoption of an innovation is voluntary in nature, reactions (indeed, prospective user conceptualisations) can be non-uniform, making prediction and extrapolation of acceptance rates hard (Venkatesh, Speier and Morris, 2002) for those marketing the innovation.

The examples above illustrate how unpredictable the acceptance of an innovation can be, and therefore how unpredictable is its diffusion in a system. Because of this element of unpredictability which sometimes makes new product launches seem like a gamble, we seek to focus on the individual end-user as the unit of analysis for our investigation. The conceptual framework underlying our study is that prospective users make a decision to adopt (or adopters make a decision to continue to use) on the basis of a consideration of:

- the benefits perceived to be offered by the innovation
- the costs (in the broadest sense) perceived to be associated with adoption of the innovation

The research programme described in this project focuses on two similar problems:

- voluntary adoption of new socially-pervasive and ubiquitous ICT product or service innovations (eg include mobile phones, location sensitive information services)
- acceptance of new socially-pervasive and ubiquitous ICT product or service innovations (eg eIDcards, eVisa, ePassport)

In line with many social informatics studies (Kling, 1980), our PoC project adopts an interdisciplinary approach to research studying the design, uses and consequences of information technologies, and considers the problems above a multifaceted issue. A multiple viewpoints approach is used is used here for a more robust understanding of the system by taking account its interaction with institutional and cultural context because of:

- The fact that individual decision making that can either be specific or contextual;
- The problem (that is to enhance acceptability and adoption) is complex and can be represented by a multiple connected tapestry of contexts comprising of various social actors (such as the government, the industry, the media and the companies), in addition to legal, political, social, and economic issues;
- The problem itself is again dynamic/non-static in nature, as result of multiple interactions and feedback.

Thus, the problems are studied:

- in situ: i.e. through definition of context or “contextual mining” for relevancy
- Longitudinally: Identification of emergence and transformation of contexts over time
- Qualitatively: To uncover richness in the web of interactions by model ling the research framework as consisting of multiple system actors with different influences.

3 Research methodology

This theory development project deals with two related studies of socially pervasive ICT implementation: (1) voluntary adoption of innovations and (2) acceptance of new socially-pervasive and ubiquitous ICT innovations. The research methodology involved the conduct of two separate but complementary sets of empirical studies to support and extend studies of adoption of innovations. The dynamics of which the innovation occurs are examined and analysed within an interpretive paradigm. We utilised the methods of "Structured case methodology" with adaptation and expansion of the grounded theory approach. We present here the background of grounded theory approach, follow by our research design.

3.1 Methodological Details

We wished to study adoption of innovation in two different settings: voluntary and enforced, and how context affects adoption and acceptance. We thus require knowledge of two selected innovations, different motivations for adoption, and the changing contexts within which the attempted deployment was taking place. The empirical studies we conducted and reported in (Ng-Kruelle et al., 2005b, Ng-Kruelle et al., 2005a, Ng-Kruelle et al., 2003) can be broadly classified as "interpretive case studies" (Walsham, 1995). Existing body of work in the IS literature based on this approach are for example that of (Markus and Lee, 2000, Orlikowski and Baroudi, 1991, Walsham, 1993).

The strategy chosen for investigation is a grounded theory approach as the study is interested in understanding social phenomenon and process. The next section is devoted to a detailed description of the specific approaches we adopted for our research study and the reasons for our choices.

3.2 Grounded Theory

Grounded theory is a qualitative research methodology developed by sociologists (Glaser and Strauss, 1967) and extended later by (Strauss and Corbin, 1998)[26]. Its popularity in IS as a research method is evident by the growing literature either based on the application, the methodology or solely philosophical (Urquhart, 2001, Orlikowski, 1993, Baskerville and Pries-Heje, 1999). Three concepts from Grounded Theory relevant to interpretive IS research are (1) constant comparative analysis – a procedure for identifying conceptual categories and their properties that may be embedded in the data; (2) theoretical sampling by which the conceptual categories are enriched through coding and integration[27]; and (3) theory (Hughes, 2004). (Strauss and Corbin, 1994) maintain that theory consists of

---

[26] Early work in (Glaser & Strauss, 1967) differs from that of (Strauss & Corbin, 1990) in subtle but essential ways. For example, "constant comparative method becomes more event-oriented than group-oriented making the theoretical sampling process more event-oriented than subject-oriented". Importantly, the coding process is more rigorous in the latter version, with the consequence that categories emerge from concepts that develop in the coding process. These differences are important for researchers undertaking action research, which is compatible with the later work in grounded theory, but less so with the earlier work. Baskerville, R. and Pries-Heje, J. (1999) Grounded action research: a method for understanding IT in practice. *Accounting, Management and Information Technologies,* **9** (1)**,** 1-23.

[27] The two procedures lead to the development of a hierarchy of integrated categories and lead to the emerging theory.Hughes, J. (2004) Reflections on the use of Grounded Theory in In-

> "plausible relationships proposed among concepts and sets of concepts... researchers are interested in patterns of action and interaction between and among various types of social units (i.e. actors)... They are also much concerned with discovering process - not necessarily in the sense of stages or phases, but in reciprocal changes in patterns of action/interaction and in relationship with changes of conditions either internal or external to the process itself" (p.274)

Another description by (Dey, 1999):

> "Theory focuses on how individuals interact in relation to the phenomenon under study; it asserts a plausible relation between concepts and sets of concepts; it is derived from data acquired through fieldwork interviews, observations and documents; the resulting theory can be reported in a narrative framework or as a set of propositions" (p. 1-2)

Thus, grounded theory is a research method that seeks to develop theory that is grounded in data systematically gathered and analyzed. According to (Martin and Turner, 1986), grounded theory is "an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data." The major difference between grounded theory and other methods is its "specific approach to theory development - grounded theory suggests that there should be a continuous interplay between data collection and analysis" (Myers, 1997). This approach is becoming increasingly common in the IS research literature because the method is found to be useful in developing context-based, process-oriented descriptions and explanations of the phenomenon (Orlikowski, 1993).

(Jones and Hughes, 2004) summarised the use of grounded theory in interpretive research and provided a sample of IS literature where the method was used. (Jones and Hughes, 2004), from their literature review, found inconsistencies in both the understanding of the method and the application of the method. One argument is that grounded theory is found appropriate for addressing certain kinds of research questions or at certain stages of the research process. Some researchers are found to change the method to suit the purpose of the research (Fitzgerald, 1997). The underlying assumptions ranges from qualitative-interpretive (Howcroft, 1998) to qualitative-positivist (Galal, 2001). Grounded Theory has been used as a complementary method (Orlikowski, 1993, Toraskar, 1991) as well as on its own (Calloway and Ariav, 1991).

3.3 Theory and research position

Based on the principles of grounded theory (Glaser and Strauss, 1967, Orlikowski, 1993), the first phase of the research involved intensive literature review, reflections and discussions, whereas the second phase were more closely directed toward the emerging concepts and themes. As reported in (Ng-Kruelle et al., 2003), we adopt the method of an iterative grounded theory, in which cycles of researches are created between "theory" and "data" to produce knowledge that enriches the cycle after. (Orton, 1997) has applied this method of iterative grounded theory in the analysis of strategic change processes in loosely coupled systems.

---

trepretive Information Systems Research. *Electronic Journal of Business Research Methods,* **7** (1).

The concept of iterations have been similarly covered by (Kock, McQueen and Scott, 1997), applied to the research method of “action research (AR)”, know also as participatory research, collaborative inquiry, emancipatory research, action learning, and contextual action research. In AR, ‘‘action’’ and ‘‘research’’ are combined into a structured process usually referred to as the AR cycle, of which variations exist (See for example (McKay and Marshall, 2001) that challenged the one cycle view of AR by (Checkland, 1981, Cronholm and Goldkuhl, 2004). The most widely accepted view of the AR cycle that comprises of five stages: diagnosing, action planning, action taking, evaluating, and specifying learning, is that provided by (Susman and Evered, 1978). This is believed to be a seminal article that laid the foundations of modern organizational AR (Kock, 2004). AR has been more prevalent in applied fields such as organization development (Kock, 2004) and education (Myers, 1997) than in information systems, apart from the few exceptions such as the works of (Checkland, 1981). (See also for example (Baskerville and Myers, 2004)’s Special Issue on Action Research in MIS Quarterly, 2004) and (Henfridsson and Lindgren, 2005)’s grounded action research study on multi-contextuality within an ubiquitous computing environment.

On our research position: we take a continuum of research positions from the role of an "independent observer". Unlike in an AR, where it has a “dual goal of both improving the organization participating in the research project, usually referred to as ‘‘client organization’’, and at the same time generating academic knowledge” (Kock, 2004) and that “the researcher is expected to apply some form of ‘‘positive’’ intervention—typically as a service to the client organization” (Kock, 2004), we take an independent stance of the SC method.

We designed our study as longitudinal, in that data are collected over a period of time as the events were taking place. This enabled us to gain access to the complex and shifting nature of the context: including actions, reactions, and feedbacks. The theoretical basis of our study evolved over time in response to both our deepening understanding gained through the collection of the field data and our changing ideas resulting from the iterative cycles of research through continuing study of the IS literature in related fields and empirical studies. The identification and development of concepts, themes and issues was achieved by reflection and by frequent discussion between the researchers. Emerging themes were produced at each phase of the study. The first phase consisted of manual seeding and coding, while the second phase consisted of computer aided contextual mining. The empirical details have been covered more extensively in (Ng-Kruelle et al., 2005a, Ng-Kruelle et al., 2005b).

3.4 Research Design: Methodology for Framework Development

The research methodology of the PoC project adopts IS qualitative research methods to reflect the needs of different research activities and phases. It involves desktop research (the internet, academic journals, trade press, etc.), structured and semi-structured elicitation of findings (internet questionnaire), and analysis - both of manual and computer assisted nature. The key part of the PoC project is the ongoing development of theories to explain and understand end-user reactions and responses to the deployment of pervasive ICT, and adoption and acceptability issues in different contexts. As a theoretical development project, it is an ongoing component of the PoC project and is explained in part below.

It appears that although it is appropriate to view the “social systems” domain as pluralist/complex, and that approaches such as multi-view/stakeholder analysis and soft sys-

tems methodology (SSM) may be suitable and compatible techniques to adopt for the investigation, there are shortcomings of using these approaches:

- Neither approach explicitly addresses the role of IT and its impact on the society, and its role within.
- There exists little practical guidance for the elicitation of requirements from the real world stakeholders especially when they consist of loosely inter-related entities that are not legally bonded together in developing mobile commerce viability.

Therefore we will adopt a variety of different research techniques to ensure important requirements of research are met – in deriving results reliability and validity of research data and findings.

3.5 Structured-case methodology

We see structured-case (SC) methodology, introduced by (Carroll and Swatman, 2000) as an "alternative" to AR. Most literature on AR currently assumes that theory evolution and exposition will occur as a natural consequence of problem formulation (Baskerville and Pries-Heje, 1999). In this project, we use the adapt rigorous treatment of the theory-formulation component of AR. In order to improve rigor, we merge some of the techniques of grounded theory (Glaser and Strauss, 1967) with the theory formulation steps similar to that of AR, minus the intervention-participative role of the researcher. The result, we hope, is a "theory-rigorous" and improved SC research method for qualitative-interpretive work.

We apply the SC methodology as a technique for deriving structured understanding of a problem issue within an interpretive paradigm. This methodology is applied for theory building, while being guided by the principles of soft systems. As the name "structured" and "case" imply, it uses a formal process model applied to an area of study (it is applicable not just to a traditional case per se, but in a broader sense, for example, to a process, system, an individual or an organisation). It is built on existing qualitative research work, but has been extended to provide a systematic approach for addressing subjective, vague problems, poorly understood phenomena or even just for knowledge discovery.

The three main components of structured-case are: the conceptual framework, a predefined research cycle (in the order of: planning, data collection, analysis and reflection), and theory building grounded on literature-based scrutiny of research findings. The core contribution of this technique is its iterative nature of building theory from qualitative data, resulting in series of updated conceptual frameworks, displaying a "spiral towards understanding". The multiple iterative approach has been similarly proposed by (Kock et al., 1997) as a method to broaden the research scope and consequently add generality to the research findings, thus bringing research rigour up closer to standards acceptable by positivists and yet preserve the elements that characterise action research as such.

In structured case, there is an ongoing refinement of the initial research questions and constructs, with continuous comparison of data with emerging themes, the literature and of external expertise. By going through a series of refinement, followed by documentation at each cycle, the dynamics of the research area in study and thereof, theory building, can be captured (Carroll and Swatman, 2000). The documentation involved in structured-case will highlight "links between the research themes (in the conceptual

framework), data (observations and interpretations in the field), the data analysis (coding using the concepts in the conceptual framework, and emergent themes) and the theory and knowledge accumulated through the research process the series of conceptual frameworks)" (Carroll and Swatman, 2000).

4 POC: Social adoption innovation system

Understanding how context emerges and transforms is important when a researcher wants to investigate how people react to a situation. The study of "contextualisation" has been applied to multiple areas in various disciplines, including that relating to complex problem solving activities (Augier, Shariq and Vendelo, 2001, Cunningham, 2001), analysis of usability and human-computer interaction (Miettinen, 1997), knowledge creation (Augier et al., 2001), creative work (Augier et al., 2001, Singer, 1998, Roth, 1997), in education (Trautman, Healey and Norris, 2001), society (Miller, Reyes and Shaffer, 1997), health (Hartman, 1991) and even in religion (Whiteman, 1997).

When an individual considers adoption of an innovation, s/he reacts through knowledge and experience to the situation, and as s/he interacts with others in the system, s/he again creates, use and share this knowledge. This is known as an interactive learning process (Meeus, 2001). In order to understand how this occurs, it is therefore necessary to understand the context – and its dynamics. Exactly how the context of innovation adoption and use develops over time and the factors influencing the interplay of the various actors within such a context is not well understood. Attempts, however have been covered rather extensively in the area of collaborative activities such as Computer Assisted Cooperative Work (CSCW) (Miettinen and Hasu, 2002). Our project builds on this existing pool of knowledge by developing an alternative user-context analysis of acceptance of innovation rather than the "network of activity system" used by (Miettinen, 1997) and other research in fields similar to this.

As mentioned before, it is the contextual dynamic, the innovation's acceptance unpredictability, in respect of socially pervasive, ubiquitous ICT innovations, which forms the focus of our project.

We have argued that user perception is "context-dependent" and, consequently. As first introduced in (Ng-Kruelle et al., 2002), and then finally refined and developed into Figure 1, the model is used to structure our analysis of the context within which the user's perceptions of the innovation develop. We see:

- the context developing through the interaction of a range of "actors" – the most important of these being the diffuser of the innovation, the industry sector, various pressure groups (appropriate to the innovation) and the Government
- that interaction being mediated through the mass and professional media (we also see the media, in part, as an independent actor in the context)
- feedback from the (evolving) views of the population (the readership of a newspaper, for example) and the views represented in the media. Consequently, we consider that the media represents a lagging proxy for the attitudes of the population
- feedback between the views expressed in the media and the other actors in the context – leading to modifications of the behaviour of these actors and of the essence and presentation of the innovation itself.

The result of this project is a methodology for representation of a social innovation adoption system with the Price of Convenience (PoC) model at the centre (See Figure 1). The Price of Convenience model (PoC) places the "balancing of costs and conveniences" at the heart of the research framework (Ng-Kruelle et al., 2002). First presented as the PoC model in (Ng-Kruelle et al., 2002) and later developed into the *PoC Social Innovation Adoption System* in (Ng-Kruelle et al., 2005b, Ng-Kruelle et al., 2005a) we demonstrated how PoC can be used is a way of looking at the entire adoption *system* for an arbitrary innovation, from product introduction to consumer and market response (not necessary in this order) through the balancing of *price* (P), in terms of perceived loss of privacy, of its adoption against the *conveniences* (C) of adoption, and perceived impact on collective *security* (S).

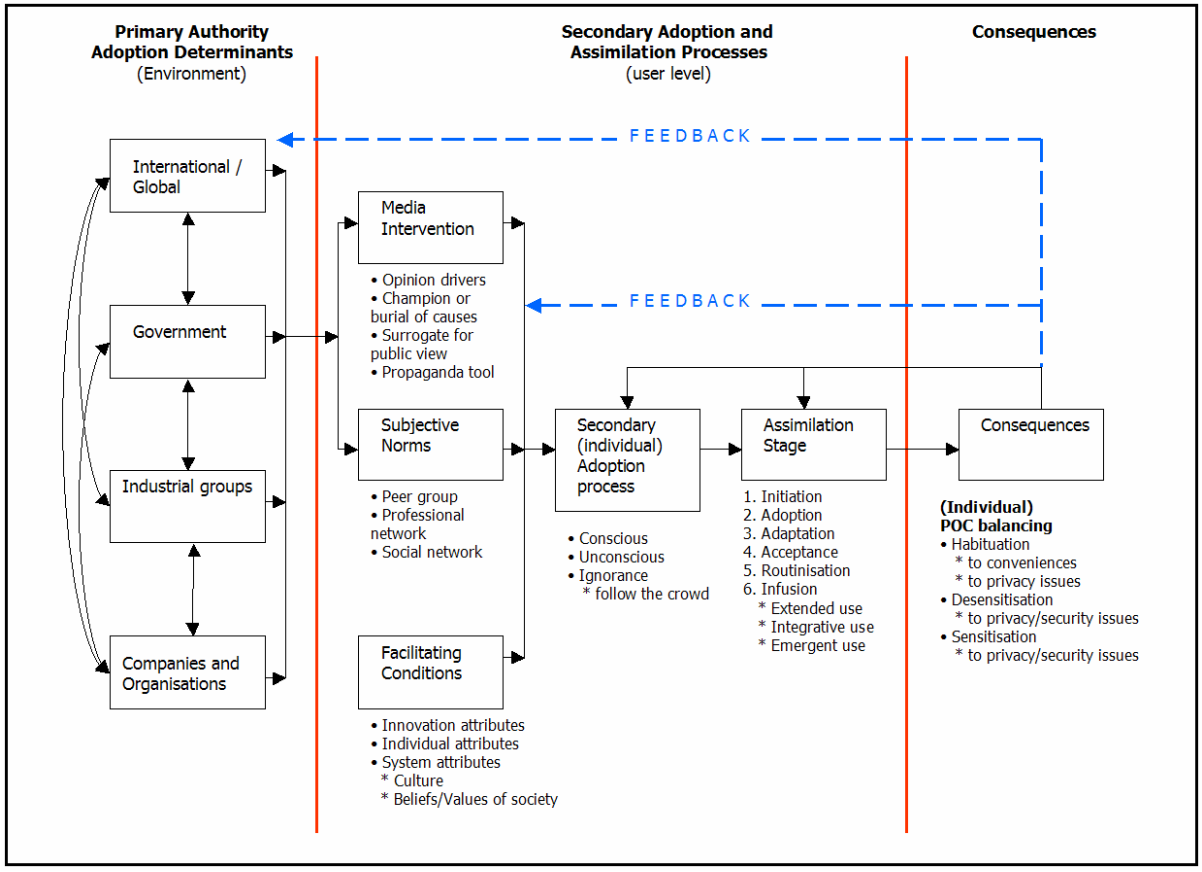


Figure 1: Conceptual and Research Model – PoC Social Innovation Adoption System

The PoC research project is founded on three key assumptions:

- that a common core set of salient beliefs drives behaviour (see, e.g., (Davis, 1989)), suggesting that adopters and non-adopters will simply have different evaluations of the same set of factors,
- that every decision made is context sensitive, depending on the different stage of adoption (see, e.g. Rogers DOI curve (Rogers 1995)),
- and that the attitude is a function of interactions, a consequence of an interactive learning process (see, e.g. (Casas, 2003)).

As future work, it will be used as the Base Model for: exploring alternatives of clustering communities and investigating usable set of applicable characteristics across the EU nation, ultimately leading to identification of a suitable technique to categorise communities with chosen homogeneous characteristics and the social context of which decision-making is based upon. The categorisation would contribute to understanding how to best introduce and install a product/innovation. It will be complemented by a set of theoretical explanations, models and indicators of end-user adoption of innovation.

5 Conclusion

We developed the PoC as an alternative way of looking at the entire adoption system from product introduction to consumer and market response (not necessary in this order) through balancing price, in terms of loss of individual privacy, against the conveniences and enhanced collective security resulting from its adoption. The approach taken is, of course, readily extensible to include other decision making factors.

This project has several novel aspects. The field of study is approached repeatedly, prior to the development of a conceptual framework (Ng-Kruelle et al., 2002) so as to develop a contextual basis to allow for the study to focus on what is relevant in a particular context. We designed our study as longitudinal, in that data are collected over a period of time as the events were taking place. This enabled us to gain access to the complex and shifting nature of the context: including actions, reactions, and feedbacks. In addition, we acquired here the knowledge of two selected innovations, different motivations for adoption, and the changing contexts within which the attempted deployment was taking place. The theoretical basis of our study evolved over time in response to both our deepening understanding gained through the collection of the field data and our changing ideas resulting from the iterative cycles of research through continuing study of the IS literature in related fields and empirical studies.

References

Ajzen, I. (1991) The Theory of Planned Behaviour. *Organizational Behavior and Human Decision Processes,* **50** 179-211.

Augier, M., Shariq, S. Z. and Vendelo, M. T. (2001) Understanding context: its emergence, transformation and role in tacit knowledge sharing. *Journal of Knowledge Management,* **5** (2)**,** 125-136.

Baskerville, R. and Myers, M. D. (2004) Special Issue on Action Research in Information Systems: Making IS Research Relevant to Practice - Foreword. *MIS Quarterly,* **28** (3)**,** 329-335.

Baskerville, R. and Pries-Heje, J. (1999) Grounded action research: a method for understanding IT in practice. *Accounting, Management and Information Technologies,* **9** (1)**,** 1-23.

Calloway, L. J. and Ariav, G. (1991) Developing and Using a Qualitative Methodology to Study Relationships Among Designers and Tools*. In:* (Eds, Nissen, H. E., Klein, H. and Hirschheim, R.) *Information Systems Research: Contemporary Approaches and Emergent Traditions. Proceedings of the IFIP WG 8.2 Working Conference, Copenhagen, 14-16 December.*Amsterdam, North-Holland. 175-193.

Carroll, J. M. and Swatman, P. (2000) Structured-case: a methodological framework for building theory in information systems research. *European Journal of Information Systems,* **9** (4)**,** 235-342.

Casas, R. (2003) *Networks and Interactive Learning Among Academic Institutions, Firms, and Government: Knowledge-Based Social Capital for Local Development*. [online]. Instituto de Investigaciones Sociales. Available from. [Accessed November 3, 2004].

Checkland, P. (1981) *Systems Thinking, Systems Practice.* Chichester, Wiley.

Cronholm, S. and Goldkuhl, G. (2004) Conceptualising Participatory Action Research – Three Different Practices. *Electronic Journal of Business Research Methods,* **1** (2)**,** 47-58.

Cunningham, N. (2001) RISC and reward? A model for the role of information systems in strategic change within healthcare orgainzations. *Organization Development Journal,* **19** (1)**,** 93-108.

Davis, F. D. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly,* 319-340.

Dey, I. (1999) *Grounding Grounded Theory.* CA, Academic Press.

Fishbein, M. and Ajzen, I. (1975) *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Reading MA, Addison-Wesley.

Fitzgerald, B. (1997) The Use of Systems Development Methodologies in Practice: A Field Study. *Information Systems Journal,* **7** (4)**,** 121-132.

Galal, G. H. (2001) From contexts to constructs: the use of grounded theory in operationalising contingent process models. *European Journal of Information Systems,* **10** (1)**,** 2-14.

Gallivan, M. J. (2001) Organizational Adoption and Assimilation of Complex Technological Innovations: Development and Application of a New Framework. *The DATA BASE for Advances in Information Systems,* **32** (3)**,** 51-85.

Glaser, B. and Strauss, A. L. (1967) *The discovery of grounded theory: strategies for qualitative research.* Chicago, Aldine.

Han, S. (2003) *Individual Adoption of IS in Organisations: A Literature Review of the Intention-Based Theories.* Turku, Finland, Turku Centre for Computer Science.

Hartman, A. (1991) Toward a Redefinition and Contextualization of the Abortion Issue. *In Social Work***,** 467-468.

Henfridsson, O. and Lindgren, R. (2005) Multi-contextuality in ubiquitous computing: Investigating the car case through action research. *Information and Organization,* **15** (2)**,** 95-124.

Howcroft, D. A. (1998) Spanning the Spectrum from Utopia to Dystopia: an Interpretive Field Study of the Nature and Characteristics of Internet Usage. In: *PhD Thesis, University of Manchester*. Manchester, UK.

Hughes, J. (2004) Reflections on the use of Grounded Theory in Intrepretive Information Systems Research. *Electronic Journal of Business Research Methods,* **7** (1).

Jones, S. and Hughes, J. (2004) An Exploration of the Use of Grounded Theory as a Research Approach in the Field of IS Evaluation. *Electronic Journal of Business Research Methods,* **7** (1).

Kling, R. (1980) Social Analyses of Computing: Theoretical Perspectives in Recent Empirical Research. *Computing Surveys,* **12** (1)**,** 61-110.

Kock, N. (2004) The three threats of action research: a discussion of methodological antidotes in the context of an information systems study. *Decision Support Systems,* **37** (2)**,** 265-286.

Kock, N. F. J., McQueen, R. J. and Scott, J. L. (1997) Can action research be made more rigorous in a positivist sense? The contribution of an iterative approach. *Journal of Systems and Information Technology,* **1** (1)**,** 1-24.

Markus, M. L. and Lee, A. S. (2000) Special Issue on Intensive Research in Information Systems: Using Qualitative, Interpretive, and Case Methods to Study Information Technology - Third Installment, Foreword. *MIS Quarterly,* **24** (3).

Martin, P. Y. and Turner, B. A. (1986) Grounded Theory and Organizational Research. *The Journal of Applied Behavioral Science,* **22** (2)**,** 141-157.

McKay, J. and Marshall, P. (2001) The dual imperatives of action research. *Information Technology and People,* **14** (1)**,** 46.

Meeus, M. T. H. (2001) Patterns of Interactive Learning in a High-tech Region. *Organisation Studies,* (January).

Miettinen, R. (1997) The Concept of Activity in the Analysis of Hetereogenuous Networks in Innovation Process. In: *Proceedings of the CSTT Workshop "Actor Network and After".*

Miettinen, R. and Hasu, M. (2002) Articulating user needs in collaborative design: Towards an activity-theoretical approach. *Computer Supported Cooperative Work (CSCW),* **11** (1-2)**,** 129-151.

Miller, F., Reyes, X. A. and Shaffer, E. (1997) The contextualization of affirmative action: A historical and political analysis. *The American Behavioral Scientist,* **41** (2)**,** 223-231.

Myers, M. D. (1997) Qualitative Research in Information Systems. *MIS Quarterly,* **21** (2)**,** 241-242.

Ng-Kruelle, G., Swatman, P., Hampe, F. and Rebne, D. (2005a) Biometrics and e-Identity (e-Passport) in the European Union: End-User Acceptability of a Controversial Innovation. In: *Proceedings of the CollECteR (Europe) 2005.* Furtwangen, Germany. June 12-13, 2005.

Ng-Kruelle, G., Swatman, P., Hampe, F. and Rebne, D. (2005b) Biometrics and e-Identity (e-Passport) in the European Union: Overcoming POC-Cultural diversity for

Common Cause? In: *Proceedings of the IADIS International Conference: e-Society 2005.* Qawra, Malta. 27-30 June.

Ng-Kruelle, G., Swatman, P., Rebne, D. and Hampe, F. (2002) The Price of Convenience: Privacy and Mobile Commerce. *Quarterly Journal of Electronic Commerce,* **3** (3)**,** 273-385.

Ng-Kruelle, G., Swatman, P., Rebne, D. and Hampe, F. (2003) The Price of Convenience: Developing a Framework for Analysing Privacy Sensitivity in the Adoption of Wireless Applications. In: *Proceedings of the 16th BLED International Conference on Electronic Commerce.* (Eds, Wigand, R. T., Tan, Y.-H., Gricar, J. e., Pucihar, A. and Lunar, T.) Bled, Slovenia. June 9-11. 480-500.

Novak, G. M. and Patterson, E. T. (1998) Just-in-Time Teaching: Active learner pedagogy with WWW. In: *Proceedings of the IASTED International Conference on Computers and Advanced Technology in Education.* International Association of Science and Technology for Development (IASTED), Cancun, Mexico. May 27-30.

Orlikowski, W. J. (1993) CASE Tools as Organisational Change: Investigating Incremental and Radical Changes in Systems Development. *Management Information Systems Quarterly,* **17** (3)**,** 309-340.

Orlikowski, W. J. and Baroudi, J. J. (1991) Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research,* **2** 1-28.

Orton, J. D. (1997) From inductive to iterative grounded theory: Zipping the gap between process theory and process data. *Scandinavian Journal of Management,* **13** (4)**,** 419-438.

Rader, M. and Riehm, U. (2000) *Editorial: Payments by mobile phone more convenient than e-wallets?* Institute for Prospective Technological Studies (IPTS), Karlsruhe, Germany. October.

Rogers, E. M. (1995) *Diffusion of Innovation.* Harper Collins.

Roth, M. S. (1997) Multiple Contextualizations. *In The Art Bulletin***,** 25-27.

Singer, A. (1998) Beautiful errors: Aesthetics and the art of contextualization. *Boundry 2,* **25** (1)**,** 7-34.

Strauss, A. and Corbin, J. (1994) Grounded theory methodology: an overview. In: Denzin N, Lincoln Y (eds) Handbook of

qualitative research. Sage, Thousand Oaks, CA. *In:* (Eds, Denzin, N. and Lincoln, Y.) *Handbook of qualitative research*Thousand Oaks, CA, Sage Publications.

Strauss, A. and Corbin, J. (1998) *Basics of qualitative research: techniques and procedures for developing grounded theory.* Thousand Oaks, CA, Sage Publications.

Susman, G. I. and Evered, R. D. (1978) An assessment of the scientific merits of action research. *Administrative Science Quarterly,* **23** (4)**,** 582-603.

Swedberg, C. (2004) Developing RFID-Enabled Phones. *RFID Journal: News,* **July**.

Toraskar, K. (1991) How Managerial Users Evaluate Their Decision Support: a Grounded Theory Approach*. In:* (Eds, Nissen, H. E., Klein, H. and Hirschheim, R.) *Information Systems Research: Contemporary Approaches and Emergent Traditions. Proceedings of the IFIP WG 8.2 Working Conference, Copenhagen, 14-16 December.*Amsterdam, North-Holland. 195-225.

Trautman, L. S., Healey, E. C. and Norris, J. A. (2001) The effects of contextualization on fluency in three groups of children. *Journal of Speech, Language and Hearing Research,* **44** (3)**,** 564-576.

Urquhart, C. (2001) An Encounter with Grounded Theory: Tackling the Practical and Philosophical Issues*. In:* (Ed, Trauth, E.) *Qualitative Research in Information Systems: Issues and Trends*London., Idea Group Publishing.

Venkatesh, V., Speier, C. and Morris, M. G. (2002) User acceptance enablers in individual decision making about technology: Toward an integrated model. *Decision Sciences,* **33** (2)**,** 297-316.

Walsham, G. (1993) *Interpreting Information Systems in Organizations.* Chichester, Wiley.

Walsham, G. (1995) Interpretive Case Studies in IS Research: Nature and Method. *European Journal of Information Systems,* **4** (2)**,** 74-81.

Whiteman, D. L. (1997) Contextualization: The theory, the gap, the challenge. *In International Bulletin of Missionary Research***,** 2-7.

Diffusion of Socially Pervasive IT Innovation through the Lens of Cognitive Elaboration and Perceived Behavioural Control

Elitsa Shumarova[1] and Paul Swatman[2]

[1] University of Koblenz-Landau, Germany
shumarova@uni-koblenz.de

[2] University of South Australia, South Australia
paul.swatman@unisa.edu.au

Abstract

This paper explores the mutual influence of Cognitive Elaboration and Perceived Behavioural Control on user acceptance and usage of innovative information technology (IT) applications. Cognitive Elaboration is being theorised as influencer and predictor of IT usage of focal interest and Perceived Behavioural Control is being built upon as a secondary (supporting) epistemic level. We draw on the Elaboration Likelihood Model (Cacioppo and Petty 1986) in order to understand the influence process by which perceptions of innovation attributes are formed. We thereby assume that individual perceptions are a key trigger in the formation of attitude toward IT usage, and that acceptance is fundamentally an informational influence (persuasion) problem. We thus analyse the IT adoption-diffusion continuum, from pre-usage stage to post-adoptive behaviour, within the context of the quality of Cognitive Elaboration, exercised by the adopting subject (organisation or individual group member). The endeavour undertaken ventures on a holistic route of thought by weighing different perspectives on individual and group level, with the emphasis shift from pure instrumentalism toward cross-referential analysis of IT usage moderators.

1 Introduction

Investigations of theories and models of Innovative Technology Uptake (ITU) have found that each has only a narrow perspective which tends to capture "just one part of the story" and only highlights particular areas of interest. No single theory appears uniquely able to explain the circumstances of any particular case (Jones & Myers 2001, p.1018).The nature of pervasive technology uptake is even more complex, and therefore challenging traditional theory of innovation. We believe that the popular question of "why technically inefficient innovations diffuse while technically efficient innovations get rejected" - the phenomena that the traditional, rational theory of innovation diffusion fails to explain adequately (Lee & Collar 2002) - should not be interpreted based on separate ("self-sufficient") predictors, while looking at technology use as the dependent

variable. Instead, analysis should employ cross-referential scrutiny of those individual predictors.

This paper engages in giving initial impulse of theoretical reasoning to serve as a starting point for the long-term task of formulating a theoretical grounding for comparative analysis of Cognitive Elaboration (CE) and Perceived Behavioural Control (PBC). CE is a rather unpopular moderator within IS literature, while PBC is a moderator, constituting a central tenet of traditional ITU theory (for an overview see Venkatesh et al. 2003). The rest of the paper is structured based on: looking at CE and PBC separately (sections 2 and 3 respectively) and investigating their cross-referential influence on IT usage (section 4).

2 Cognitive Elaboration (CE)

As we said earlier, we have assumed (based on, inter alia, Innovation Diffusion Theory - Rogers 1962) that individual perceptions of IT are a key trigger in the formation of attitude toward IT usage, and that acceptance is fundamentally an informational influence (persuasion) problem. In order to understand the "influence-persuasion" process in greater depth, we borrow the construct of CE from psychology. In classical psychological terms CE is being described as comprehension of content in terms of stored beliefs and evaluation of arguments, including processes such as evaluation, recall, critical judgment, and inferential judgment. However, elaboration may not always lead to persuasion. Therefore, we are primarily interested in the quality of cognitive elaboration, which depends on the individual's motivation and ability to process. Against this background, we consider the Elaboration Likelihood Model (ELM) (Cacioppo & Petty 1986) to be a highly relevant theoretical device to aid understanding of the "influence-persuasion" process regarding IT innovation.

2.1 Prior Research

Though ELM has a rich history in social psychology (e.g., Petty et al. 1981) and marketing (e.g., Lord et al. 1995) research, its application in information systems research is just beginning to emerge (Bhattacherjee & Sanford 2004). Three independent studies (Mak et al. 1997, Dijkstra 1999, Sussman & Siegel 2003) have attested to the empirical validity of ELM in IS contexts, though all three studies were conducted within the context of information acceptance rather than technology acceptance.

The first study to apply ELM within the context of technology acceptance, to the best of our knowledge, is Bhattacherjee and Sanford´s (2004) theoretical articulation and empirical test of the role of persuasion strategies on individual IT usage behaviour. The study draws upon the following ELM definitions and axioms:

a.) ELM definitions

- *Elaboration likelihood* is the inherent difference in individual ability and motivation to elaborate.
- *Motivation to process* is typically operationalized as recipients' involvement or perceived relevance of the available information.
- *Ability to process* is typically operationalized as prior expertise or experience.
- *Central route* of persuasive influence - requires a person to think critically about issue-related arguments in an informational message and scrutinize the relative

merits and relevance of those arguments, prior to forming an informed judgment about the target behavior.

- *Peripheral route* of persuasive influence - involves less cognitive effort on the part of the individual, where subjects rely on cues regarding the target behavior (e.g., how many users have previously accepted the system, whether the system is endorsed by IT experts), rather than on the quality of arguments, while forming cognitions about the target behavior.
- *Argument quality* refers to the persuasive strength of arguments embedded in the information content of a message.
- *Peripheral cues* relate to information about the content (meta-data) but not its embedded arguments (e.g., number of messages, number of prior users, source likeability, and source credibility).

b.) ELM axioms

- The two routes process two different types of information: *arguments* (in central route) versus *cues* (in peripheral route).
- Elaboration likelihood moderates the effects of argument quality and peripheral cues on cognition change, as depicted in *Figure 2* (see Appendix).
- When elaboration is high, the central persuasive route is likely to occur; conversely, the peripheral route is the likely result of low elaboration (Cacioppo & Petty 1979, 1986).

Bhattacherjee and Sanford´s (2004) research has resulted in some important findings, which we synthesise and connect with ELM´s (Cacioppo & Petty 1986) detailed graphical representation. Thus we visualise the combined findings of the two research studies. This is depicted by *Figure 1* in the following section.

2.2 Analytical Framework

We introduce the “ELM in IT Usage Context” model, depicted in *Figure 1*, as an interpretation combining the theoretical underpinnings of the ELM (Cacioppo & Petty 1986), and the empirical findings of Bhattacherjee and Sanford´s (2004) study. The aim is to provide visual clarity through the lens of CE as a moderator of IT usage. Some of the core epistemological ELM categories are revisited and assigned ITU-related meaning, as follows:

- Bhattacherjee and Sanford (2004) operationalized the motivation and ability dimensions of elaboration likelihood in IT usage context as job relevance and user expertise respectively - we visualize this in quadrant 2 and 3 of the framework (see *Figure 1*).
- Central route arguments were operationalized as relating to the potential benefits of system usage (e.g., expected cost savings, improved productivity, or better quality decisions), as well as relating to comparison of alternative systems, and system maintenance issues (e.g., availability of support services) - we visualize this (based on Cacioppo & Petty 1986) in quadrant 4, 5 of *Figure 1*.
- The effect of well-articulated issue-relevant arguments on user cognitions was found to be more stable over time than that of peripheral cues such as expert

recommendations - we visually represent this by central attitude change (quadrant 6 of *Figure 1*).

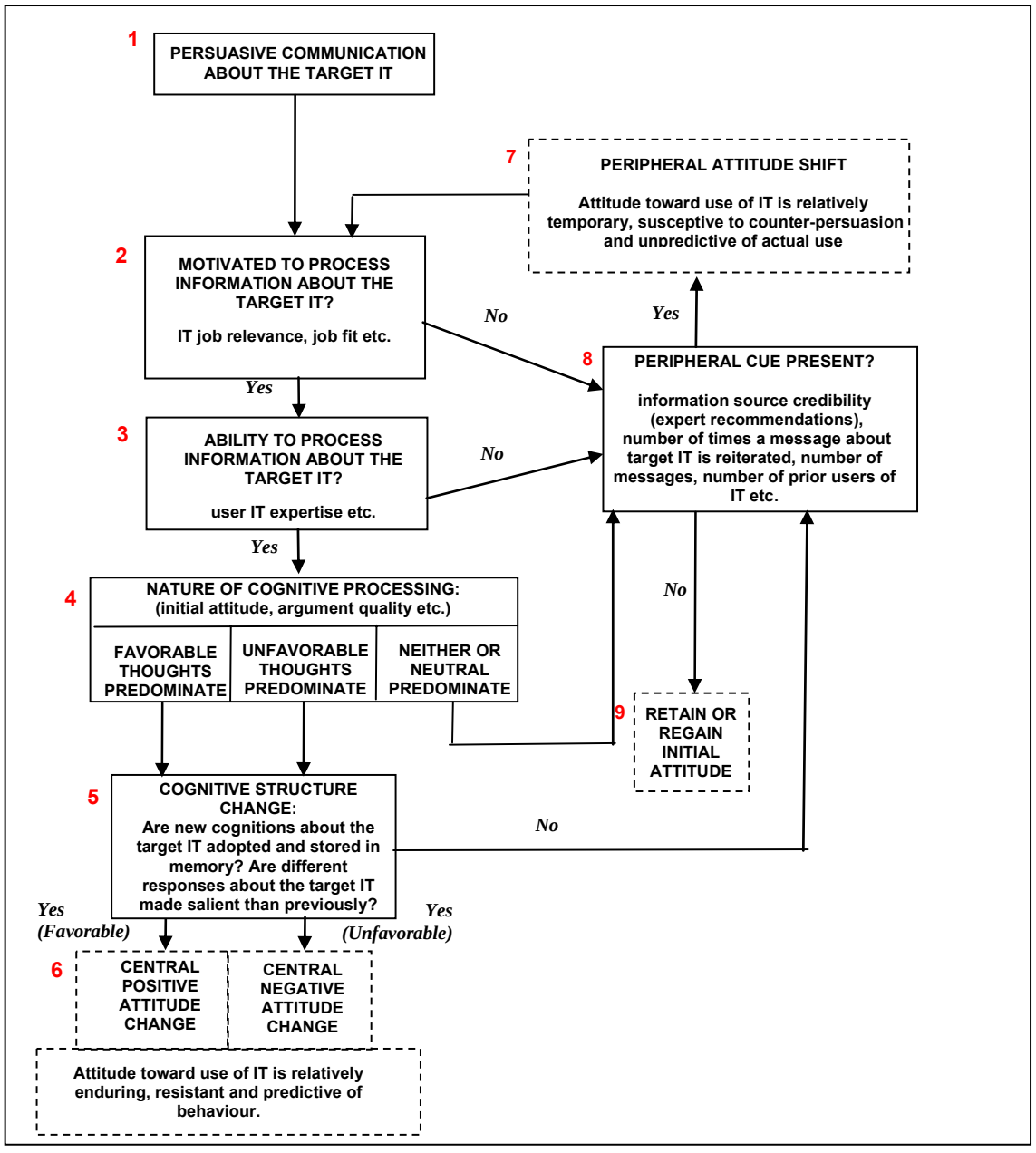


Figure 1: ELM in IT Usage Context - Authors´ interpretation on Cacioppo & Petty (1986) and Bhattacherjee & Sanford (2004).

- The effect of source credibility on attitude was proven to “wear out” faster over time than that of argument quality on perceived usefulness. Thus, attitude formed via less elaborative examination of peripheral cues is represented in *Figure 1* as less stable, temporary, susceptive to counter-persuasion and unpredictive of actual use (quadrant 7).
- Peripheral cues in IT usage context were operationalized as related to: (a) characteristics of the information source (e.g., source credibility, source likeability), and (b) characteristics of information presentation (e.g., number of times a par-

ticular message is reiterated). Source credibility[28] is defined as the extent to which an information source is perceived as being believable, competent, and trustworthy by information recipients (Petty et al. 1981, Sussman & Siegal 2003) - (quadrant 8).

- People with high elaboration likelihood were found to be more likely to engage in careful scrutinization of an information message, and therefore, tended to be more persuaded by argument quality than by peripheral cues. In contrast, those with low elaboration likelihood (less IT expertise) could only be motivated by peripheral cues (Bhattacherjee & Sanford 2004). This is depicted in *Figure 1* by the relational paths connecting the quadrants.

2.3 Motivation

The ELM is a process theory of persuasion and cognition change that is specifically designed to account for the differences in persuasion outcomes across individuals and organizational contexts (Petty et al. 1981, Cacioppo & Petty 1986). Viewing IT usage through the lens of ELM is a novel theoretical perspective, and we find it suitable because of two types of argumentation: (a) time-related focus of research, and (b) rational versus heuristic focus of research (presented in the following two subsections).

2.3.1 Time-related focus of research

Classical ITU theory has produced a number of models, among the most frequently quoted being the Innovation Diffusion Theory (IDT) (Rogers 1962), the Theory of Planned Behaviour (TPB) (Azjen & Fishbein 1975), the Technology Acceptance Model (TAM) (Davis et al. 1989), the Hybrid TPB-TAM (Taylor & Todd 1995), as well as the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003). Later researchers tended to view these classical theories as representing a somewhat two-dimensional approach to the issue and extended the approach via a network-based understanding of the innovation process (Callon & Labour's 1981, Bijker & Pinch's 1984), while redefining the social diffusion system as a network, in which communication patterns are analysed as relational structures (Scott 2000, Wassermann and Faust 1994). Evolutionary diffusion theory (Nelson & Winter 1982; Metcalfe 1994, Dosi & Nelson 1994, Lambooy & Boschma 2001, Fagerberg 2003, based on Schumpeter 1949) extended the concept still further with focusing upon open systems and areas of rapid change, differentiations, complexities and unexplained outcomes in technology diffusion (for an overview see Krueger & Swatman 2005).

Most of these subsequent research streams have one common feature – they focus on the cognitive processes leading to usage, after the acquisition and processing of relevant IT usage information, rather than the sociological process of informational influence (Bhattacherjee & Sanford 2004). Thus, they direct all efforts toward analysing the effects of (inter alia) communication channel and innovation attributes on innovation diffusion, rather than the influence process by which perceptions of innovation attributes are formed.

[28] Source credibility is particularly relevant for IT products and services given the rapid rate of technological change in this area, since users often rely on advice from trusted expert sources to inform or educate them on the latest or most relevant IT (Bhattacherjee & Sanford 2004).

For example, TAM only tacitly acknowledges the informational influence hypothesis in that it subsumes such influence as “external variables” preceding individual beliefs regarding IT usage. In other words, TAM and similar models assume IT usage beliefs (resulting from informational influence) as given, and examine how these beliefs (e.g., perceived usefulness, perceived ease of use) influence attitude and intention toward IT usage, and ultimately IT usage behavior (Bhattacherjee & Sanford 2004).

Another example is IDT, which distinguishes between communication channels (e.g., mass-media versus interpersonal) but not between the informational content communicated by those channels (e.g., a more detailed review versus a less detailed review of a given IT published in similar trade journals) or information sources within each channel (e.g., a well-respected author versus one less-known author writing similar reviews of an IT in comparable trade journals) (Bhattacherjee & Sanford 2004). Thus, ignored are important aspects of information content and source, as at least equally important as the communication channel.

Within this direction of thought, we argue that research focus should be redirected toward informational influence as key trigger in the formation of individual perceptions (within organizational context) regarding IT usage. In this respect, we view ELM as a suitable theoretical device to aid analysis.

2.3.2 Rational versus Heuristic focus of research

As we saw above, TAM and similar models assume IT usage beliefs (resulting from informational influence) as given, and see the IT adopter as a rational actor who fully understands the context. A good argument against this paradigm is Dosi and Nelson’s (1994, pp.163-164) view of a less than perfectly rational [business] environment: “If one wants a model in which it is presumed that the actors fully understand the context ... then the formidable challenge facing the ‘rational’ models let alone a supposedly ‘rational’ actor is what it means to ‘fully understand’ the context, whenever the latter depends in some complex, non linear ways on the distribution of micro decisions and on chance and is always full of surprises”.

Frameworks like TAM and IDT correspond with traditional consumer choice theory which studies consumer decisions based on the assumption of a rational decision-maker, with well defined and stable system of preferences. The decision-maker is assumed to have knowledge of all the relevant aspects of the products available for choice as well as the consequences of each alternative choice (Niva & Timonen 2001).

During the past couple of decades, rational choice theory has been challenged by those researchers, often psychologists, who stress that people make decisions based on simplifying strategies, heuristics, which often lead to biases and errors in the resulting decisions. On the other hand, rationalists strongly criticize the heuristics-and-biases approach which “. . . would lead us to believe that humans are hopelessly lost in the face of real-world complexity, given their supposed inability to reason according to the canon of classical rationality . . .” (Gigerenzer & Goldstein 1996, p. 651).

According to Gigerenzer and Goldstein (1996), the heuristics approach and the classical rationality approach have more in common than is apparent at first glance, as both are based on cognitive calculation and probabilities, that is - on information processing. Information processing, therefore, works as epistemic “glue” between both approaches.

For this reason, we advocate information processing as a central point of view to analyse IT adoption/usage decision-making, with the emphasis shift on the influence process by which perceptions of IT innovation are formed. In the context of ELM, special scrutiny deserves the case of peripheral cue based heuristics for framing subsequent cognitions, with implications on habitual (Ng-Kruelle and Swatman 2003) end-user behaviour.

3 Perceived Behavioural Control (PBC)

PBC has been employed as an additional (compared to TAM) predictor by the Theory of Planned Behaviour (Ajzen 1991) as well as the Hybrid Technology Acceptance Model (Taylor & Todd 1995). It has been theorised as "perceptions of internal and external constraints on behaviour" (Taylor & Todd 1995, p.149). As such, PBC encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions (Venkatesh et al. 2003). It has typically been operationalized through items like:

- "I have control over using the system",
- "I have the resources necessary to use the system",
- "I have the knowledge necessary to use the system",
- "Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system",
- "The system is not compatible with other systems I use" (Venkatesh et al. 2003).

PBC may be compared to "dominating and resisting power" – constructs from psychology, defined as:

- dominating power – that power which attempts to control and coerce [actions] (Sharp et al. 2000, p.2);
- resisting power – that power which attempts to set up situations, groupings or actions which resist the impositions of dominating power (Sharp et al. 2000, p.3).

Reichel (2004) regarded "reflexive control" as better suited (i.e., than adaptation) candidate for a causal mechanism controlling and driving social change. He argued that through the individual´s reflexivity, action is rationalised and control over systems is exerted. Thus, he outlined a "stylised" setup of subsequent reflexive control steps:

- Practical knowledge gathered in interactive social practices;
- Reflexive monitoring: periodical control of action to establish (enforce) internal and
- external conformity;
- Rationalisation of action: production of codifiable hypotheses with respect to inferences about social action (discoursive knowledge);
- Repeated application of rationalized interpretative patterns;
- "Sedimentation" and/or "codification" of discoursive knowledge in social routines
- (Reichel A. 2004).

We consider the outlined sequence of reflexive control steps as applicable in operationalizing PBC within IT usage context, especially in relation to phenomena like “routinization”, “habituation” (to be discussed later in this paper).

4 CE and PBE cross-referential influence on IT usage

CE´s effect on IT usage has been analysed cross-referentially and comparatively to Perceived Usefulness and Attitude Toward Use (e.g., Bhattacherjee & Sanford 2004). However, CE has rarely been viewed in reference to PBC. Pure rationality imposes a set of constraints on the possibility to reconcile these two constructs into a coherent comparative analysis. It is not the ambition of this paper to find proof of direct relevance between the two or to operationalize their joint impact on IT usage in a precise manner. While the latter may well be the subject of future work, we presently confine ourselves within outlining a framework of popular IT usage phenomena (*Table 1*) and explaining how they sustain a collection of illustrative joint outcomes from PBC and CE balancing, with regard to IT usage behaviour.

Table 1 represents a set of “PBC versus CE” balancing outcomes, selected based on their temporal subsequence, as well as on their integrative illustrative weight (authors´ opinion) as major issues, well discussed within IS literature.

Two axes of analysis are formed: vertically - individual and group PBC balancing, and horizontally – different types of CE peripheral route balancing (per ELM). The ELM is considered capable of covering both individual and group outcomes because it is specifically designed to account for the differences in persuasion outcomes across individuals and organizational contexts (Petty et al. 1981, Cacioppo & Petty 1986). Against this background, PBC group balancing is understood to refer not only to collective intentionality (Ylikoski 2004) (e.g. joint intention and commitment, mutual belief, we-attitudes, collective acceptance and agreement, collective responsibility, and the like) but is also taken to cover collective action.

PBC individual balancing	**PBC group balancing**	**CE peripheral route balancing**
Pervasive message distribution	Critical mass pressure	message repetition, number of prior users of IT
Behavioural acquisition	Innovating mindlessly (bandwagon effect)	source credibility
Routinisation, Habituation, Flow	“Winner take all” eBusiness dynamics	source credibility

Table 1: PBC versus CE balancing outcomes

The rest of the paper explains briefly each of the phenomena, listed in *Table 1*, and shows the presence of CE and PBC balancing in each of the cases, and how they correlate with regard to their mutual influence on IT usage.

Pervasive message distribution (Shumarova & Swatman 2005): The boundless re-re-distribution of behavioural messages, enabled by efficiently linked flows of information, stimulating infectious cross-talk of shared pre-understanding among network members. The level of individual PBC is likely to be influenced by CE peripheral route balancing in the form of message repetition and number of prior users of IT.

Behavioural acquisition (a: Bandura 1986, Shumarova & Swatman 2006, b: Rogers 1986, Berkowitz 1988):

(a) Motivational cross-contamination, resulting from watching the actions and outcomes of others' behaviour, thus pushing adopters into complacency; this is accompanied by speedier judgments, quicker pace of activity, mimetic responses, and a tendency to favour impulsive adoption behaviour.

(b) The interpersonal linkages created by the sharing of information in the interpersonal communication structure, that is, the network.

The level of complacency is likely to be influenced by PBC, in correlation with CE peripheral route balancing in the form of source credibility.

Routinization (based on Cooper & Zmud 1990): implies IT usage, exercised as a normal activity - a consequence of multiple exposures to the IT artefact. Reichel (2004) posited "routines" as the dominating mode of social activities. Routines provide actors with self-awareness. Continuity of social practices implies reflexivity. Through reflexivity, routines are consolidated (Reichel 2004). Routinization, in this context, never comes in a neutral context for neutral effect, but alters human subjectivity while inviting higher levels of human-actor complicity and higher levels of PBC. Relevant here is the set of subsequent reflexive control levels (Reichel 2004) (see 3. above).

Habituation (Ng-Kruelle & Swatman 2003): how an individual, based on previous habits and experience will continue to either reject or accept an innovation without indulging in much pre-thought or structured decision making. As related to IT usage and exhibited throughout social networks, may play the role of subjective norm (Shumarova & Swatman 2006) within e-communities: pervasive informational cascades may prevail, falsely suggesting that a broad, substantive, and well-considered consensus exists.

Flow (Csikszentmihalyi 1990, Theory of Flow): a state of high cognitive elaboration and intense involvement, in which "people are so involved in an activity that nothing else seems to matter" (p. 4). Dimensions of flow include intense concentration, a sense of being in control, a loss of self-consciousness, and transformation of time. Trevino and Webster (1992) described four dimensions of the flow experience in the context of information technologies, one of them being the control dimension, capturing the individual's perception that s/he exercises control over the interaction with the technology. Hoffman and Novak (1996) further theorized that flow would result in several outcomes such as a positive subjective experience, increased learning, and increased level of PBC.

These increased levels of PBC (in the case of Routinization, Habituation and Flow) are likely to be dependent on the perceived source credibility (CE peripheral route balancing).

Critical mass pressure (a: Farrell & Saloner 1987; b: Markus 1987):

(a) Excess inertia around an existing standard because of reluctance among users to leave a mature network and join an immature one.

(b) The utility of communication medium to its users will rise with the number of people using the system.

The level of group PBC is likely to be influenced by CE peripheral route balancing in the form of message repetition and number of prior users of IT.
Innovating mindlessly with IT (Swanson & Ramiller 2004): The commonplace practice of innovating mindlessly with IT as being entertained whenever organizations choose to be inattentive to the firm's own circumstances; by doing so, they let IT-usage routines lull them into complacency with some widely touted "best practice". Swanson and Ramiller (2004) saw the origins of "IT-mindlessness" in attention deferral – i.e., peripheral route CE balancing. IT-mindlessness may extend into bandwagon pressures, exhibited through the bandwagon effect (also called "me too" variety or"follow the crowd" effect) (Swanson & Ramiller 2004): this effect originates in a self-reinforcing process (critical mass pressure), which yields a tendency for a community to become locked-in to widely adopted technology standards.

"Winner take all" e-business dynamics (consequence of critical mass pressure) (Frank & Cook 1995, Shapiro & Varian 1998): a special kind of "e-monopoly", where second class means no class, the winner takes all. Thus, the stakes for successful innovation have become high indeed.

The levels of PBC (in the cases of innovating mindlessly, and "winner take all" dynamics) are likely to depend on CE peripheral route balancing in the form of perceived source credibility.

5 Conclusion

The analysis has provided a novel theoretical perspective of analysing CE and PBC cross-referentially, while focusing on the acquisition and processing of relevant IT usage information (based on ELM). This enables a more detailed examination of the influence process by which perceptions of IT innovation are formed. We believe that this approach holds much promise in helping to proactively motivate IT usage in a preferred direction. We hope that this study has sparked the interest of other academic research towards the long-term goal of building a comprehensive understanding of persuasion strategies related to IT usage and will inspire future researchers to investigate this ignored yet potentially fruitful area of IT usage research.

References

Agarwal, R. and Karahanna E. (2000). „Time flies when you're having fun: cognitive absorption and beliefs about Information Technology usage". MIS Quarterly 24. No.4: pp.665-694.

Ajzen, I. (1991). "The Theory of Planned Behaviour", Organizational Behaviour and Human Decision Processes (50:2): pp. 179-211.

Ajzen, I. and Fishbein, M. (1975). „Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research." Addison-Wesley, Reading, MA.

Bandura, A. (1986). "Social Foundations of Thought and Action: A Social Cognitive Theory". Prentice Hall, Englewood Cliffs, NJ.

Berkowitz, S. (1988). „Afterword: Toward a formal structural sociology“. In: Wellman, B. and Berkowitz, S.D. (Eds.). Social Structures, A network approach. London: Jai Press: pp.477-497

Bhattacherjee, A. and Sanford, C. (2004). "Persuasion Strategies for Information Technology Usage: an Elaboration Likelihood Model." http://mis.temple.edu/research/documents/BhattacherjeeITUsage.pdf .

Bijker, W.E. and Pinch, J.T. (1984), "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit of Each Other," in The Social Construction of Technological Systems, W.E. Bijker and P.T. Hughes and J.T. Pinch, Eds. Cambridge: MIT Press.

Cacioppo, J. and Petty, R. (1979). „Effects of message repetition and position on cognitive response, recall and persuasion”. Journal of Personality and Social Psychology 27: pp.97-109.

Cacioppo, J. and Petty, R. (1986). „The Elaboration Likelihood Model of persuasion”. New York: Academic Press.

Callon, M. and Latour, B. (1981). "Unscrewing the Big Leviathan: How actors macrostructure reality and how sociologists help them to do so," in Advances in Social Theory and Methodology: Towards and Integration of Micro- and Macro-Sociologies, K.D. Knorr-Cetina and A.V. Cicourel, Eds. Boston: Routledge.

Cooper, R. and Zmud, R. (1990): "Information Technology Implementation Research: A Technological Diffusion Approach", Management Science, Vol. 36, No. 2, pp.123-139.

Csikszentmihalyi, M. (1990): “Flow: The Psychology of Optimal Experience”, Harper and Row, New York.

Davis D., Bagozzi F. and Warshaw, P. (1989). "Extrinsic and Intrinsic Motivation to Use Computers in the Workplace." Journal of Applied Social Psychology (22:14): pp. 1111-1132.

Dijkstra, J. (1999), “User Agreement with Incorrect Expert System Advice,” Behavior & Information Technology (18:6), pp. 399-411. In Bhattacherjee A. and Sanford C. (2004). "Persuasion Strategies for Information Tech-nology Usage: an Elaboration Likelihood Model".

Dosi, G. and Nelson, R. R. (1994). “An Introduction to Evolutionary Theories in Economics”, Journal of Evolutionary Economics, Vol.4, pp.153-172. In Wilkins L. and Swatman P. (2005). "Evolutionary Diffusion Theory and the EXDOC Community: Greater Explanatory Power for e-Commerce Diffusion?" iNSYL working papers.

Fagerberg, J. (2003). "Innovation: A Guide to the Literature".In Workshop "The Many Guises of Innovation: What we have learnt and where we are heading". Ottawa.

Farrell, J. and Saloner, G. (1987). “Competition, Compatibility and Standards: The Economics of Horses, Penguins and Lemmings”. In Fichman, R. (2000). The Diffusion and Assimilation of Information Technology Innovations.

Frank, R. and Cook, P. (1995). “The Winner-Take-All Society“, Free Press, New York.

Fichman, R. (2000). „The Diffusion and Assimilation of Information Technology Innovations". In Framing the Domains of IT Management: Projecting the Future Through the Past, Robert Zmud editor, Pinnaflex Publishing.

Gigerenzer, G. and Goldstein, D.G. (1996): „Reasoning in the fast and frugal way: models of bounded rationality". Psychological Review, 4, pp.650–669.

Hoffman, T. and Novak, D. (1996). „Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations", Journal of Marketing (60), pp. 50-68. In Agarwal, R. and Karahanna E. (2000). Time flies when you're having fun: cognitive absorption and beliefs about Information Technology usage. MIS Quarterly 24. No.4: pp.665-694.

Jones, N. and Myers, M. D. (2001). „Assessing Three Theories of Information Systems Innovation: An Interpretive Case Study of a Funds Management Company", Proc. Pacific Asia Conference on Information Systems, Seoul, Korea, pp.1005-1019. In Wilkins L. and Swatman P. (2005). "Evolutionary Diffusion Theory and the EXDOC Community: Greater Explanatory Power for e-Commerce Diffusion?", iNSYL working papers.

Koskela, H. (2004). „Webcams, TV Shows and Mobile phones: Empowering Exhibitionism". Surveillance & Society, CCTV Special (eds. Norris, McCahill and Wood) 2(2/3): pp. 199-215.

Krueger C. and Swatman P. (2005). "The Impact of Internet Technology on the Online Content Sector: Value Webs in online news and music", iNSYL working papers.

Lambooy, J. G. and Boschma, R. A. (2001) „Evolutionary Economics and Regional Policy", Annals of Regional Science, Vol.35, Springer Verlag, pp.113-131.

Lee, J. and Collar, E. (2002). "Information Technology Fashions: Building on the Theory of Management Fashions". MIT Center for Coordination Science.

Mak, B., Schmitt, B. H., and Lyytinen, K. "User Participation in Knowledge Update of Expert Systems," Information & Management (32:2), February 1997, pp. 55-63. In Bhattacherjee A. and Sanford C. (2004). "Persuasion Strategies for Information Tech-nology Usage: an Elaboration Likelihood Model."

Lord, K. R., Lee, M. S., and Sauer, P. L. (1995). "The Combined Influence Hypothesis: Central and Peripheral Antecedents of Attitude toward the Ad," Journal of Advertising (24:1), Spring 1995, pp. 73-85.

Markus, M. (1987). „Towards a "critical mass" theory of interactive media: Universal access, interdependence and diffusion". Communication Research 14: 491-511.

Metcalfe, J. S. (1994). "The Economics of Evolution and the Economics of Technology Policy", Economic Journal, Vol.104, pp.931-944.

Ng-Kruelle, G., Swatman, P., Hampe, F., Rebne, D. (2003). "The Price of Convenience: Developing a Framework for Analysing Privacy Sensitivity in the Adoption of Wireless Applications", Bled, Slovenia, June 9-11.

Nelson, R. R and Winter, S. G. (1982). "An Evolutionary Theory of Economic Change", Belknap Press, Cambridge, Mass. and London.

Niva M. and Timonen P. (2001). "The role of consumers in product-oriented environmental policy: can the consumer be the driving force for environmental improvements?" International Journal of Consumer Studies 25(4): 331–338.

Petty, R. E., Cacioppo, J.T., and Goldman, R. (1981). “Personal Involvement as a Determinant of Argument-Based Persuasion,” Journal of Personality and Social Psychology (41:5), pp. 847-855. In Bhattacherjee A. and Sanford C. (2004). "Persuasion Strategies for Information Tech-nology Usage: an Elaboration Likelihood Model."

Reichel A. (2004). "(Re-)Structuration of System Dynamics." Proceedings of the Twenty-Second International Conference of the System Dynamics Society.

Rogers, E. (1962, 1986, 1995). „Diffusion of Innovations“. Free Press, New York.

Scott J. (2000). "Emerging Patterns from the Dynamic Capabilities of Internet Intermediaries." Journal of Computer-Mediated Communication 5(3).

Schumpeter, J. (1949 reprinted 1989), "Economic Theory and Entrpreneurial History, Change and the Entrepreneur," in J. Schumpeter, „Essays on Entrepreneurs, Innovations, Business Cycles and the Evolution of Capitalism”, R.V. Clemence, Ed. New Brunswick: Transaction Publishers.

Shapiro, C. and Varian, H. (1998). „Information Rules: A Strategic Guide to the Network Economy”, Harvard Business School Press, Boston.

Sharp, J., Routledge, P., Philo, C., and Paddison R. (2000, eds.) „Entanglements of Power: Geographies of Domination/Resistance“. London: Routledge. In Koskela, H. (2004). „Webcams, TV Shows and Mobile phones: Empowering Exhibitionism“. Surveillance & Society, CCTV Special (eds. Norris, McCahill and Wood) 2(2/3): pp. 199-215.

Shumarova, E. and Swatman, P. (2005). „User Adoption of Socially-Pervasive ICT Innovations - Some Open Issues”. iNSYL Working Papers.

Shumarova, E. and Swatman, P. (2006).“The Dynamics of Innovation in Networks - Innovating Sustainably with IT: A System Dynamics Perspective on IT Innovation Diffusion Modelling”, iNSYL Working Papers.

Sussman, S. W., and Siegel, W. S. (2003) “Informational Influence in Organizations; An Integrated Approach to Knowledge Adoption,” Information Systems Research (14:1), pp. 47-65. In Bhattacherjee A. and Sanford C. (2004). "Persuasion Strategies for Information Tech-nology Usage: an Elaboration Likelihood Model".

Swanson, B. and Ramiller, N. (2004). “Innovating mindfully with Information Technology”. MIS Quarterly Vol. 28 (No. 4): pp. 553-583.

Taylor S. & Todd P., (1995). „Understanding Information Technology Usage: A Test of Competing Models”. Information Systems Research (6:4): pp.144-176.

Trevino, L. and Webster, J. (1992). „Flow in Computer-Mediated Communication: Electronic Mail and Voice Mail Evaluation and Impacts”, Communication Research (19:5): pp.539-573.

Venkatesh V. et al. (2003). "User Acceptance of Information Technology: Toward a Unified View." MIS Quarterly 27: pp.425-478.

Wassermann, S. and Faust, K. (1994): „Social Network Analysis. Methods and Applications“. Cambridge: University Press.

Wilkins L. and Swatman P. (2005). "Evolutionary Diffusion Theory and the EXDOC Community: Greater Explanatory Power for e-Commerce Diffusion?" iNSYL working papers.

Ylikoski P. (2004). "Collective inteltionality and sociality." Uinversity of Helsinki.

Appendix

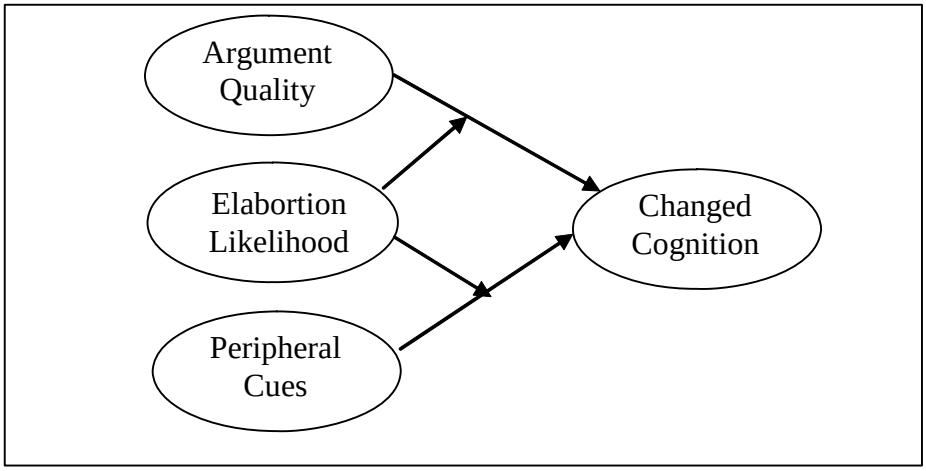


Figure 2: Elaboration Likelihood Model (Cacioppo & Petty 1986) [29]

[29] For more information on the ELM, see Cacioppo and Petty (1986) and Cacioppo and Petty (1979).

e-Learning Readiness in the Classroom: a study of Hong Kong primary and secondary teachers

K.K.T. So[1] and P.M.C Swatman[2]

[1] University of South Australia
teddyso@i-cable.com

[2] University of South Australia
paula.swatman@unisa.edu.au

Abstract

E-Learning is an area of considerable importance in both public and private sectors globally. The promises of just-in-time learning, however, have not always been met. One possible explanation for the often disappointing results of E-Learning implementations is lack of adequate training for those supporting learners. In this paper we look at the effectiveness of primary and secondary teacher preparation for E-Learning in Hong Kong – an area of double concern, as the E-Learning literature (both academic and professional) is primarily concerned with either corporate or academic implementations. Hong Kong was selected as the site for the study because the government has introduced a series of reforms designed to support school-based E-Learning (EMB, 2004).A significant body of literature, however (Fullan, 1994; Heinrich, 1995; Wang, 2002), suggests that the way teachers teach is a product of their own schooling, training, and experiences. Can teachers change their pedagogical approaches if they have not been given sufficient and appropriate training program on how to integrate new ICT technologies into their teaching? The paper presents the results of a pilot survey of Hong Kong teachers, and assesses their readiness for e-learning. Results suggest that respondents are not yet fully prepared to use e-learning technologies – with differences in readiness perceived between male and female; and secondary and primary school teachers; as well as between teachers from different secondary school 'bandings'. On the basis of a factor analysis, the paper then makes some preliminary recommendations to assist in solving the identified problems.

1 Introduction

With the increasing uptake of computer and communications technology over the past 15 years the move to knowledge-based, rather than manufacturing-based, societies is gathering pace. Hong Kong is not exempt from this global trend and, to maintain its competitiveness, is endeavouring to transform itself into an information society. As a

result, reforms have been introduced in many aspects of life and, in particular, in education over the past few years.

From 1998 to 2003 Hong Kong's government poured HK$5 billion into a five-year IT strategic plan for primary and secondary schools, designed to provide a solid infrastructural foundation for subsequent Information and Communications Technology (ICT) innovations. At the end of that five-year period all schools had set up substantial computer networks, with primary and secondary schools each having 91 and 247 networked computers (respectively); and all schools having broadband Internet connections, at speeds ranging from 1.5 to 10 Mbps. In training terms, teachers in every primary and secondary school in Hong Kong had received 18 hours of basic IT training (BIT), with 75% of school teachers receiving a further 30 hours of intermediate IT training (IIT); and 25% of teachers receiving an additional 30 hours of IT training (Upper Intermediate; UIT) (EMB, 2004). Sadly, however, although the lion's share of this first IT strategic plan budget was spent on purchasing and setting up IT infrastructure and on teacher training, the anticipated change / paradigm shift in pedagogy did not eventuate (CITE, 2003; para. 42 & 43) and it became clear that further changes would be needed if Hong Kong was to rival its Asian neighbours as a leader in ICT educational attitudes and activities.

Hong Kong was not alone in pouring funds into an ICT-led societal transformation. Neighbouring countries, such as Singapore, Taiwan and South Korea have also initiated ICT strategic plans – Singapore, indeed, launched its second such strategic plan in 2002 (MOE, 2006) – as have a number of other industrialised nations in Asia and around the world. Clearly, Hong Kong was under pressure to continue its ICT transformation strategy. On the basis of the well-established hardware infrastructure and the lessons learnt from the first IT strategic plan, the Education and Manpower Bureau (EMB) released its second Information Technology strategic plan "Empowering Learning and Teaching with Information Technology" in July 2004. The focus of the second strategic plan is rather different from the first, which emphasised the initial set-up of the hardware infrastructure and teacher training. The second strategic plan focuses on making real changes to pedagogy, on the promotion of life-long learning and e-learning, the use of wireless technology as an extension of the existing wired network, and on the new roles of both parents and students in the life-long learning environment (EMB, 2004). Since February 2005, EMB has started to allocate funding to all seven hundred plus primary schools, as well as to four hundred plus secondary schools. Schools are expected to utilise this funding to acquire the necessary e-learning platform(s); and to provide relevant teacher training and parental IT programs over the next two years.

The Economist ranks the overall e-learning readiness of Hong Kong as 19th out of the 60 countries surveyed, and as 20th out of 60 in the education scores (The Economist, 2003).

	Education rank (of 60)	Industry rank (of 60)	Government rank (of 60)	Society rank (of 60)	Overall rank (of 60)
Sweden	6	4	1	2	1
Canada	2	3	14	6	2
USA	1	1	22	1	3
Finland	9	5	2	5	4
South Korea	4	1	16	12	5
Singapore	11	7	19	4	6
Taiwan	13	9	25	17	16
Hong Kong	**20**	**13**	**20**	**15**	**19**
Japan	24	22	32	24	23
Malaysia	27	15	28	32	25

Table 1: e-Learning Rankings by Category (extracted from The Economist, 2003)

To understand whether Hong Kong can take maximum advantage of the developing Information Society, it is clearly important to investigate 'if' and 'how' Hong Kong's teachers are prepared to embrace new ICT approaches in their teaching and learning activities. This research is needed because:

- Existing models have so far been designed for and tested only against business organisations and higher education institutions such as universities (Borotis & Poulymenakou, 2004; Chapnick, 2000, Kaur & Abas, 2004). Up till now, there have only been a very few validated models for primary and secondary schools.
- Since the education reform started in 2000, many Hong Kong teachers have indicated strong negative feelings towards the business models introduced into schools. As a result, a "localised" assessment model within the education context is vital for gaining the acceptance of teachers.
- Given the significant investment of government resources and ICT implementation into schools in Hong Kong, the educational establishment (as well as the teachers themselves) urgently need a sound and thoroughly validated model to assist in the integration of e-learning in schools.
- The rapid growth and evolution of ICT and learning technologies makes it imperative that we truly understand what is needed, so that investment into e-learning is as cost-effective and appropriate as possible. Investing large sums into 'sexy' technology which later proves inappropriate for school environments is something governments simply cannot afford!

The goal of this research project is thus to discover just how ready Hong Kong's primary and secondary school teachers are. The project therefore investigates:

- Teacher willingness to use new technology in the classroom
- Teacher ability and readiness to integrate e-learning into their teaching; and
- The establishment of the factors influencing teacher readiness/ability.

This project, while obviously focusing on the Hong Kong experience of school-level uptake of e-learning, is also of potential benefit to other countries within Asia (and, possibly, even more widely), as they explore the use of e-learning technology in new teaching and learning environments. Together with other research (Kaur & Abas, 2004; Ya'acob, Nor & Azman, 2005) these results should provide a clearer picture of how Asian countries are responding to the e-learning challenge.

The next section of the paper examines the existing literature on e-learning, identifying possible models of e-readiness for use in a school environment. We then introduce and discuss the findings of a pilot survey of Hong Kong school teachers; and on the basis of the factors identified in this survey, make some preliminary recommendations and discuss the next steps for this project.

2 Literature Review

The forces driving the implementation of e-learning in the commercial world are now widely recognised and accepted across virtually all industry sectors. Many even speak of the Merrill Lynch e-learning "megatrends" (Learnframe, 2001), such as the changing demographics resulting from the aging of the baby boomers and a reduced "knowledge half-life", (so that many books are out-of-date even before they are printed) which, together with the rapid expansion of technology, force firms and their employees into ongoing lifelong learning and training activities. At the same time, organisations are witnessing a number of the benefits of e-learning, such as cost savings, and increased flexibility and productivity (Hall, 2001).

Organisations in both public and private sectors increasingly view continuous learning as the key to maintaining their competitive advantage (Goldstein & Ford, 2001). e-Learning is considered the appropriate solution to the call for a just-in-time, accessible, ubiquitous approach to providing learning at a lower cost (Borotis & Poulymenakou, 2004). Because the ways in which the online curriculum is delivered are new – and very different from the traditional approach – a major factor influencing the success of e-learning is teacher training. Instructors must themselves be educated in how to take advantage of these updated teaching methods. *"An ineffective teacher can waste the time of 30 or 40 students. But bad teaching online can touch thousands.* 'We can create mass damage quickly'*."* (The Economist, 2003; p. 12).

A significant body of literature (see, for example, Fullan, 1994; Heinrich, 1995; Wang, 2002) supports the view that the way teachers teach is a product of their own schooling, training, and experiences. It is unreasonable to expect teachers to change their existing pedagogical approaches if they have not themselves been provided with sufficient and appropriate training in how to integrate ICT and new teaching technologies into their instruction programs.

Readiness is defined as being *"prepared mentally or physically for some experience or action"* (Webster's New Collegiate Dictionary). Borotis & Poulymenakou (2004) define e-learning readiness as *"the mental or physical preparedness of an organization for some e-learning experience or action"*. e-Learning readiness assessment helps an organisation to design e-learning strategies comprehensively and to implement its ICT goals effectively (Kaur & Abas, 2004). Learners must also be "e-ready" so that a coherent achievable strategy, tailored to meet their needs, may be implemented (infodev, 2001). In sum, e-learning readiness assessment provides key information to organisations to supply solutions which can cater to the specific needs of each learning group (McConnell International, 2000).

Before implementing e-learning programs, therefore, organisations need to expand the usual needs assessment process by creating a high-level requirements document that includes: 1) objectives (macro organisational objectives and micro target learner population objectives); 2) an e-learning readiness score; 3) a list of advantages and potential obstacles to e-learning adoption; and 4) a list of possible e-learning configurations

(Chapnick, 2000). Chapnick designed a model for measuring the e-learning readiness of an organisation by answering the questions: a) Can we do this? b) If we can do this, how are we going to do it? and c) What are the outcomes and how do we measure them? His proposed model groups different factors into eight categories:

- **Psychological readiness**. This factor considers the individual's state of mind as it impacts the outcome of the e-learning initiative. This is considered one of the most important factors and has the highest possibility of sabotaging the implementation process.
- **Sociological readiness**. This factor considers the interpersonal aspects of the environment in which the program will be implemented.
- **Environmental readiness**. This factor considers the large-scale forces operating on the stakeholders both inside and outside the organisation.
- **Human resource readiness**. This factor considers the availability and design of the human-support system.
- **Financial readiness**. This factor considers the budget size and allocation process.
- **Technological skill (aptitude) readiness**. This factor considers observable and measurable technical competencies.
- **Equipment readiness**. This factor considers the question of the proper equipment possession.
- **Content readiness**. This factor considers the subject matter and goals of the instruction.

Singapore's Ministry of Education (MOE) found this model especially useful for school principals and heads of department planning to introduce e-learning in their school (MOE, no date). One of the major drawbacks of this model for teachers in schools, however, is that it is designed to measure the readiness of using e-learning in business organisations and does not fit neatly into the school environment. Building on Chapnick's model, Kaur and Abas (2004) designed a model for measuring the e-learning readiness of the Open University Malaysia. Their model consists of eight constructs: learner, management, personnel, content, technical, environmental, cultural and financial readiness. Taking a slightly different approach, Borotis and Poulymenakou (2004) proposed a seven-component model of e-learning readiness, based on previous research + their own experience, to counter the lack of congruency in predefined components of e-learning readiness.

These e-learning readiness models, however, excellent as most of them are, do not match the needs of primary or secondary school environments perfectly since they were constructed for business organisations, universities or higher education institutions (Borotis & Poulymenakou, 2004; Chapnick, 2000; Hoban, Lawson, Mazmanian, Best & Seibel, 2005; Rosenberg, 2000). As e-learning is being launched in Hong Kong's schools at the system level, there is a clear need to develop a framework for e-learning readiness which is specifically designed for the needs of primary and secondary schools.

An additional factor to be taken into consideration is a body of research findings which link gender differences to levels of computer acceptance (Yuen & Ma, 2002; Russell & Bradley, 1997) – an issue which is also relevant to teachers' e-learning readiness. In

his research into 462 middle and high school students, Young (2000) found significant gender differences in attitudes to computers. His research showed that boys were more likely to have claimed computers as a male area. Russell and Bradley (1997) found that male teachers reported significantly greater confidence with computers than did female teachers; and recommended that the design of teacher professional development should take gender differences into account, allowing for the particular needs of female teachers.

3 Research Approach

The overall research project, of which this paper reports an early set of results, is an inductive study designed to evaluate the e-learning readiness of teachers in Hong Kong's schools. The overall study will survey teachers from a range of schools in Hong Kong, to ascertain background, experience and satisfaction with existing methods of e-learning preparation.

In a pilot survey, reported in this paper, a questionnaire with 29 questions (see Appendix A) was sent to 200 teachers of primary and secondary schools in the period from December 2004 to January 2005. All items were measured on a five-point Likert scale, with 5 indicating "strongly agree" and 1 indicating "strongly disagree". 148 questionnaires, of which 131 were valid, were completed and returned, giving an effective response rate of 65.5%. Descriptive statistics, one-way analysis of variance (ANOVA), post hoc tests, and Factor Analysis were applied to analyse the data using SPSS version 11.

4 Data Findings and Discussion

Applying Factor Analysis to the survey responses to identify the factors influencing the e-learning readiness of teachers showed differences in perceived readiness between: male and female teachers; secondary school and primary school teachers; and teachers of secondary schools in different "bandings". The results of this study are summarised in tables 2, 3 and 4, while the factors formed through Factor Analysis are presented in tables 5 and 6.

4.1 Primary vs. Secondary School Experiences

As Table 2 illustrates, primary school teachers have significantly different perceptions from secondary school teachers on the topic of e-learning readiness. Although the amount of IT training in terms of time and opportunity offered to both primary and secondary school teachers by the EMB is officially the same, primary teachers still consider that they know less about what e-learning is than do their secondary school colleagues. They also feel that primary students do not have sufficient IT competencies to use e-learning technologies.

Moreover, their confidence in their principals' understanding and support of using e-learning in teaching and learning is not as high as that the secondary school teachers, although an explanation for this discrepancy might well be found in the comparatively shorter history of placing computers in primary schools.

Items	School Type	4.2 N	Mean	F value
My principal/senior management knows what is e-learning	Primary	64	2.88	4.668 *
	Secondary	67	3.27	
My principal/senior management supports the use of e-learning	Primary	64	3.23	4.100 *
	Secondary	67	3.55	
I know what is e-learning	Primary	64	3.33	4.333 *
	Secondary	67	3.66	
My students have enough IT skills to use e-learning technologies	Primary	64	2.59	9.710 **
	Secondary	67	3.09	
Assess to web is not a problem to my students	Primary	64	2.83	12.924 ***
	Secondary	67	3.48	

Table 2: e-Learning Readiness of Teachers of Primary vs. Secondary Schools (One-Way ANOVA) (*:p < 0.05; ** p < 0.01; ***: p < 0.001)

In Hong Kong, secondary schools have had to teach computer studies as a subject since 1982 – giving teachers and students the opportunity to use computers on a daily basis for nearly 25 years; and to gradually build up a culture and confidence in using / operating computers. In addition, most secondary school teachers are university graduates, the majority of whom have had the chance to use computers during their university studies.

By contrast, it was not until 1998 (the year when the first IT strategic plan in education was launched), that primary schools in Hong Kong had any computers. It then took another 1-2 years to convert normal classrooms into computer laboratories, to complete the cabling of these rooms and to set up all computer hardware. As a result, most primary teachers and their principals have had only 5-6 years' experience in learning how to operate computers, or in experimenting with integrating IT into their teaching – and even less time to explore the use of e-learning in their curricula. Moreover, most primary school teachers are graduates of teacher training colleges and have had little opportunity to use computers in their pre-service training.

Access to the World Wide Web varies widely between countries. According to the latest statistics from EMB (2004), the average numbers of computers installed in primary and secondary schools in Hong Kong are 97 and 247 respectively, with computer to student ratios of about 1:9 and 1:5 respectively. These data make it clear that accessing computers for any purpose is a significantly greater problem for primary school students. Although the number of public terminals has increased markedly over the past few years, primary students are generally considered too young to move freely around the city by themselves. From a traditional Asian point of view, young children are expected either to stay at home or to remain in school for their own safety. As a result, their access to public computer terminals is far more restricted than that of their older siblings or friends who are already in high school.

4.3 Gender Differences

Items	Gender	N	Mean	F value
My principal / senior management knows what is e-learning	Male	54	3.30	4.010 *
	Female	60	2.90	
The IT infrastructure in my school can support e-learning	Male	54	3.50	3.947 *
	Female	60	3.13	
My school has a culture of sharing and team work	Male	41	2.66	4.257 *
	Female	56	3.04	
I know what is e-learning	Male	54	3.74	6.898 **
	Female	60	3.28	
I am ready for integrating e-learning in my teaching	Male	54	3.54	4.355 **
	Female	60	3.20	
I have enough IT competency to prepare the e-learning materials	Male	54	3.69	6.632 *
	Female	60	3.25	

Table 3: e-Learning Readiness of male vs. female Teachers (One-Way ANOVA) (*: $p < 0.05$; ** $p < 0.01$; ***: $p < 0.001$)

Gender difference is always a controversial topic – and computing is no exception. As we have already briefly noted in the literature review, some researchers have identified a gender difference in dealing with computing, while others have not. The responses to the pilot survey identified a quite marked gender difference to e-learning readiness. In all three questions “I know what is e-learning”, “I am ready for integrating e-learning in my teaching”, and “I have enough IT competency to prepare the e-learning materials”, male teachers demonstrated far higher levels of confidence than did female teachers, although both groups had received equal amounts of IT training from the government. Interestingly, a further gender difference was shown in response to the question about sharing/team work cultures, with female teachers responding far more positively than males. As Table 3 shows, this was the only question in this group to which female respondents gave a more positive answer than males – it would appear that the findings of this study support those of Yuen and Ma (2002), and Russell and Bradley (1997), who previously identified is gender bias in perception of IT competence.

4.4 Bandings in Secondary Schools

There are about 400+ secondary schools in Hong Kong, which are categorised into three ‘bands’, according to the achievement and performance in public examination levels of the students entering from primary schools. The highest achievers will go to band 1 secondary schools, and the lowest to band 3 schools. While it is sometimes difficult to distinguish a difference between teachers from band 1 and band 2 secondary schools, together their responses are significantly different from those of the teachers from band 3 schools. In attempting to identify these differences, the one-way analysis of variance (ANOVA) was applied to find out which variables were statistically significant. Nine variables satisfied this condition, as Table 4a illustrates:

Items		Sum of Squares	df	Mean Square	F
My school can afford the budget of using e-learning in Teaching & Learning	Between Groups	5.426	2	2.713	2.894*
	Within Groups	57.183	61	.937	
	Total	62.609	63		
My school has a culture of sharing and team work	Between Groups	7.836	2	3.918	4.782*
	Within Groups	42.601	52	.819	
	Total	50.436	54		
I am ready for integrating e-learning in my teaching	Between Groups	3.677	2	1.839	2.246*
	Within Groups	49.932	61	.819	
	Total	53.609	63		
I have enough IT competency to prepare the e-learning materials	Between Groups	6.044	2	3.022	3.087*
	Within Groups	59.706	61	.979	
	Total	65.750	63		
My students know what is e-learning	Between Groups	3.232	2	1.616	2.544*
	Within Groups	38.752	61	.635	
	Total	41.984	63		
The parents of my students support the use of e-learning at home	Between Groups	6.928	2	3.464	5.348**
	Within Groups	39.509	61	.648	
	Total	46.438	63		
My students have enough IT skills to use e-learning technologies	Between Groups	3.762	2	1.881	2.627*
	Within Groups	43.675	61	.716	
	Total	47.438	63		
I think my students are ready for e-learning	Between Groups	6.056	2	3.028	4.775*
	Within Groups	38.678	61	.634	
	Total	44.734	63		
Assess to web is not a problem to my students	Between Groups	5.513	2	2.757	3.094*
	Within Groups	54.346	61	.891	
	Total	59.859	63		

Table 4a: e-Learning Readiness of Teachers in Different Secondary School Bandings (ANOVA) (*: $p < 0.05$; ** $p < 0.01$; ***: $p < 0.001$)

As there are more than two categories (bands 1, 2, and 3) in the independent variables, a Post Hoc test was then applied to further differentiate the data – Table 4b summarises these results.

Items	(I)Secondary School Banding	(J)Secondary School Banding	Mean Difference (I – J)
My school can afford the budget of using e-learning in Teaching & Learning	Band 3	Band 1	-.50
		Band 2	-.63*
My school has a culture of sharing and team work	Band 3	Band 1	-.97*
		Band 2	-.61*
I am ready for integrating e-learning in my teaching	Band 3	Band 1	-.62*
		Band 2	-.37
I have enough IT competency to prepare the e-learning materials	Band 3	Band 1	-.58
		Band 2	-.65*
The parents of my students support the use of e-learning at home	Band 3	Band 1	-.81*
		Band 2	-.56*
My students know what is e-learning	Band 3	Band 1	-.12
		Band 2	-.49*
My students have enough IT skills to use e-learning technologies	Band 3	Band 1	-.58*
		Band 2	-.43
I think my students are ready for e-learning	Band 3	Band 1	-.65*
		Band 2	-.61*
Assess to web is not a problem to my students	Band 3	Band 1	-.73*
		Band 2	-.48

Table 4b: e-Learning Readiness of Teachers in Different Secondary School Bandings (Post Hoc)

Teachers from band 3 schools perceived their schools, themselves, and their students to be inferior to those from band 1 and band 2 schools. At the school level, they did not believe that their schools had a culture of sharing, which is important to the development of a learning organisation. At the classroom level they perceived both themselves and their students to be unready for e-learning. Another vital factor in taking full advantage of e-learning is support from the parents – unfortunately, band 3 teachers' perception of the level of support from their students' parents is the lowest of the three bandings. There were some surprises – in a number of cases (particularly budget and students' own e-learning awareness) band 3 teachers perceived band 2 schools to be better prepared than band 1 schools. Overall, however, it is clear that teachers from band 3 secondary schools were as lacking in confidence and preparedness for e-learning as primary school teachers.

4.5 Factors Influencing Teachers' e-Learning Readiness

The next stage of analysis was the identification of factors influencing the respondents' readiness for e-learning. Principal Component Factor Analysis in SPSS version 11.0 was employed to extract factors, using Varimax rotation with Kaiser Normalisation. In the factor designation, individual loadings of 0.5 or greater were used. Six factors with Eigenvalues equal to or greater than one were extracted. Interpretative labels are suggested for each of these six factors according to their characteristics: Students' Preparedness, Teachers' Preparedness, IT Infrastructure, Management Support, School Culture; and Preference to Meet Face-to-Face.

Items	**Fac. 1**	**Fac. 2**	**Fac. 3**	**Fac. 4**	**Fac. 5**	**Fac. 6**
Factor 1 – Students' Preparedness						
My students know what is e-learning	.785					
The parents of my students support the use of e-learning at home	.759					
My students are capable to manage their time well in e-learning	.800					
My students have enough IT skills to use e-learning technologies	.796					
I think my students are ready for e-learning	.810					
Assess to web is not a problem to my students	.541					
Factor 2 – Teachers' Preparedness						
I know what is e-learning		.618				
I think e-learning is helpful to improve teaching and learning		.667				
I think it is the right time to promote e-learning in my school		.632				
I am ready for integrating e-learning in my teaching		.765				
I have enough IT competency to prepare the e-learning materials		.657				
Factor 3 – Infrastructure						
The IT infrastructure in my school can support e-learning			.865			
The technical support is adequate to support e-learning			.846			
My school can afford the budget of using e-learning in Teaching & Learning			.760			
Factor 4 – Management Support						
My principal / senior management knows what is e-learning				.805		
My principal / senior management supports the use of e-learning				.773		
My school has a plan for e-learning in the coming future				.519		

Factor 5 – School Culture						
My colleagues know what is e-learning					.660	
We have a shared vision among the colleagues for e-learning					.659	
My school has a culture of sharing and team work					.715	
My colleagues' IT competency is high enough to conduct e-learning					.714	
Factor 6 – Preference to Meet Face-to-Face						
I prefer face-to-face lessons with my students						.841
My students prefer face-to-face lessons instead of meeting online						.716

Table 5: Factor Loadings of the Teachers' e-Learning Readiness (Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.) with Interpretative Labels

As with other organisations, ICT infrastructure, management support, and organisational (school) culture are part of the influential factors. In addition to teachers' own readiness and their preferences for meeting face-to-face, students' and their parents' preparedness are also crucial. The factors identified here are similar to those identified by Ya'acob, Nor & Azman (2005) whose research shows Malaysian teachers' and students' perceptions of the effectiveness and degree of readiness in embracing ICT (p. 16). The two sets of research results can usefully be compared and contrasted because:

1. Both Hong Kong and Malaysia are Asian countries, with some similarities of culture and educational approach (although there are also significant cultural differences)
2. Their e-learning readiness rankings are close together (see Table 1)

Several factors identified in this research agree with the research done by Ya'acob, Nor & Azman (2005). Factor 1 (Students' Preparedness) includes the items related to students' and parents' preparedness, as well as access to the Internet; and factor 2 (Teachers' Preparedness) includes the items related to teachers' willingness and degree of readiness for ICT, as the following quotes indicate:

> "the teaching and learning of English the Smart Way cannot be implemented effectively because of constraints such as non-readiness on the students' part as for the teachers …" (Ya'acob et al., 2005, p.22).
>
> "… the readiness on the teachers' and students' part is attributable to the exposure and access to the use of computers, …" (ibid, p. 24).
>
> "Moreover, access to web is critical to the success of utilising the network to facilitate e-learning …" (ibid, p. 23).

In addition, the findings "limitation of infrastructure, such as computer labs and continuous limitations to access the network hamper the effective of technology supported

teaching and learning" (ibid, p.24) agrees with factor 3 (Infrastructure) identified in the present survey.

5 Conclusion

Although substantial resources have been poured into ICT in education planning, schools in Hong Kong are still at the initial stages of employing e-learning in their daily teaching and learning activities. To fully understand why the results of the initial HK$5 million IT strategic plan for education had such disappointing results in terms of culture change, it is clear that a full-scale needs assessment should be conducted before any e-learning programs are launched, to ascertain the factors affecting teachers' computer use and the implications of these factors upon teachers' professional development strategies (Yuen & Ma, 2002).

This pilot study prepares the way for a more substantial investigation of Hong Kong teachers' and students' readiness to accept and adopt e-learning in primary and secondary schools. The findings of this initial survey suggest that only in the higher 'band' secondary schools do teachers feel confident they are ready to take on e-learning in the classroom – and even there, female teachers' confidence appears to lag that of their male colleagues. These findings, with their apparent similarities to data collected in Malaysian schools on readiness for ICT generally, suggest that there is still a long way to go before schools in the region will be able to take full advantage of the opportunities provided by 21st century technology.

In more detailed survey and interview studies, to be undertaken over the next 12-18 months, we plan to refine the data collected and identify obstacles and opportunities for teacher e-learning readiness and uptake in Hong Kong. Nonetheless, the findings to date do enable the formation of some preliminary recommendations:

- EMB should consider providing more support to primary school principals and teachers who, as a result of their short history of acquaintance with computers, need more technical support and in-service training to build confidence in integrating ICT into their daily teaching.
- The concept of using ICT in education should be emphasised in school principal training programs to enable them to adopt a leadership role in developing the new curriculum and promoting / coordinating the use of ICT in teaching and learning.
- There appears to be evidence suggesting that the design of teacher professional development should take gender into account, providing for the particular needs of female teachers in computer education.
- As Ya'acob, Nor & Azman (2005) have suggested, training should be offered to teachers on a continuous, rather than a one-off, basis so that their ICT knowledge is upgraded over time (ibid, 24).
- In order to gain support from parents in using e-learning at home, more resources should be invested in schools for conducting parent training programs. Access to the Internet and the need to overcome the digital divide are the two critical issues to be dealt with before e-learning can be fully and effectively implemented in Hong Kong schools.

References

Borotis, S. and Poulymenakou, A. (2004). e-Learning Readiness Components: Key Issues to Consider Before Adopting e-Learning Interventions. Retrieved on Nov. 2, 2005 from http://www.eltrun.gr/papers/eLReadiness_ELEARN2004.pdf

Centre for Information Technology in Education (CITE). (2003). Second International Information Technology in Education Study Module 2 (SITES M2). Retrieved on Dec. 15, 2004 from http://sitesdatabase.cite.hku.hk/keyfinding/001_key%20finding%20-%20final%20wtih%20tables.pdf

Chapnick, S. (2000). Are You Ready for E-Learning? Retrieved on Dec. 19, 2004 from http://www.astd.org/ASTD/Resources/dyor/article_archives.htm.

Education and Manpower Bureau (2004). Empowering Learning and Teaching with Information Technology. Hong Kong. Government Printers.

Fullan, M. (1994), Change Forces. Second Edition. London, New York: The Falmer Press.

Goldstein, I. and Ford, J. (2001). Training in Organizations (4th Ed.): Wadsworth Publishing.

Hall, B. (2001). E-Learning Guidebook. Six Steps to Implementing E-Learning. Retrieved Jan. 16, 2006, from http://www.brandonhall.com/public/forms/sixstepdb/

Heinrich, P. (1995). Developing a Whole School IT Policy. Pitman Publishing: London.

Hoban, D., Lawson, S., Mazmanian, P., Best, A., and Seibel, H. (2005). The Self-Directed Learning Readiness Scale: a factor analysis study. Medical Education (39), pp. 370-379.

infoDev (2001). E-Readiness as a Tool for ICT Development. Retrieved on Feb. 24, 2005 from http://www.infodev.org/library.

Kaur, K. and Abas, Z. (2004). An Assessment of e-Learning Readiness at the Open University Malaysia. International Conference on Computers in Education (ICCE2004), Melbourne, Australia.

Learnframe Inc. (2001). Driving Forces Behind e-Learning. Retrieved Jan. 15, 2006, from http://www.learnframe.com/aboutelearning/page8.asp

McConnell International LLC. (2000). Risk E-Business: Seizing the Opportunity of Global E-Readiness Report. Retrieved on Feb. 24, 2005 from http://www.mcconnellinternational.com/ereadiness/EReadinessReport.htm.

Ministry of Education, Singapore. (no date). Are you ready for e-learning? Retrieved on Dec. 19, 2004 from http://www.moe.gov.sg/edumall/rd/research_summaries.htm.

Ministry of Education, Singapore. (2006). Overview of the Masterplan II for IT in Education. Retrieved on Jan. 15, 2006 from http://www.moe.gov.sg/edumall/mp2/mp2.htm

Rosenberg, M. (2000). The E-Learning Readiness Survey. Retrieved on Dec. 19, 2004 from http://www.ucalgary.ca/srmccaus/eLearning_Survey.pdf

Russell, G. and Bradley, G. (1997). Teachers' computer anxiety: Implications for professional development. Education and Information Technologies, 2, 17-30.

The Economist. (2003). The 2003 e-Learning Readiness Rankings: A White Paper from the Economist Intelligence Unit 2003. Retrieved on Dec. 19, 2004 from http://www.eiu.com.

Young, B. (2000). Gender Differences in Student Attitudes Toward Computers. Journal of Research on Computing in Education, 33(2), 204-217.

Ya'acob, A., Nor, N., and Azman, H. (2005). Implementation of the Malaysian Smart School: An Investigation of Teaching-Learning Practices and Teacher-Student Readiness. Internet Journal of e-Language Learning & Teaching, 2(2), pp. 16-25.

Yuen, A. and Ma, W. (2002). Gender Differences in Teacher Computer Acceptance. Journal of Technology and Teacher Education (2002) 10(3), 365-382.

Wang, Y. M. (2002). When Technology Meets Beliefs: Preservice Teachers' Perception of the Teacher's Role in the Classroom with Computer. Journal of Research on Technology in Education, 35(1), p.150-161.

HB and Related Lightweight Authentication Protocols for Secure RFID Tag/Reader Authentication Title

Selwyn Piramuthu

Decision and Information Sciences
University of Florida, Gainesville, Florida 32611-7169
selwyn@ufl.edu

Abstract

The Lightweight authentication protocols are necessary in Radio-Frequency Identification (RFID) applications due to tag-level constraints. Over the past few years, several such protocols have been proposed and analyzed. We focus on the HB protocol and its variants. We show the vulnerability of some of these to attacks on tags, where the adversary pretends to be a valid reader, and propose a modified protocol that avoids this type of attack.

1 Introduction

Radio-Frequency Identification (RFID) tags are poised to supplant barcodes in the very near future. The market for RFID systems including tags, readers, data processors and associated devices has been growing, and is expected to reach US$3B in 2010. Advantages of RFID tags over barcodes are many including their capacity to store more information, and the ease with which they can be read since they don't require line of sight (Finkenzeller, 2002). The primary impediment to their widespread use is their cost. Privacy and security issues also play a major role in the success of RFID tag implementations due to the ease with which the object they are attached to can be identified and/or tracked by an adversary. There also exists a few means to disabling tags from being read (e.g., Blocker tag presented in Juels et al., 2003; Clipped tags presented in Karjoth and Moskowitz, 2005) including cases where the user simply destroys the tag along with the tagged object (Warren, 2006).

Most current implementations of RFID tags are not secure, and can leak data about the object to which it is attached. An adversary can also silently track/monitor the object. Some common types of attacks on RFID tags include eavesdropping, replay attack, man-in-the-middle attack, loss of data including DoS (denial of service) and message hijacking, skimming and forgery (including cloning), and physical attack. Although there are means to protect tags against some of these attacks, vulnerabilities are discovered often enough that there seems to be no such thing as perfect protection (e.g., Bono et al., 2005 show how they defeated the security of an RFID device known as a Digital Signature Transponder manufactured by Texas Instruments that helps secure millions

of highway toll payment transponders and automobile ignition keys; Rieback et al., 2006a present details of virus attack on RFID tags; SCISSEC 2006 presents a DoS attack against Frequency Hopping Spread Spectrum). For excellent surveys on security/privacy issues as related to RFID tags, the reader is referred to Garfinkel et al. (2005) and Rieback et al. (2006b).

When dealing with privacy/security issues in RFID tag implementations, their processing power and memory constraints dictate lightweight authentication protocols. Several researchers have proposed and evaluated protocols that fit the bill of being lightweight and at the same time being secure to a reasonable extent (Avoine and Oechslin, 2005; Dimitriou, 2005; Weis et al, 2004).

One such is the HB protocol that was proposed by Hopper and Blum (2001). The HB protocol is based on the hardness of the LPN (Learning Parity with Noise) problem, hence is deemed secure to the extent the related LPN problem is secure. Although this protocol works well under most circumstances where passive adversaries exist, an active adversary can break its secureness. Juels and Weis (2005) modified HB to include protection against active attacks from adversaries. However, this (HB^{+}) too was not completely secure under certain circumstances (Gilbert et al. 2005). Bringer et al. (2006) later modified HB^{+} to secure it against active attacks from adversaries as described in Gilbert et al. (2005). We show that the protocols (HB^{++} and HB^{++}[first attempt]) presented in Bringer et al. (2006) are vulnerable to active attacks, and present a modified solution.

This paper is organized as follows: we provide a brief overview of HB and its variants in the next section. This is followed by suggested modifications to a recent variant of the

HB protocol (HB^{++}). Section 3 includes brief security analysis of the proposed modifications, and Section 4 concludes the paper.

2 HB and its variants

We briefly describe and evaluate HB and its variants in this section. After providing a brief introduction to the protocols, we consider some security violations that may occur and discuss possible remedies that were provided in the literature. We then propose modifications to HB^{++}, a recent variant of HB.

Notations Used:

a, b: random k-bit binary vectors

x, x', y, y': k-bit secret key vectors

ν**:** noise bit (=1 with probability $\eta \in [0, ½]$)

2.1 HB

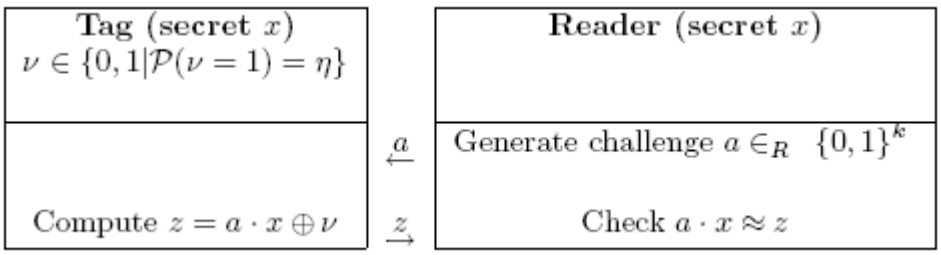


Fig. 1: A round of HB protocol (Hopper and Blum, 2001)

An overview of a round of HB protocol is given in Figure 1. Here, ***a.x*** and **a** $\oplus$ **x** represent scalar product and exclusive-or (XOR) of k-bit binary vectors ***a*** and ***x*** respectively. The HB protocol relies on the computational hardness of Learning Parity with Noise (LPN) problem, and not on classical symmetric key cryptography solutions (Bringer et al., 2006). It is meant only to be secure against passive attacks, and it is not secure against active attacks. The round given in Figure 1 is repeated *r* times and the tag is authenticated if check on the reader's side fails at most η times. A simple active attack where an adversary pretending to be the reader transmits a fixed ***a*** to the tag several times can retrieve the value of ***x***.

2.2 HB$^+$

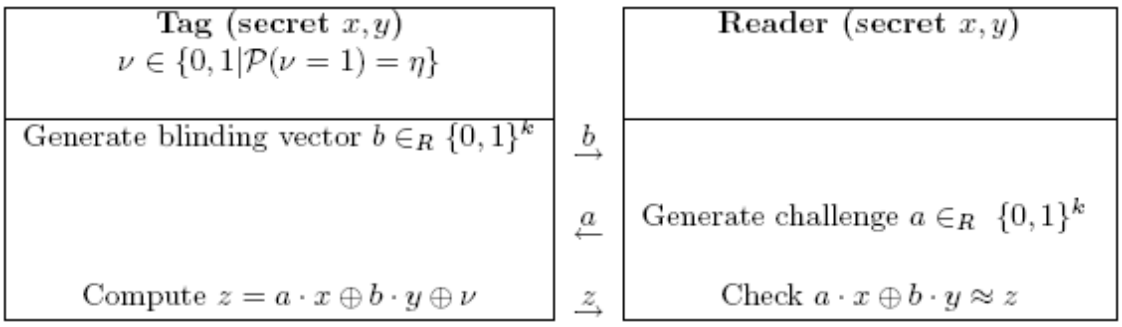


Fig 2: A round of HB$^+$ protocol (Juels and Weis, 2005)

Juels and Weis (2005) modified the HB protocol and showed the modified protocol (HB$^+$) to be secure against active attacks. A round of HB$^+$ is given in Figure 2. They introduced another k-bit vector secret key (***y***) that is shared between the reader and a tag. They also modified the HB protocol such that the tag, and not the reader, initiates the authentication process. The tag first transmits a k-bit blinding vector to the reader. The other modification is in the way ***z*** is computed. A scalar product of the newly introduced secret key (***y***) and the blinding vector (***b***) is XOR-ed with the ***z*** in HB.

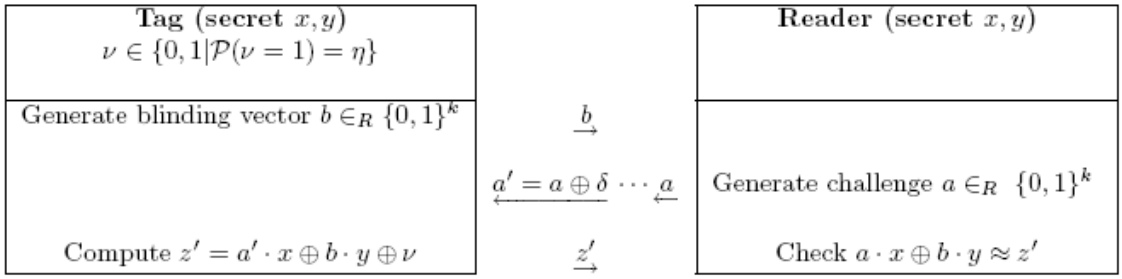


Fig 3: The attack on a round of HB$^+$ protocol (Gilbert at al., 2005)

Although Juels and Weis (2005) showed HB$^+$ to be secure against active attacks, Gilbert et al. (2005) showed that HB$^+$ is not secure against a simple man-in-the-middle attack that was not considered in former. A description of this attack is given in Figure 3. Here, the adversary is assumed to be capable of manipulating challenges sent by a legitimate reader to a legitimate tag during the authentication process. The adversary is also assumed to have the capability to recognize when an authentication procedure succeeds or fails. The core of the attack consists of manipulating the challenge sent by the reader (*a*) by sending the XOR of ***a*** and a constant k-bit vector **δ** to the tag on all *r* rounds of the authentication process. If the authentication succeeds, **δ.*x*** = *0* with a high probability. If the authentication fails, **δ.*x*** = *1* with a high probability. Here, one can manipulate **δ** to reveal each bit of the secret key ***x*** one by one. The protocol can be repeated k times to retrieve all bits of the secret key ***x***.

Once ***x*** is identified, the adversary can impersonate the tag and send a given blinding vector ***b*** to the reader. In return to the reader's response, the adversary can transmit ***a.x*** to the reader. When authentication succeeds, the adversary knows that ***b.y*** = *0* with high probability. On the other hand, if authentication fails the adversary knows that ***b.y*** = *1* with high probability. Using these, the adversary is able to derive the other secret key ***y***. When both the secret keys (***x, y***) are revealed to the adversary, the privacy of this tag is under threat.

The HB$^+$ protocol is not secure against another form of attack from an adversary who pretends to be a valid tag reader. Here, the adversary is assumed to have the capability to intercept all communication between a tag and a reader, and the ability to block transmission of any communication from the tag to the reader. The adversary is also assumed to be capable of transmitting ***a*** to the tag before the tag can initiate the

next round with a new ***b*** value. I.e., the reader repeatedly transmits ***a*** to the tag, keeping it busy computing ***z***s. The following should also work with different **b**s during different rounds of the protocol for small values of k, given that the Learning Parity with Noise (LPN) problem is known to be NP-hard (Berlekamp et al., 1978). Blum, Kalai and

Wasserman provide the best known algorithm for solving the LPN that requires a runtime of $2^{O(k/\log k)}$ (Blum et al, 2003). Earlier, several instances of the LPN problem that were presented by DIMACS were solved by brute force algorithms by several researchers (e.g., Greentech Computing, 1998 using propositional logic; Warners and van Maaren, 1998 using an extension of a variant of DavisPutnam algorithm published in 1960). Warners and van Maaren (1998) solved the LPN problem for keylength k=32 in about 5 minutes. Juels and Weis (2005) estimate the runtime required for the problems presented by DIMACS to be in the order of 2^{24} using the algorithm presented in

Blum et al. (2003). They also estimate that for a keylength of 160, the runtime would be in the order of 2^{64}.

When the authentication process begins as the tag sends ***b***, the adversary intercepts it and transmits ***a=0*** to the tag. The tag then computes ***z*** (= ***b.y*** $\oplus \nu$) and transmits it to the reader, which in this case is the adversary. The process can be repeated enough number of times until ***b.y*** is retrieved. Since ***b*** is known to the adversary, ***y*** can be inferred. Knowing ***a, b***, and ***y***, the process can be repeated until ***x*** is identified. The adversary takes advantage of the fact that communication between the tag and the reader is controlled by the reader - i.e., when the authentication succeeds, the protocol ends. Since the adversary is the reader during this attack, it can continue with as many rounds of the protocol as is necessary until it succeeds in identifying the secrets (***x, y***).

In the effective attack against HB$^+$ proposed by Gilbert et al. (2005), the tag and reader are authenticated by the time the secrets are known to the adversary. It is possible that this tag, once authenticated, may leave the “system" and would no longer interact with any reader. Under these circumstances, the attack presented in the previous two paragraphs has an edge since it happens without any interaction between tag and reader.

2.3 HB^{++}[first attempt] and HB^{++}

Tag (secret x, y, x', y') $\nu, \nu' \in \{0,1 \mid \mathcal{P}(\nu = 1), \mathcal{P}(\nu' = 1) = \eta\}$		**Reader** (secret x, y, x', y')
Generate blinding vector $b \in_R \{0,1\}^k$	$\xrightarrow{b}$	
	$\xleftarrow{a}$	Generate challenge $a \in_R \{0,1\}^k$
Compute $\begin{cases} z = a \cdot x \oplus b \cdot y \oplus \nu \\ z' = f(a) \cdot x' \oplus f(b) \cdot y' \oplus \nu' \end{cases}$	$\xrightarrow{(z, z')}$	Check $\begin{cases} a \cdot x \oplus b \cdot y \approx z \\ f(a) \cdot x' \oplus f(b) \cdot y' \approx z' \end{cases}$

Fig 4: A round of HB^{++}[first attempt] protocol (Bringer at al., 2006)

Tag (secret x, y, x', y') $\nu, \nu' \in \{0,1 \mid \mathcal{P}(\nu = 1), \mathcal{P}(\nu' = 1) = \eta\}$		**Reader** (secret x, y, x', y')
Generate blinding vector $b \in_R \{0,1\}^k$	$\xrightarrow{b}$	
	$\xleftarrow{a}$	Generate challenge $a \in_R \{0,1\}^k$
Compute $\begin{cases} z = a \cdot x \oplus b \cdot y \oplus \nu \\ z' = \mathrm{rot}(f(a), \rho) \cdot x' \oplus \\ \quad \mathrm{rot}(f(b), \rho) \cdot y' \oplus \nu' \end{cases}$	$\xrightarrow{(z, z')}$	Check $\begin{cases} a \cdot x \oplus b \cdot y \approx z \\ \mathrm{rot}(f(a), \rho) \cdot x' \oplus \mathrm{rot}(f(b), \rho) \cdot y' \approx z' \end{cases}$

Fig 5: A round of HB^{++} protocol (Bringer at al., 2006)

In response to Gilbert et al.'s (2005) attack on HB$^+$, Bringer et al. (2006) proposed two protocols (HB^{++}[first attempt] (Figure 4) and HB^{++} (figure 5)) that secures against such man-in-the-middle attacks. However, these protocols are still not immune to attacks from adversary that pretends to be an authentic reader. HB^{++}[first attempt] was shown to not be immune to attacks in Bringer et al. (2006).

Another vulnerability arises from the fact that the protocols HB^{++} and HB^{++}[first attempt] contain ***z*** as in HB+, and this ***z*** can be used to identify the secrets ***x*** and ***y***. This is a vulnerability since the adversary can track the tag knowing only ***z.*** The adversary can easily compute ***z*** using man-in-the-middle attack (Gilbert et al., 2005) or by pretending to be a valid reader as discussed earlier in this section.

Ignoring the possibility of this attack, the adversary still needs to identify the other two secrets (***x',y'***). Here, the adversary is assumed to have the capability to receive transmissions from the tag and block these transmissions from reaching the reader. The adversary can manipulate ***a*** to its advantage to retrieve the secret keys *(**x', y'***). Initially, the adversary can transmit ***a**=0* to determine *f(**b**).**y'***. Once this is accomplished, the adversary can set ***a**=1* to determine ***1.x'*** $\oplus$ *f(**b**).**y'***. The adversary can then identify the secret ***x'*** from *f(**b**).**y'*** and ***1.x'*** $\oplus$ *f(**b**).**y'.***

During the next several rounds of the protocol, the adversary can assign *a=b* and determine *f(**b**). (**x'*** $\oplus$ ***y')***. Knowing this, *f(**b**). **y'***, and ***x'***, the adversary can determine ***y'***.

Bringer et al (2006) modified HB^{++}[first attempt] to rectify a vulnerability they identify and propose HB^{++} (Figure 5) that has protection against these vulnerabilities. However, HB^{++} too is prone to a similar attack where an adversary pretends to be a valid reader. Here, again, ***z*** can be used to retrieve the secrets ***x*** and ***y*** as in HB+. To retrieve the other two secrets (***x', y'***), we make the following assumption: ρ is updated only once during a round, and a round for this purpose is defined as beginning with transmission of ***b*** by the tag and ending with the checking of ***z*** and ***z'*** by the reader. Updates to ρ probably occur at the beginning of each round (Bringer et al., 2006). However, a fast adversary can communicate with the tag several times in-between two successive transmissions of ***b*** by the tag.

As long as ***b*** and ρ remain constant when the adversary is communicating with the tag, the following would help reveal the other two secrets ***x'*** and ***y'***. The adversary is assumed to have the capability to intercept ***b*** transmitted by the tag and to prevent ***b*** from reaching the reader. The adversary can manipulate ***a*** to its advantage to retrieve the secret keys (***x', y'***). Initially, the adversary can transmit ***a**=0* to determine *rot(f(**b**), ρ)*. **y'**. Once this is accomplished, the adversary can set ***a**=1* to determine ***1.x'*** $\oplus$ *rot (f(**b**),ρ).**y"***. The adversary can then identify the secret ***x'*** from *rot(f(**b**), ρ).**y'*** and ***1.x'*** $\oplus$ *rot(f(**b**), ρ).**y'***.

During the next several rounds of the protocol, the adversary can assign ***a=b*** and determine *rot(f(**b**),ρ).(**x'*** $\oplus$ ***y')***. Knowing this, *rot(f(**b**), ρ).**y'***, and ***x'***, the adversary can determine ***y'***.

2.4 Proposed modifications to HB^{++}

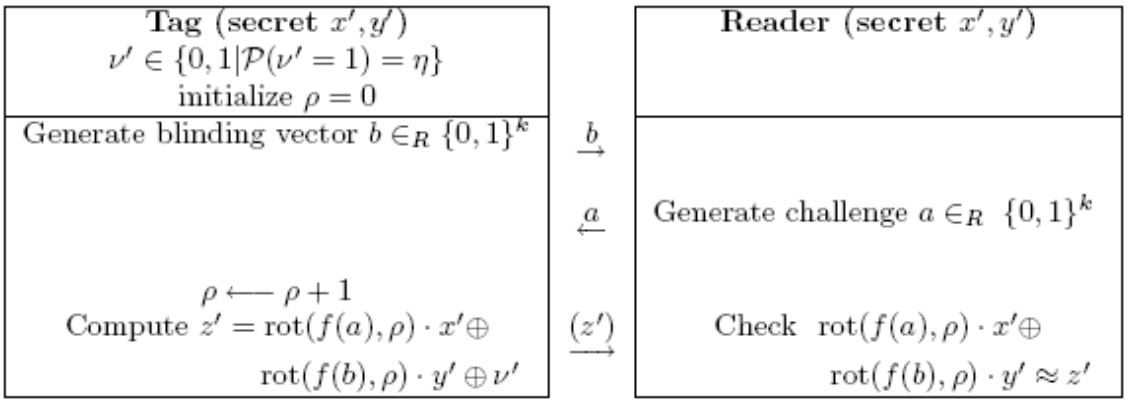


Fig 6: A round of Modified HB^{++} protocol

In order to maintain the proofs of security for the adversary model presented in Juels and Weis (2005), the proposed modifications keep the crux of HB^{+} intact. The main modifications are as follows:

Removal of ***z*** and related vectors (***x,y***) and ν. This is to prevent the attack mentioned earlier. A side effect of this keeps the protocol `lightweight.'

Update *ρ* every time ***z*** is computed. This is to prevent usage of the same *ρ* before initiation of the next round from the tag's end.

The first modification (removal of **z** and its related vectors) prevents the tag from being tracked since it is relatively easy to determine **z** as compared to **z'**. The second modification renders **z'** more secure since it is difficult to determine z' when *ρ* changes everytime **z'** is computed.

3 Security Analysis

Following Dimitriou (2005), we present a brief security analysis on the proposed modifications to HB^{++}.

Attack on a tag. This type of attack refers to the scenario where an adversary pretends to be the reader. Since the protocol is based on avoiding exactly this type of attack, it is hoped that the adversary will not be able to succeed.

Attack on the reader. Here, the adversary pretends to be a valid tag. This type of attack will not succeed because of the shared secret keys (***x'*** and ***y'***).

Attack on the communication between tag and reader. An adversary can block messages between the reader and a tag. When this happens, the authentication process is broken and it doesn't succeed. Repeated interactions, either blocking transmissions

or through man-in-the-middle attacks, leaves the door open for an adversary to learn the secret keys.

Attack on user privacy. Since no `private' information is transmitted during validation, this is of no concern here.

Attack on location privacy. This is of concern since the secrets do not change over different runs of the protocol.

Attack against the key. This happens when an attacker listens in on the transaction and tries to identify the key values. Again, if the keys are selected appropriately (e.g., Lenstra and Verheul, 2001), this is not of concern.

Attack against implementation. Provided the keys and the random numbers are genereted with caution, this is not of concern.

Disassembling the tags. These tags are clearly not tamper-resistant, and can be disassembled to retrieve the structure of z' as well as the secret keys (x', y').

4 Conclusion

We discussed and evaluated HB and its variants for RFID tag/reader authentication. In addition to the security compromises that have been mentioned in the literature, we provided yet another security compromise that can occur due to an adversary pretending to be a valid reader. This threat is worse since the valid reader is not involved when the adversary interacts with the tag to identify the secret keys. We also showed the vulnerability of a recent variant of HB (HB^{++}), and presented a means to avoid this vulnerability. Although the proposed method is not secure against all types of attack by an adversary, it is reasonably secure against those that were considered while maintaining the `lightweight' characteristic of the protocol.

Acknowledgements:

The author would like to thank Professor J. Felix Hampe for his helpful comments

References

Avoine, Gildas; Oechslin, Philippe (2005): RFID Traceability: A Multilayer Problem, In: Financial Cryptography - FC'05, LNCS, Springer, 2005.

Berlekamp, E.R.; McEliece, R.J.; Tilborg, V. (1978): On the Inherent Intractability of Certain Coding Problems, in IEEE Transactions on Information Theory, IT-24, 1978, pp. 384-386.

Blum, Avrim; Kalai, Adam; Wasserman, Hal (2003): Noise-Tolerant Learning, the Parity Problem, and the Statistical Query Model, in: Journal of the ACM, 50(4), July 2003, pp. 506-519.

Bono, Steve; Green, Matthew; Stubblefield, Adam; Juels, Ari; Rubin, Avi; Szydlo,Michael (2005): Security Analysis of a Cryptographically-Enabled RFID Device. In: Procedings of the 14th USENIX Security Symposium, 2005, pp. 1-16.

Bringer, Julien; Chabanne, Herve; Dottax, Emmanuelle (2006): HB^{++}: a Lightweight Authentication Protocol Secure Against Some Attacks, in: IEEE International

Conference on Pervasive Services, Workshop on Security, Privacy and Trust in Pervasive and Ubiquitous Computing -- SecPerU, 2006.

Davis, Martin; Putnam, Hilary (1960): A Computing Procedure for Quantification Theory, in: Journal of the ACM, 7, 1960, 201-215.

Dimitriou, Tassos (2005): A Lightweight RFID Protocol to Protect Against Traceability and Cloning Attacks, in: Proceedings of the IEEE International Conference on Secu-

rity and Privacy for Emerging Areas in Communication Networks - SECURECOMM, 2005.

Finkenzeller, Klaus (2002). RFID Handbook, second edition, Wiley & Sons, 2002.

Gartner (2005): RFID Market $3 Billion in 2010, December 13th, 2005

Gilbert, Henri; Robshaw, Matthew; Sibert, Herve (2005): An Active Attack Against

HB^+ - A Provably Secure Lightweight Protocol, in: IEE Electronic Letters 41, 21, 2005, pp. 1169-1170.

Hopper, Nicholas J.; Blum, Manuel (2001): Secure Human Identification Protocols, in

C. Boyd (ed.) Advances in Cryptology - ASIACRYPT 2001, Volume 2248, Lecture Notes in Computer Science, Springer-Verlag, 2001, pp. 52-66.

Juels, Ari; Rivest, Ronald L.; Szydlo, Michael (2003): The Blocker Tag: Selective Blocking of RFID Tags for Consumer Privacy. In: V. Atluri (ed.) 8th ACM Conference on Computer and Communications Security, 2003, pp. 103-111.

Juels, Ari; Weis, Stephen A. (2005): Authenticating Pervasive Devices with Human

Protocols, in V. Shoup (ed.) Advanced in Cryptology - CRYPTO'05, Volume 3126, Lecture Notes in Computer Science, Springer-Verlag, 2005, pp. 293-308.

Karjoth, Günter; Moskowitz, Paul A. (2005): Disabling RFID tags with visible confirmation: clipped tags are silenced, in: Proceedings of the 2005 ACM Workshop on Privacy in the Electronic Society (WPES05), 2005, pp.27 - 30

Lenstra, Arjen K.; Verheul, Eric R. (2001): Selecting Cryptographic Key Sizes, Journal of Cryptography, 14(4), 2001. pp. 255-293.

Rieback, Melanie R.; Crispo, Bruno;Tanenbaum, Andrew S. (2006a): Is Your

Cat Infected with a Computer Virus? In: Proceedings of 4th IEEE International Conference on Pervasive Computing and Communications. (PerCom 2006), Pisa, Italy, March 2006.

Rieback, Melanie R.; Crispo, Bruno;Tanenbaum, Andrew S. (2006b): The Evolution of RFID Security. In: IEEE Pervasive Computing, vol. 5(1), 2006, pp.62-69.

SCISSEC (2006): RFID DoS Vulnerabilities Uncovered in new UHF Tags, 6 April 2006.

Warren, Susan (2006): Why Some People Put These Credit Cards in the Microwave, in The Wall Street Journal Online, 10 April 2006.

Weis, Stephen A. ; Sarma, Sanjay E.; Rivest, Ronald; Engels, Daniel W. (2004):

Security and Privacy Aspects of Low-Cost Radio Frequency Identification Systems, in: Proceedings of the 1st Security in Pervasive Computing, Lecture Notes in Computer Science,volume 2802, 2004, pp. 201-212.

Applying Biometrics in Customer Relationship Management

Alexandra Bohnet and J. Felix Hampe

University of Koblenz
{ahorn|hampe}@uni-koblenz.de

Abstract

Citizens may be forced to use biometrics in government applications such as a passport or identity card. Customers, however, may voluntarily choose biometric authentication in certain scenarios due to added convenience and the increased speed of certain touch point processes. Despite the investment in implementation, companies could increase security and lower costs in the long run – thus reducing fraud by correctly identifying legitimate users and perhaps by saving on personnel. It is believed that in the long run customers who are pleased with the addition of biometrics will remain loyal. This paper aims to show where companies can implement biometrics in authenticating customers identities and why they should consider it. We claim that customer acceptance of biometric authentication plays a great role for market success. Beside a review of what is involved in biometric processes and a literature review, case descriptions of Automated Border Controls at two European airports are given as examples, plus a retail scenario with a Virtual Customer Card. We aim to pave the way for empirical research on biometrics in CRM by presenting different perspectives.

1 Introduction

Authentication of a person until now has mainly been restricted to ownership (e.g. keys) and knowledge (passwords, PIN) [Armington et al. 2002]. Irritated about the stacks of smart cards and lists of secret passwords that can be easily stolen [Rila 2002], users may be relieved to use the third method of authentication: biometrics. The science of “verifying or identifying an individual based on his or her distinguishing physiological or behavioral characteristics” [Bolle et al. 2004] has been expanded to include an “automated use” [Nanavati et al. 2002] hence allowing users a fast, convenient way of confirming their identity.

Reactions to world-wide terrorism, especially after the attacks on the World Trade Center in New York City on Sept. 11, 2001, caused a renewed interest in using biometrics for security reasons [Nolde 2004]. After some initial applications involving tarmac access control and aircrew processing, increasingly more programs for airlines to cooperate with airport operators and border police for Automated Border Controls (ABC) were initiated [Weimann 2004]. In this way, all partners claim, biometrics can be used

in order to provide increased security, greater convenience and value-added service for the customer – here, the passenger – while perhaps being leaders in providing this technology and enjoying a competitive advantage.

After a short look at where customer touch points are found in Customer Relationship Management, the basics of biometric authentication - including remarks on performance, usability and acceptance – are outlined. Examples of biometric applications in Schiphol Airport in Amsterdam, Frankfurt International Airport in Frankfurt and two Point of Sale (POS) solutions follow. Summary and outlook emphasize the importance of finding the right biometrics for the right situation for the right customer, thus leading us to building up business scenarios for eventual comparison.

2 Research Approach

A literature review revealed that while there are numerous sources on both biometrics and the area of CRM, there is little yet to be found linking the two together. Therefore the relevance of authentication for CRM was used as the starting point for looking at how the biometric process could fit into various scenarios. This viewpoint and the working examples found (many biometric applications do not get widespread commercial use) led to a structured case description. We consider this paper to be a report on work in progress.

3 Customer Relationship Management and Customer Touch Points

There are manifold definitions of CRM given in the literature. For our purposes, substituting “profit” by the term “advantages”, the following definition seems specifically appropriate. According to Shaw [Shaw 1999], “Customer Relationship Management is an interactive process for achieving the optimal balance between corporate investment and the satisfaction of customer needs to generate the maximum profit”. He also goes on to say that activities undertaken by a company should build a “provable causal chain: linking outputs to customer motivation to customer behaviour and thence to outputs.”

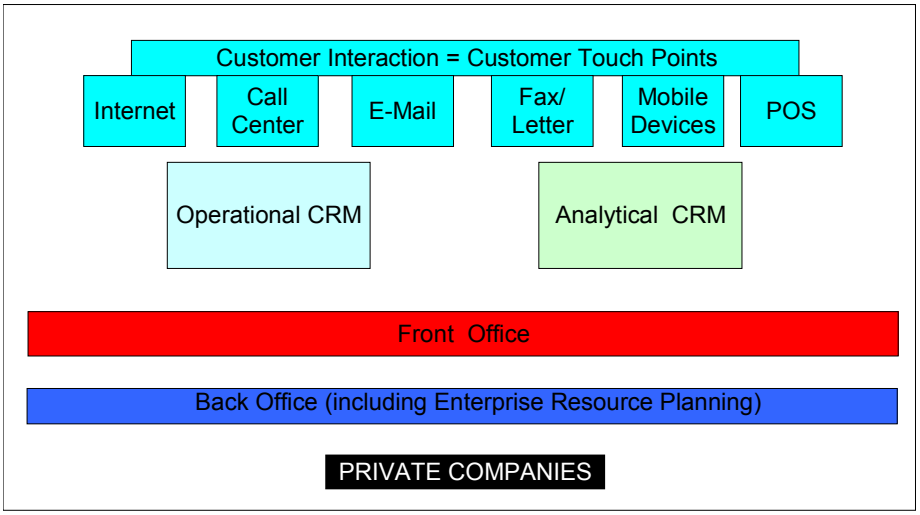


Fig. 1: Company CRM components, based on [Hampe et al. 2002] and [META Group 2001]

The customer interaction, or the touch points (cf. top layer in Figure 1), is where the customer is confronted with the biometric enrolment and authentication process. This can vary from a Point of Sale (POS) payment system where a salesperson is present, to an automated entrance gate. As Seybold writes, that point is undoubtedly important, but "rarely the center of the customer's experience. It's just a way station on the road to a broader goal." [Seybold 2001] Therefore, she suggests that the company create "customer scenarios" in order to visualize the whole experience, from the goal of the contact to the variations and activities that customer carries out. Customers are under steady pressure to get things done quicker, so if a company can think broadly about the challenges their customers face - rather than a narrow view of what to sell them - and truly makes their lives easier, then that will earn their loyalty [Seybold 2001].

Prahalad and Ramaswamy go on to encourage the use of customer competence, by recognizing that tech-savvy consumers can become partners in creating value and they should be included as a part of the "extended enterprise". They believe that customers' expectations can somewhat be shaped by encouraging an active dialogue, managing customer diversity and co-creating personalized experiences. Managing these experiences means giving the customers as much choice and flexibility as possible – especially in the communication and distribution channels, which should evolve. The key challenge here is to ensure that "the nature and the quality of the fulfillment, the personalized experience for the individual, is not very different across the channels." [Prahalad et al. 2001]

As Hampe [Hampe 2004] summarizes, in a world where the products and services are increasingly similar and the customer is better informed, a company needs to introduce new business models and strategies and new technologies to keep the customer bound to the company. The goals are:

- to win new customers in the most cost-effective way possible
- to increase customer loyalty so as to reduce the number of customers that leave
- especially to identify the most profitable customers so that they can be treated in a special way.

In all, the authentication of a customer, whether through ownership, knowledge or biometrics, is important to CRM for monetary and security reasons. If the customer can also recognize these benefits, this leads to trust and eventually increased loyalty to the company.

4 Biometric approaches to authentication

4.1 Verification vs. Identification

Nanavati defines biometrics as the "automated use of physiological or behavioural characteristics to determine or verify identity." [Nanavati et al. 2002] This constitutes biometric authentication. The difference between determining or verifying a person and identifying him/her is a core feature of biometric systems. **Verification** is used when an individual declares a particular identity, presenting a "unique identifier" - such as an ID number - and a biometric measurement [Bolle et al. 2004]. Most biometric systems being used today still rely on the simpler verification [Ashbourn 2000]. Verification can also be referred to as **1:1 matching**: one attempts to prove that the person is who he

declares he is. This method can be said to be the authentication of a known person [Nolde 2002].

Identification, or 1:n matching, is the method that will be most challenging in the future, especially when there will eventually be biometric data from millions of people saved in one system. It takes into account *only* the biometrics, comparing the biometric provided to the whole database in order to find out who that person is [Bolle et al. 2004]. Therefore, we can speak here of the authentication of an unknown person [Nolde 2002].

4.2 General Characteristics of Biometrics

Biometric methods can be split into two categories, according to whether the *behavioural* trait is performed actively (such as voice or signature) or the *physiological* characteristic is collected passively (like fingerprints and iris patterns) [Nolde 2002]. The most popular biometrics in use are fingerprint, face and voice. Iris recognition is increasingly being used in airport scenarios.

Before the generic process for using biometrics is discussed, the properties of the biometric to be chosen should be mentioned as these may influence customer acceptance at the touch point. Bolle lists five “Desirable Characteristics of a Human Identifier” [Bolle et al. 2004]:

Universality - every person should have that biometric

Uniqueness - no two people should have the same biometric trait (i.e. height would not be distinctive enough)

Permanence - the identifier should remain stable over time, and not be changeable

Collectability - the biometric should be easily and quickly collected by a sensor

Acceptability - no user in general should refuse to submit to the collection and measurement of it.

4.3 General Biometric Authentication Process

Regardless of which biometric is used, the basic model is the same for the verification and identification process and is composed of **enrolment, template creation** and **biometric matching**. A template is the mathematical representation of biometric data. After the appropriate biometric has been chosen, the enrolment process can begin. This may take place at the same place/machine where the application is later used (see Hanover Zoo example) or more likely at a special enrolment desk or centre like at the Frankfurt Airport scenario.

The complete process flow of biometric verification and identification is composed of the following steps based on [Nanavati et al. 2002]:

Enrollment starts with the user providing (along with valid documents of his “official” identity) a biometric, which is captured by a sensor. This usually involves more than one picture or print, in order to get a representative impression at the time of enrolment. Long term accuracy depends on quality enrolment at this stage.

The raw data is converted into a ***template*** by *feature extraction*. The template file usually is less than 1 kilobyte in size, allowing it to be easily stored, encrypted and transmitted. The template is stored in either a central database or in a distributed database,

such as a portable token (e.g. smart card), in order to be used for future comparisons. *Enrollment* is complete.

The next time the user approaches a sensor for verification or identification, the biometric data is once again captured and converted into a template during *presentation*. That template is compared to the enrolment templates.

Once an *enrolment or quality score* has been established (which indicates the degrees of similarity between the templates), then it is compared to a pre-set ***threshold*** determined for the system and a *decision* is made. If the score is higher than the threshold, the template is a *match* and that is passed on, i.e. *acceptance* has occurred. If the score is lower than the threshold, the template is a *non-match*, and that result is transmitted, i.e. *rejection* has occurred. The rate of acceptance and rejection are part of the *performance metrics*. A result may also be *inconclusive,* meaning a user may be prompted to provide either another sample or a different proof of identity.

The performance metrics that are crucial to determining the security of a system will not be dealt with in detail here. They are related to the probabilities that unauthorized users are accepted into the system or, almost worse, that authorized users are rejected. High denial rates lead to user dissatisfaction [Rila 2002] and may cause customers to boycott the application. These rates vary greatly under laboratory versus real-life conditions [European Communities 2005]. The fact that anyone can have ownership or knowledge as authentication - but that not all customers will be able to enrol for biometric verification - must not be overlooked.

4.4 User Acceptance

Along with technical factors and implementation factors, Ashbourn devotes much thought to human factors, i.e. the users. Ordinary citizens may accept biometric systems if they can see the related benefits for themselves, but companies have perhaps overemphasized greater security instead [Ashbourn 2000]. He believes that “one of the first key tasks should be an analysis of the prospective user base coupled to some sort of initiative to capture their thinking and response to such a proposal.” [Ashbourn 2000]

The same author stresses four areas that affect the use of a biometric system [Ashbourn 2004]:

User psychology. Traditional biometric performance metrics are not sufficient to predict performance as users and their willingness to comply affect usage.

Individual characteristics. This is a controversial area concerning ethnicity, aging and gender, where relatively little research has been done. Yet the effects of age (e.g. minimum age for enrolment, wear and tear in old age) and other personal attributes should be taken into consideration.

Scalability. Although generally thought to be a technical factor, it affects user populations once they spread to a degree that has not yet been reached (millions of users in a database).

Usability. Linked to scalability, practical usability encompasses the operational environment like ergonomic design and an easy to use interface, plus operational variables such as lighting, humidity, temperature and maintenance.

Troitzsch and Bente [Troitzsch et al. 2004] pointed out in 2004 that usability can also be defined by the ISO certification (ISO DIN 924-11, 1999) as effectiveness, efficiency

and user satisfaction. Usability can be tested by interviews or eye-tracking, plus expert evaluation, but there still a lack of well-documented studies. The only factors so far that have been identified to have an impact on usability have been gleaned from general usability studies on, for example, cultural factors and user characteristics.

In our setup for future research we plan to strongly focus on that specific issue, as it might provide the most important guidance for improved design criteria of biometric applications even in other scenarios (e.g. biometrics for mobile payments, etc.).

4.5 Reasons for Using Biometrics

Biometrics are generally used for the following reasons [Nanavati et al. 2002]:

Increased security. Used for either logical or physical access control, or for a higher certainty as to the verification and identification of an identity, this is often the decisive factor in whether to introduce biometrics or not.

Increased convenience. Replacing knowledge and ownership as methods of authentication can allow greater ease of use for users and the company, and perhaps allow a more complex allocation of rights, where no human intervention is necessary.

Increased accountability. Tied in with security, an automated method of verification does not allow corruption and buddy systems. Better automated auditing and reporting are possible, which may be seen as a deterrent to fraud.

While the above uses are especially valid for biometric verification, Nanavati continues, **fraud deterrence** and **fraud detection** are two main benefits from biometric identification

The user may or may not be in agreement with the above reasons. In certain government applications, there may be no choice (e.g. social benefit card), but as customers, the following factors may affect their behaviour and hence the acceptance of a certain system: technical literacy [National Academy of Engineering 2002]; laws and societal norms [Lessig 2001]; the effect of the media, ethnicity, age, gender, and impact of denial such as denial of physical access or denial of a service [Rila 2002].

The advantages of identifying and authenticating a user for CRM may be to reduce fraud (e.g. preventing the collection of multiple benefits), save on personnel (e.g. avoiding manual checking) and to achieve a competitive advantage [European Communities 2005].

5 Cases of Biometric Applications in Use

Iris recognition used in various airports at Automated Border Controls is the main example in this paper because airports are currently primary areas in which to test biometrics, and security is of such high value, thus encouraging industry and governments to push the current boundaries of use [Dunstone 2003]. Iris recognition, although accounting for only 10% of the biometric market share [Biometric Technology Today 2005],was used since it is regarded as one of the most secure technologies [Daugman 2003]. Other Point of Sale systems illustrate more common uses of fingerprint and face recognition technology.

5.1 Airport Automated Border Controls

In general, one can say that the current situation of checking a passenger only at the border control leaves a gap in security, as there are many opportunities to change identities between the departure and arrival passport controls [IBM 2002]. However, at certain airports, a biometric control point is available after check-in, using a variety of biometrics: fingerprints, face recognition and iris scans. Two major iris Automated Border Control (ABC) programs with strong CRM aspects are explained here.

5.2 Schiphol Airport, Amsterdam, The Netherlands [Privium 2005]

Background: In October 2001, a one-year pilot project using iris scans for an Automated Border Crossing system was started at Schiphol Airport in Amsterdam, The Netherlands. This makes it one of the established iris control airport implementations (it was the world's first airport to employ an ABC using iris recognition), and the first large-scale biometric authentication application in the Netherlands.

The "Privium programme" is unique in that it encompasses more than just biometric verification. The system was "originally conceived as part of a loyalty program to ease the use of facilities by frequent flyers while retaining the ability to track that usage" [Withers 2002]. It was designed to make the time spent at the airport more comfortable, but it turned out to be even more effective, allowing the Dutch Border Police to identify those registered flyers faster and more reliably, i.e. it increased security. These, indeed, are core issues of CRM.

The iris template data is stored on the smart card and not in central databases (as compared to Frankfurt), which may appeal more to the Dutch sense of data privacy.

Originally implemented as a one year test , the success of the program encouraged the Schiphol Group to continue and expand; thus, it was approved in October 2002 by the Dutch Ministry of Justice and the Koninklijke Marechaussee, and Privium is now a fixed element of the airport infrastructure.

Membership: Privium membership comes in two levels, with differing fees and benefits. Privium Basic costs € 99 per year and includes a smart card for fast-track Automatic Border Passage, and separate hand luggage and separate hand luggage dedicated security check lanes. The Privium Plus membership at € 119 per year not only provides the passenger with a smart card for "fast-track" Automatic Border Passage, and the dedicated security check lanes, it also includes priority dedicated parking, valet parking and separate dedicated check-in facilities. The cooperating airlines offer separate check-in desks, which are often the business check-in counters, irrespective of which class the member is flying in. All these services together can significantly cut down the time needed for frequent flyers to enter and fly out of the airport.

Enrollment Statistics: Within three years of introduction, Privium had more than 13,000 registered members

Summary: The airport operator, The Schiphol Group, look to Privium not only to enhance security, provide value-added service to passengers, integrate airlines into a holistic security scheme, and save costs on security personnel (the rest can spend their time on the standard passenger), but also as a means of testing it in order to market it to other airports worldwide. The Privium program is a part of Schiphol's corporate vision: to develop profitable world-wide "AirportCities" that make an airport less like a place that houses airplanes and passengers, and more like a hub for businesses, en-

tertainment, shopping, logistics and information. They have developed a customer-centric strategy that aims for a “unique experience” when a passenger passes through one of their AirportCities, not just an efficient stop in the “travel process”, thus exemplifying the customer scenario previously mentioned. This concept has been exported to other international airports such as JFK in New York and Brisbane Airport in Australia.

5.3 Frankfurt International Airport, Frankfurt, Germany [Bundespolizei 2005]

Background: In February 2004, a six-month pilot project using iris scans for “Automated and Biometrics-Supported Border Controls” (ABG) was started at the Frankfurt International Airport, Germany. The German Federal Border Police (Bundesgrenzschutz or BGS) tried to encourage registration by emphasizing the speed with which a passenger may pass non-Schengen flight passport controls. Both Fraport AG, as the operating company of the Frankfurt Airport, and the Deutsche Lufthansa AG support this project as “yet another way of improving service for passengers”. The Federal Minister of the Interior authorized the project. On the BGS website, the project is carried out in “close consultation” with Fraport and Lufthansa, while the Federal Commissioner for Data Protection monitors the project. The template data is stored in a central database.

Membership: The service is free. Currently run as an extended pilot project, the enrolment only covers the Automated Border Control – a gate with an iris scanner and a passport reader. There is no program as such; hence, no extra benefits are available.

Enrollment Statistics: By September 2005, 15,500 persons had voluntarily registered for the ABC at the Frankfurt Airport, 1,600 of which come from other EU countries.

Summary: Deutsche Lufthansa AG flatly states that they work together with Fraport AG in order to appeal to frequent travellers. They believe that this form of fast check-in will provide additional comfort and convenience, thus achieving “another way of improving service for passengers". On the Lufthansa website, the ABC is found under the section “Bodenprodukt”, which is a ground service. They also sent out letters to frequent flyers in 2004, pointing out the advantages and encouraging registration. Fraport AG is also an airport operator that competes worldwide to offer comprehensive airport management [Fraport 2005].

5.4 Scenarios of Point of Sale Implementations

The first implementation is not only of interest due to its somewhat unusual scenario, but also because it shows how the first biometric chosen was not compatible to the surroundings and target group and was replaced by another.

5.4.1 Hanover Zoo [Hannover Zoo 2005]

This scenario concentrates on verifying authorised users of high value entrance tickets. Over the years, the financial losses resulting from the abuse of many season tickets being lent to family and friends had constantly mounted. With sales of more than 60,000 tickets per season, the zoo management decided that stemming the loss would only be possible by personalizing the tickets, i.e. introducing biometrics.

At first, a fingerprint verification system was chosen in order to verify the holders of the season tickets – by which criteria is not known. In May 2001, five outdoor entry gates were equipped with optical fingerprint scanners and connected to the existing ticketing

and cashier system. Instead of the expected ease of use for visitors and decrease in fraud, the zoo management encountered the following problems: unacceptable error rates, repeated crashes, especially children - over half of the visitors - failed to enrol as the information needed from the fingers were not distinct enough (e.g. the forks or whorls) and therefore were not properly captured and stored. Additionally, visitors found the enrolment procedure (the fingerprint had to be captured three times) too elaborate. In cold weather, the infrared light did not generate a close enough likeness of the lines so that the integrated CCD chips could not extract the templates for comparison to the stored reference data.

As a result, the fingerprint scanners were eventually removed in 2003. Manual controls at the gate were reinstated while the search for a more reliable biometric verification method continued. A successful test with a face recognition system was done under real-time conditions in November 2002. The new tailor-made “Smile and Go!” system was installed in 2003. A special enrolment kiosk was installed in the cashier area near the entrance, allowing immediate registration.

Already within the first season of use, with maximum sales of 1,500 season tickets per day and 10,000 visitors per day, the following advantages were noticed: integration into existing ticketing system caused no problems, the system proved to be very robust under all weather conditions and contactless verification increased user acceptance.

5.4.2 Virtual Customer Card (VCC) [it-werke 2005]

Finally, by giving a rough example from the retailing business, we aim to enhance the scope of potential day-to-day application scenarios in CRM Clearly, given the very few results accessible so far, this case only indicates directions on how to conduct a study design in the future, when more experiences get available.

Customers may be interested in customer card systems, but are often faced with the problem of having the card with them, or losing out on the points/miles/discounts offered by enrolling in the bonus systems. The same German company, it-werke, that developed the digiPROOF® fingerprint payment system that has been introduced into EDEKA supermarkets in southern Germany has also come up with the iCARD™, a Virtual Customer Card that won the “Business in Baden” Innovation Prize 2004 in Germany.

Made especially to aid in customer retention, the iCARD™ works as the standard bonus card – except that the card does not exist. Instead, customers enrol in the system with a fingerprint and all further purchases and bonuses are tallied by the scanner and computer, with a receipt if desired. The system can be expanded to accommodate other functions such as payment, process authorization or proof of membership without changing the hardware. Customers can check their account on the internet and the module for this can easily be integrated into a company’s website. The goals of such a card are comfort and acceptance for the customer (as no plastic card needs to be presented), reduction of costs since the cards are eliminated and administration is minimal, reduced management effort and costs since resetting or loss of card is eliminated, plus flexibility and scalability are possible (can be expanded to all branches).

At the end of 2005, two Wagener department stores in Baden-Baden, Germany, introduced the VCC. After only six weeks, over 10% of customers were using the “Touch and Pay” system. The store owners clearly see advantages in identifying buying patterns, tailoring advertising, and saving on the plastic cards. The customers need no re-

ceipts in order to return items and are credited with 1-5% of their purchases as a reward for enrolling their biometric pattern into the system.

6 Summary and Outlook

The enterprises that have made the decision to install biometrics are pleased with their leading role and seem to intend to stay in for the long run. Although the installations have not been inexpensive, customer convenience and satisfaction on the one hand, plus the customer's authentication for the company (for example, the airports) on the other, is the trade-off for now. The companies depend upon the systems chosen as being scalable for their customer projections. The customers, for their part, trust the companies with their personal data, thus showing that corporate privacy policies can result in financial payoffs [Cavoukian et al. 2002]. **Customer acceptance** is crucial to continued use of any system, and is affected by many factors such as usability, technical literacy, laws, societal norms, the effect of the media, ethnicity, age, gender, and impact of denial (such as denial of access or a service).

While it-werke and their retail installations may be most concerned with freeing customers from PINs, cards, signatures and reducing waiting lines, the side effects of observing buying habits and building customer loyalty is enticing. The Hanover Zoo needed to reduce financial losses due to the unlawful use of season's tickets by other visitors, and thus the success of the face recognition there will encourage applications in other similar areas such as theatres, soccer stadiums, museums, swimming pools, student unions. Hence, wherever verification can take place with no great security risks, the cost/benefit analysis is positive due to a large number of potential customers [Ziegler 2003].

Interesting to note in these examples is that on the one hand there was a fingerprint system company looking to spread its application, and on the other hand there was a zoo seeking to find the right biometric application for its situation (and was not successful the first time). The whole customer scenario must be looked at, and not only must institutions decide first of all which biometric is appropriate for their particular situation - e.g. due to customer acceptance, cost, location or climate - but also which company and components will be suitable for the deployment. Otherwise the result will be high failure rates. The **target group** must also be taken into consideration, as e.g. in Hanover, the children could not always be properly scanned, although they make up a large proportion of visitors. In this respect, cultural variations on world-wide applications must also be considered (e.g. respecting physical privacy).

The ultimate success factors will be: Will biometric solutions work reliably? Will they be financially acceptable? Will my customers accept them ? To incorporate all these thoughts, it is advantageous that systems be planned with biometrics right from the start and not added as an afterthought.

In the next phase of our research, we aim to link concepts and results from research frameworks like "Price of Convenience" [Ng-Kruelle et al. 2005] thus enhancing the discussion by incorporating the underlying privacy issues. Furthermore we intend to analyse additional structured case studies and their comparison in more detail, thereby reflecting on the ongoing debate on biometrics in CRM from an application perspective.

References

Armington, J.;Purdy, H.;Koznek, P.Martinez, R. (2002): Biometric Authentication in Infrastructure Security, in: Proceedings of the InfraSec 2002, Bristol, U.K., LNCS 2437, 2002, pp. 1-18.

Ashbourn, J. (2000): Biometrics: Advanced Identity Verification. The Complete Guide., Berlin et al: Springer, 2000.

Ashbourn, J. (2004): Practical Biometrics. From Aspiration to Implementation, Berlin et al: Springer, 2004.

Biometric Technology Today. (2005): 2004 Market Review, Biometric Technology Today, January 2005, from http://www.compseconline.com/free_articles/bttjan05.pdf

Bolle, R.;Connell, J.;Pankanti, S.;Ratha, N.Senior, A. (2004): Guide to Biometrics, New York: Springer, 2004.

Bundespolizei. (2005): Bundespolizei, from http://www.bundespolizei.de/cln_030/nn_484498/DE/Home/Automatisierte__Grenzkontrolle/Automatisierte__Grenzkontrolle__anmod.html__nnn=true

Cavoukian, A.Hamilton, T. J. (2002): The Privacy Payoff. How Successful Businesses Build Customer Trust., Toronto: McGraw-Hill Ryerson, 2002.

Daugman, J. (2003): Iris recognition: Enhancing airport security, efficiency and convenience, in: international airport review, pp. 15-21.

Dunstone, T. (2003): The use of biometric tetchnology in airports, from http://www.biometricsinstitute.org/bi/Articles/0303_AirportReview1.pdf

European Communities. (2005): Biometrics at the Frontiers: Assessing the Impact on Society, from http://europa.eu.int/comm/justice_home/doc_centre/freetravel/doc/biometrics_eur21585_en.pdf

Fraport. (2005): Fraport, from http://www.fraport.de

Hampe, J. F. (2004): Notes from 'Wirtschaftsinformatik der Dienstleistungsindustrie: CRM', from http://www.uni-koblenz.de/~hampe/lectures/WiDi/WiDi-060.pdf

Hampe, J. F.Schwabe, G. (2002): Mobiles Customer Relationship Management, in: Reichwald (Ed.), Mobile Wertschöfpung, 21 pages, Wiesbaden: Gabler, 2002.

Hannover Zoo. (2005): Hannover Zoo, from http://www.zoo-hannover.de/zoo-hannover/en/zoo_v3/home.php

IBM. (2002): IBM looks airline security in the eye, from http://www-1.ibm.com/industries/wireless/doc/content/news/pressrelease/291888104.html

it-werke. (2005): iCARD, from http://www.it-werke.de/html/icard/

Lessig, L. (2001): Preface to a Conference on Trust, from http://www.lessig.org/content/archives/prefacetoaconference.pdf

META Group. (2001): Provisioning the CRM Ecosystem: Assessing Technology Risk.

Nanavati, S.;Thieme, M.Nanavati, R. (2002): Biometrics. Identity Verification in a Networked World, New York, Toronto: John Wiley & Sons, Inc., 2002.

National Academy of Engineering. (2002): Technically Speaking: Why All Americans Need to Know More About Technology, from http://www.nae.edu/nae/techlithome.nsf

Ng-Kruelle, G.;Swatman, P.;Hampe, J. F.Rebne, D. (2005): A Multi-Perspective Framework for System Design: Measuring Price of Convenience Dynamism in End-User Encounters with Innovation, in: Proceedings of the 18th Bled eConference, Bled, Slovenia2005.

Nolde, V. (2002): Grundlegende Aspekte biometrischer Verfahren, in: NoldeLeger (Ed.), Biometrische Verfahren. Körpermerkmale als Passwort. Grundlagen, Sicherheit und Einsatzgebiete biometrischer Identifikation, 20-34, Köln: Deutscher Wirtschaftsdienst, 2002.

Nolde, V. (2004): Applying biometric systems today: The right decision?, in: Proceedings of the Second International BSI Symposium on Biometrics 2004 - BIometrics in the Reflection of Requirements, Ingelheim 2004, pp. 123-128.

Prahalad, C. K.Ramaswamy, V. (2001): Co-opting Customer Competence, in (Ed.), Harvard Business Review on Customer Relationship Management, pp. 1-25, Boston: Harvard Business Press, 2001.

Privium. (2005): Privium from www.privium.nl

Rila, L. (2002): Denial of Access in Biometrics-Based Authentication System, in: Proceedings of the InfraSec 2002, Bristol, U.K., LNCS 2437, 2002, pp. 19-29.

Seybold, P. B. (2001): Get Inside the Lives of Your Customers, in (Ed.), Harvard Business Review on Customer Relationship Management, pp. 27-48, Boston: Harvard Busines School Press, 2001.

Shaw, R. (1999): CRM Definitions - Defining customer relationship marketing and management, in: SCNEducation (Ed.), Customer Relationship Management - The Ultimate Guide to the Efficient Use of CRM, 23-30, Braunschweig/Wiesbaden: Vieweg., 1999.

Troitzsch, H.Bente, G. (2004): Usability and Acceptance Issues in Biometric Security Technology, in: Proceedings of the BioSec 1st Workshop, Barcelona, 2004.

Weimann, D. (2004): Pilot Project "Automated and biometrics-based border checks (ABG)", in: Proceedings of the Second International BSI Symposium on Biometrics 2004 - BIometrics in the Reflection of Requirements, Ingelheim, 2004.

Withers, S. (2002): Biometrics special: Who are you?, from http://www.zdnet.com.au/news/security/0,2000061744,20266478-1,00.htm

Ziegler, P.-M. (2003): Adlerauge. Europas größte Gesichtserkennungsanlage im Zoo Hannover, c't 9/2003, p. 26: Biometrie, from http://www.heise.de/ct/03/09/026/

Pathways Home: developing & deploying technology to support patient empowerment in the self-management of chronic illness in the community

Elizabeth Cummings[1] and Paul Turner[2]

[1] University of Tasmania and Smart Internet Technology CRC
Elizabeth.Cummings@utas.edu.au

[2] University of Tasmania and Smart Internet Technology CRC
Paul.Turner@utas.edu.au

Abstract

This research-in-progress paper presents an examination of, and reflections on, the challenges of using information and communication technologies (ICTs) to support community-based patients suffering chronic respiratory conditions to achieve increased levels of self-management and self-efficacy. The research highlights how building genuine patient-centred systems that do not simply replace dependency on health professionals for dependency on technology presents significant conceptual and practical difficulties. More specifically, in the age of customisation it also opens up discussions on how 'individualised care' can be supported by systems that need to be able to support a cohort of patients and what this implies about the end-points IS research tends to implicitly presume in its system development life cycles.

1 Introduction

The growing crisis in health care delivery is, at least, partly attributable to the increasing incidence of chronic illness and/or complex medical conditions associated with the rapidly ageing populations of most 'first world' countries. There have been numerous responses to chronic illness including one set of approaches that emphasize the importance of enfranchising the patients and/or their carers to become co-participants in their own care. At the most basic level, these approaches are premised on assumptions that patients are both able and willing to participate, that their involvement will improve disease treatment, management and education and the net result will be positive results in terms of health outcomes. To date, the wide range of methodologies and assessment procedures used by those implementing these approaches has made comparisons of efficacy difficult. Although most evaluations have reported some benefits, it is evident that considerable complexity and uncertainty remains around how best to support self-management of chronic illness (Warsi et al., 2004).

Alongside these approaches, e-Health and the development and deployment of information and communication technologies have also been promoted as a way of addressing the health crisis. Again, it is noticeable that these approaches are underpinned by assumptions that downplay the socio-technical, clinical and legal challenges that need to be overcome before benefits are realised. Indeed, despite some evidence about the positive role technology can have on the self-management of chronic illness (Celler et al., 2003) more general strategic evaluations of eHealth research raise concerns about the claims made. While much research reports positive benefits from technology use in health, serious questions have recently been raised about the reliability of many of these results and revealed how many measures of success have little to do with improvements in patient care or outcomes (Wyatt, 2004).

From the above discussion, it is evident that approaching the development and deployment of technology to support self-efficacy and self-management of chronic illness amongst community-based patients is highly complex. As a result the research approach adopted in this paper was based on recognition of the need to ensure a detailed understanding of the patients, their needs and complex interactions with health professionals, the health system and their wider social environment. At a practical level, this approach was underpinned by the insight that "finding out prior to design what the unique requirements are, and designing to support them, is much more cost-effective in the long run than finding out after launch that your design does not meet requirements" (Mayhew, 2001).

This paper adopts a patient-centred approach in its examination of, and reflections on, the challenges of using information and communication technologies (ICTs) to support community-based patients suffering chronic respiratory conditions to achieve increased levels of self-management and self-efficacy. From within discourses on how to support patient empowerment, the research reviews literature on a range of approaches advocated for building self-efficacy and self-management based on existing models of chronic disease management. From an information systems perspective, this research is informed by theoretical insights drawn from a range of approaches that indicate that successful design and deployment of technology rely on understanding users needs and ensuring technology is both easy to use and useful (Singh et al., 2003). The research highlights how building genuine patient-centred systems that do not simply replacing dependency on health professionals for dependency on technology presents significant conceptual and practical difficulties. More specifically, in the age of customisation it also opens up discussions on how 'individualised care' can be supported by systems that must support a cohort of patients and what this says about the end-points IS research tends to implicitly presume in its system development life cycles

2 The Pathways Home for Respiratory Illness Project

The 'Pathways Home for Respiratory Illness Project' (Pathways Home) is a collaborative effort involving researchers from the School of Medicine, School of Nursing and School of Information Systems, University of Tasmania. The project is supported by the Tasmanian Department of Health and Human Services and funded by the Commonwealth Department of Health and Ageing through the Australian Health Care Agreement and is due for completion in June 2008. Pathways Home aims to assist two cohorts of patients: those with Chronic Obstructive Pulmonary Disorder (COPD) and those with Cystic Fibrosis (CF) to achieve increased levels of self-management, self-efficacy and empowerment in relation to their respiratory conditions. This paper is fo-

cused only on the COPD cohort. The project provides mentoring services via community health care nurses and the use of technology to support electronic self-monitoring techniques. These changes in care delivery involve ensuring that patients "have the confidence and skills to manage their condition; the most appropriate treatments to assure optimal disease control and prevention of complications; a mutually understood care plan; and careful, continuous follow-up" (Wagner et al., 2001: 66). The technology allows the patient to collect and view graphically data on their daily symptoms. This information is also available to the nurse mentor and respiratory clinician. The project aims to investigate whether patients become able to increase their capacity to identify, understand and respond appropriately to alterations in their condition in a manner that will prevent severe exacerbations and reduce hospitalisations. The overall aim of Pathways is to evaluate the impact of these newly acquired skills for improving health outcomes at individual and population levels, to evaluate the sustainability of maintaining and expanding the project and its applicability to other chronic illnesses.

The focus on chronic illness is directly related to the fact that up to 75% of patients presenting for healthcare have chronic conditions (Fries et al., 1993). COPD is the fourth leading cause of death in Australia and a significant cause of morbidity. It consumes $2.5 billion (8%) of Australian health expenditure and accounts for 8% of deaths (AIHW, 1998). Extrapolated from national figures COPD is estimated to affect over 7000 Tasmanians, with over 450 new cases being diagnosed each year (NSW Health, 2003). Hospitalisation of COPD patients is often precipitated by an exacerbation requiring acute care support. These patients often have little or no contact with the acute care sector between exacerbations, with varying degrees of input from community health sectors and sporadic contact with specialists or general practitioners (GPs). Best practice suggests that developing seamless models of care reaching across the acute care/ community interface, incorporating education, rehabilitation and medical and patient self management would be most suited to meet the dual requirements of improved outcomes for patients and a decrease in hospital bed days for this group of patients. Supported early discharge and home based care of patients with exacerbations of COPD have shown promising results with positive responses from patients, carers and health care providers and demonstrated savings made in the terms of cost (Barnett, 2004). The project also draws on existing, validated monitoring tools, such as the St George's Hospital Respiratory Questionnaire in conjunction with project developed evaluation tools focused on monitoring a range of elements relating to respiratory physical symptoms (sputum, breathlessness, cough and spirometry) as well as the use of sense of wellbeing, level of self-efficacy, depression and anxiety scales.

2.1 The Project Team

The project team consists of a small multidisciplinary group including respiratory clinicians and researchers from nursing and information systems. Team formation and the process of negotiating positions, roles and decision-making processes within the team was undertaken during the initial phase of the project. As has previously been noted, the navigation of power relations is always an important factor in multi-disciplinary team formation, but the experience of the Pathways Home project appears to indicated that this is particularly so within the medical field where existing perceptions on the role of patients and questions over clinical autonomy and care delivery need to be addressed 'head-on' in building a patient centred approach (Atwal and Caldwell, 2005).

On a practical level, it is also useful to acknowledge that despite the strong support across the team for a patient centred approach the requirement for project plans, ethics approvals and time-lines led to many of the early decisions on project design and implementation being taken exclusively by the team. However, it is also worth acknowledging the considerable domain knowledge of team members and strenuous efforts put into validating any assumptions made about the patient cohort prior to interactions with any recruited patients. It is also noteworthy that as patients have become directly involved and experienced with the project how their capacity for engagement and the provision of input on how they would like their needs supported by the technology. For example, in relation to the interface used by patients for daily diary entries and in how longitudinal data views of these entries were provided. The project also flexibly supports patients to build self-efficacy without technology via paper-based diaries with any subsequent decision to migrate to an electronic solution driven by the patients themselves.

2.2 The Participants

As indicated above, alongside the research team themselves there are two main groups of project participants involved in the Pathways Home project ie. mentors (Community Health Nurses) and the patients. The mentor group of Community Health Nurses have an important role to act in partnership with the patients assigned to them to facilitate their development of self-efficacy and self-management. This paper is focused primarily on the experience of patients as it relates to the challenges of developing and deploying technology. Therefore, no further remarks will be made about the mentor group. The patients in the COPD cohort are generally older individuals between the ages of 50 and 90. Many of the COPD patients have little or no experience with information technology and many also have other medical conditions that impose challenges of technology use, for example, physical manipulation and/or visualisation of small pieces of equipment can be problematic. This has implications for the technology design and implementation.

3 Technology Development and Deployment: building a patient centred approach.

Numerous approaches to systems analysis and design recognise that involving users is an important aspect of system design and deployment. Indeed, there is now a large volume of research into the adoption and use of technologies that reveals that to increase the probability that a consumer technology will be successful it is important that it meet the following criteria:

- To be easy to use;
- To provide relative value – in terms of cost, convenience, mix of channels or better ways of conducting the activity;
- To have acceptable social and cultural meanings
- To support the generation of trust (Singh et al., 2003).

Within the Pathways Home project, the approach leveraged insights drawn from a range of sources that have deployed user centred methodologies in multidisciplinary settings (Barnard and Grudin, 1988; Grudin, 1990; Giaglis, 2001; Iivari et al., 2001; Mayhew, 2001; Singh et al., 2003). However, due to several project constraints it was

also necessary to find a method for incorporate insights from these user-centred approaches into rapid development techniques including feature driven development (FDD) and UML modelling. From the literature it is clear that FDD has had some success in enabling translation and communication with non-technical staff. As a result to ensure balanced engagement across the multidisciplinary team it was decided that of the approaches that were available that FDD was the most appropriate design/development method.

Within this context it was also evident that the system being built was for use by a cohort of users, many of whom would have had no or very little exposure to computers and the Internet. As a result, because the overall system needed to fulfil the requirements of patients, mentors and the research team, it was decided to build feature sets rapidly for each cohort and then to model the relationships between. The development actually combined UML modelling and feature driven development. This worked very well as a conduit for conceptually mapping the project out for the team and stimulated vigorous discussion within the team about how elements of self-efficacy around COPD would interact with the patients and/or mentors capacity to use the technology. Ultimately, these interactions produced an innovative approach that produced a range of ways for participants to interact with the project and produced a staged approach to the roll-out of the technology. Unfortunately, the disadvantage of this process was that development actually became more prolonged than had been initially anticipated, despite the fact that it was supposed to be a rapid development process. In essence, the project team decided that it was critical to provide project participants with the opportunity to build experience in self-efficacy and self-management prior to trying to introduce any technology. As a result the team had an opportunity to interact with the patient cohort and acquire a detailed understanding of individual patients situations.

In this regard, the information systems researchers in the team also developed a deeper understanding of the conceptual framework underpinning patient empowerment that was to be supported by the technology solutions being developed. Within the area of chronic illness two important elements of this patient-centred approach are the concepts of self-efficacy and self-management. Following Bandura (1994) self-efficacy is defined as: “people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave. Such beliefs produce these diverse effects through four major processes. They include cognitive, motivational, affective and selection processes” (Bandura, 1994: 71). Closely aligned to self-efficacy is the concept of self-management that involves individual chronically ill patients working in partnership with their carers and health professionals to manage their illness. Adapting the Flinders Human Behaviour & Health Research Unit (2004) approach, the aim in this project is to ensure that patients are able to self-manage to the extent that they have knowledge of their condition and various treatment options, negotiate a plan of care and review/monitor the plan, engage in activities that protect and promote their health, monitor and manage the symptoms and signs of the condition, and manage the impact of the condition on physical functioning, emotions and interpersonal relationships.

From a technology perspective, interactions with patients revealed that patients exhibited diverse levels of physical and psychological capacities as a result of their illness as well as a wide range of abilities, experiences, support mechanisms and interests in re-

lation to participating in the project, building self-efficacy and self-management competencies, and, adopting and utilising technology.

Significantly, the research team were explicitly aware that the technology in itself would not produce self-efficacy, but rather by supporting an environment through which the process of daily monitoring of symptoms and making associations between each of the symptoms and the actions required to improve how the individual feels might. As a consequence, patients are able to collect and view daily symptom data through their own paper or electronic diaries and also have access to longitudinal views of their diaries as an aid to their development of self-efficacy and self-management skills.

Critically, the project team remain keen to avoid the possibility that any technology system introduced will end up simply replacing patient dependency on health professionals with a dependency on the technology, where patients end-up undertaking the monitoring of their symptoms without actually developing the self-efficacy and self-management skills necessary to respond to changes in their illness. As a result, the project team continue to make considerable efforts to identify and accommodate the range of patient characteristics from amongst potential users of the system in the design, deployment, training and use of the technology developed. In essence, this involved providing a variety of different accessibility tools and the provision of an extensive range of data entry methods to enable accessibility for all members of the disease cohort. The team are also monitoring individual patient's development of self-efficacy with awareness that the need to utilise the technology may itself reach an end-point and no longer be required.

More specifically, this resulted in the following aspects of the tailored solution developed:

- At the level of systems architecture the project relied on four application modules: the research management system, the participant portal, the mentor portal and the workflow system. The research management system, participant portal and mentor portal are all web-based applications built using Oracle HTMLDB 1.5 (Application Express), The applications operate on a Mac OS X Server (V10.4) running the Oracle 10G Database environment and HTTP server. The web-based applications were secured using the Oracle HTMLDB built-in authentication scheme, with user sessions accessed via HTTPS and encrypted using a 128 bit SSL Certificate. Workflow was implemented using XForms and Microsoft's Infopath 1.5 Forms.
- At the level of hardware/software project participants were provided with the following equipment: Mentors received laptop computers running a full suite of Microsoft applications including InfoPath 1.5 forms. COPD patients received desktop computers with accessibility options tailored to users needs including the use of track-balls. CF Patients will receive Hand-held wireless enabled Pocket PCs. Different interfaces were also developed in response to on-going patient feedback.
- At the level of education and training on self-efficacy and self-efficacy mentoring: all team members and mentors participated in an intensive two day work-shop on training in self-efficacy and mentoring and capacity building in self-efficacy
- At the level of education and training on information systems: mentors and patients were given an initial assessment to identify skills/capabilities. This was fol-

lowed by tailored training of mentors (community health nurses) and patients on an individual basis to stimulate adoption and usage.

- From the perspective of the research team the database was designed to collect all information from the forms generated and used by the mentors; all the information entered by patients in their daily diaries and on-going action-plans as well as data and web-logs for use to generate usage patterns statistics. A document management system and archive of qualitative field notes was also maintained (Cummings and Turner, 2006).

4 Discussion and Conclusions

The Pathways Home project is being developed within a broader context of patients becoming aware of the possibilities for them to participate more actively in their own care. Within chronic disease management there is also a growing awareness of the need to integrated approaches across the hospital and community care divide. While it is still early preliminary insights from home-based care of patients with exacerbations of chronic obstructive pulmonary disorder (COPD) are showing promising result for the patients, their carers, and health care professionals as well as leading to reductions in overall cost of care.

As this research-in-progress paper has revealed there is a need to be wary of simplistic arguments around how benefits will be generated through the introduction of technology and self-management and to genuine need to consider underlying assumptions about the role, impact and importance of information, given that it is one factor among many that influence health attitudes, perceptions, actions and outcomes. More specifically as interventions supporting self-management become more common there is a need to consider how assessments of benefit in terms of a cohort of patients inform us about individual patient's experience and what this implies for terms like 'individualised care' or 'patient empowerment' (Muir Gray, 2004). If patients are supported to monitor their conditions it will have to be both in relation to strict clinical indicators provided by the clinicians through evidence based medicine, and also individual indicators or triggers that the patient themselves may identify as important or subsequently identify as a result of the documented self-management process. This approach acknowledges that patients are individuals and not merely bundles of clinical indicators. In this way the project is moves self-management away from simply another medical intervention to open up the possibility of supporting individualised care through the patient and his/her interactions with health professionals and the health care system. Following Muir Gray (2004) this involves:

- Informing and educating patients about self-management and about their condition;
- Encourage patients to reflect on their options and relate these to their own personalised priorities;
- Facilitate individualised/personalised care interactions with health professionals based on an awareness of individual patients preferences and self-expressed priorities and self-management experiences;

These considerations are essential if we are serious about encouraging patient self-management as it must be anticipated that the experience will change patients' percep-

tions, expectations and decisions with regard to their chronic disease in ways that may be different from conventional clinical practice (Cummings and Turner, 2005).

More broadly, for information systems researchers there are conceptual and practical implications arising from attempting to build and implement patient centred systems. At the conceptual level, conventional systems development life cycles tend to have on-going maintenance of the system as a final step premised on the assumption that the system will be successful and that it will be continuous but also implying a system where the technology will remain central. However, within the context of the Pathways Home project we also need to consider how to prevent building in such technology dependence amongst the patients in order that real self-efficacy is achieved. At the practical level, there are also challenges around the extent to which needs expressed patients are implemented and how this design dialogue involves between the researchers and individual patients as well as for the patient cohort as a whole.

This research paper has examined and reflected on some of the challenges of using ICTs to support community-based patients suffering chronic respiratory conditions to achieve increased levels of self-management and self-efficacy. The research highlights how building genuine patient-centred systems that do not simply replace dependency on health professionals for dependency on technology presents significant conceptual and practical difficulties. From a technology perspective, this work is informed by theoretical insights draw from a range of approaches that indicate that successful design and deployment of ICTs rely on understanding users needs and ensuring technology is both easy to use and useful (Singh et al., 2003). This paper has introduced the possibility that systems can be developed with a planned withdrawal phase and that this is a valid challenge to the current systems development life cycle.

References

AIHW (1998) " Australia's Health 1998, Sixth biennial health report No. AUS 10" In: Health and Welfare Expenditure seriesAustralian Institute of Health and Welfare, Canberra.

Atwal, A. and Caldwell, K. (2005) "Do all health and social care professionals interact equally: a study of interactions in multidisciplinary teams in the United Kingdom" In: Scandinavian Journal of Caring Sciences, 19, 268-273.

Bandura, A. (1994) "Self-efficacy" In: Encyclopedia of human behavior, Vol. 4 (Ed, Ramachaudran, V. S.) Academic Press, New York, pp. 71-81.

Barnard, P. and Grudin, J. (1988) "Command Names" In: Handbook of Human-Computer Interaction(Ed, Helander, M.) North-Holland, Amsterdam.

Barnett, M. (2004) "Supported discharge for patients with COPD" In: Nursing Standard, 18, 33-38.

Celler, B., Lovell, N. and Basilakis, J. (2003) "Using information technology to improve the management of chronic disease." In: Med J Aust., 179, 242-6.

Cummings, E. and Turner, P. (2005) "Pathways Home: Considerations for Technology Solutions aimed at Supporting Self-management of Chronic illness." In: HIC 2005(Eds, Grain, H. and Wise, M.) Health Informatics Society of Australia (HISA), Melbourne, Australia.

Cummings, E. and Turner, P. (2006) "Considerations for deploying web and mobile technologies to support the building of patient self-efficacy and self-management of chronic illness" In: Web Mobile-Based Applications for Healthcare Management(Ed, Al-Hakim, L.) Idea Group, Inc, (Forthcoming).

Flinders Human Behaviour & Health Research Unit (2004) http://som.flinders.edu.au/FUSA/CCTU/Home.html, 19/09/2005.

Fries, J., Friday, G., Gira, C., Cooper, P., England, M., Graves, R., Sokolov, J. and Wright, D. (1993) "Reducing healthcare costs by reducing the need and demand for medical services" In: New England Journal of Medicine, 329, 5-9.

Giaglis, G. M. (2001) "A Taxonomy of Business Process Modeling and Information Systems Modeling Techniques" In: International Journal of Flexible Manufacturing Systems, 13, 209-228.

Grudin, J. (1990) "The Computer Reaches Out: The Historical Continuity of Interface Design" In: CHI 90 ProceedingsACM.

Iivari, J., Hirschheim, R. and LKlein, H. K. (2001) "A Dynamic Framework for Classifying Information Systems Development Methodologies and Approaches" In: Journal of Management Information Systems, 17, 179-218.

Mayhew, D. J. (2001) Investing in Requirements Analysis, http://www.taskz.com/ucd_invest_req_analysis_indepth.php, 01/07/2005.

Muir Gray, J. A. (2004) "Self-management in chronic illness" In: The Lancet, 364, 1467-8.

NSW Health (2003) NSW Clinical Service Framework Chronic Respiratory disease (Volume1), http://www.health.nsw.gov.au/pubs/c/pdf/chronic_resp_vol1.pdf, 02/02/2005.

Singh, S., Turner, P., Burke, J. and Castro, M. (2003) "The Discovery Phase of User-Centred Design: Putting Users First in the Design of Smart Internet Technologies" In: Fourteenth Australasian Conference on Information Systems(Ed, University, E. C.) WA.

Wagner, E. H., Austin, B. T., Davis, C., Hindmarsh, M., Schaefer, J. and Bonomi, A. (2001) "Improving chronic illness care: translating evidence into action" In: Health Aff, 20, 64-78.

Warsi, A., Wang, P., LaValley, M. and Avorn, J. (2004) "Self-management Education Programs in Chronic Disease: A Systematic Review and Methodological Critique of the Literature" In: Archives of Internal Medicine, 164, 1641.

Wyatt, J. (2004) "Evaluating Health Informatics Research" In: Keynote Address, Health Informatics ConferenceHealth Informatics Society of Australia, Brisbane.