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Sociological and Philosophical Aspects of Human Interaction with Technology

Advancing Concepts

Anabela Mesquita

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methodological support for bringing users and developers closer together and individual and organizational attitudes to development. The purpose of this chapter is to make some general conclusions on how to bring about change when approaching a large public authority with the purpose of introducing usability and user centered systems design.

The issue of e-learning quality remains prominent on end users' (the learners') agenda. It is no surprise that many non-motivated adult learners abandon prematurely their e-learning experiences. This is attributed in a great extent to the poor design and usability of e-learning applications. This chapter proposes a usability framework that addresses the user as a learner and extends the current e-learning usability practice by focusing on the affective dimension of learning, a frequently neglected issue in e-learning developments. Motivation to learn, a dominant affective factor related with learning effectiveness, has been similarly neglected. Usability and instructional design constructs as well as Keller's ARCS Model are being employed within the framework proposed in this work upon which new usability evaluation methods can be based. This framework integrates web usability and instructional design parameters and proposes motivation to learn as a new type of usability dimension in designing and evaluating e-learning applications.

Radio Frequency Identification (RFID) technology offers a lot of promises. To redeem them, RFID applications have to respect privacy and they need to be supported by the legal system. The chapter evaluates how the current EU directives on data protection support emerging applications that are based on RFID tags. The evaluation is based on user scenarios that illustrate human needs in relation to technologies and applications. The chapter continues earlier analyses and uses more realistic and state-of-the-art applications and scenarios. We conclude by pointing out further research needs in the field of RFID and data protection.

(IT) development, but it is often challenging, especially in the product based software development context. This chapter critically examines the practice of 'listening to the voices of the users'; how it is accomplished in product based software development. First literature addressing users' role in the product development context is reviewed. Afterwards, empirical analysis in three IT companies involved in

On the one side, it could be argued that ICT provide a perceived anonymity for people downloading and distributing child abusive material, also labeled child pornography. While, on the other side the technology offers powerful surveillance mechanisms to monitor these activities and thus constitutes a powerful tool for law enforcement. This chapter aims to explore how offenders manage the risk of surveillance when downloading, distributing and exchanging child abusive material. Critical research with a focus on panopticon is used as a theoretical framework. The data is drawn from interviews with offenders, convicted of child pornography. The findings show that the offenders have developed technological and social strategies to reduce the risk of surveillance and addresses the need of a new theoretical concept better adjusted to surveillance practices that allow the many to watch the many. The ultimate motivation for researching this topic is to contribute to the development of effective child protection strategies.

Mobile applications such as multimedia messaging service (MMS) promises a new way to share rich content of information that enhances its users' personal connectivity experiences as well as productivity. However, the adoption of MMS seems to be unexpectedly slow (Bonte, 2008). As mobile phones become ever smarter (or complex) in functions, understanding the adoption behaviors of complex mobile services such as MMS becomes utterly important to both practitioners and academic. This chapter introduces a multi-facet model for MMS adoption by integrating the well-known behavioral models such as TAM and TPB with other factors including intrinsic motivation, personal innovativeness and critical mass. An internet survey of 213 subjects with prior experience in MMS usage found strong support for the proposed model. The results show that the adopter's attitude toward MMS is the most dominating factor in shaping his/her intention to use MMS, followed by subjective norm and perceived behavioral control. Moreover, the results further suggest adopter's intrinsic motivation is the most important motivating factor for attitude toward using MMS. Implications of these findings are discussed for researchers and practitioners.

The authors compared user evaluation of a text based dialogue system with a simple pick list for the same task. The authors matched the systems in terms of key factors, such as design for Usability, and took into account individual differences between participants that might have influenced their perception, such as Locus of Control, Experience and Personality. They found participants rated the text based dialogue system as being more informative, more credible, less frustrating and more persuasive than the simple pick list system. Participants' ratings were dependent on their Personality, Locus of Control and reported level of physical activity. Participants did not differentiate between the systems in terms

of their ease of use, indicating the other observed differences were not due to a simple difference in Usability. This study demonstrated the benefits of including automated dialogue in a system designed to help people find solutions for their exercise barriers. Further work is required to establish in what other situations dialogue provides a benefit.

Measurements related to user expectations, behaviors and experiences can provide useful data to many roles and teams in a company. Each role provides different views to the question "what should be measured, and why?" We conducted an empirical study on user experience (UX) measurement needs at different units and levels in one corporate (Nokia) and asked which kinds of UX measurements would be useful for different functions. We identified common UX measurement needs on 8 different themes.

Investigators occasionally rely on intuitive feelings during crime solving, but have no technological tool targeting directly on mediating this investigation factor. Technology that encourages the sharing and alerting of hunches therefore seemed to be needed. A motive analysis of interviews with criminal investigators was performed as part of an investigation aiming at adding hunches to the criminal investigators' visualization tools (the project management system to keep track of the investigation). Purpose of the study was to explore how a motive analysis (by revealing the criminal investigators' motives and attitudes) could contribute in the first phase of the design. The assumption that designing for intuition could be useful, was confirmed by all of the informants. The study gave valuable input to how motive analysis could be used to identify suitable requirements, by resulting in a proposed technological concept supporting the use of intuitive feelings in criminal investigation.

This chapter presents a design theory for an emerging genre in digital content called Ubiquitous Contents. To design entertaining experience, the chapter introduces the design concept of the Experience Chain. Examples are shown to illustrate how people, artifacts, and environment can be seamlessly connected to design emotional and entertaining experiences through the interaction.

In this chapter we introduce a learning perspective to the discipline 'user-driven innovation' which has entered the scene of systems design since the new millennium. We position user-driven innovation vis-a-vis participatory design and Scandinavian systems design by identifying the defining characteristics of user-drive as the relationship between power over interaction, and learning in interaction. From this position we regard the designer-user-relationship as a mutually asymmetrical partnership and we introduce the concept of "mutual but asymmetrical learning" as a core for user-driven innovation in systems design. The chapter outlines fundamentals of user-drive in systems design, stressing designers' open interest to learn from users, put users first, and follow users' lead regarding their professional knowledge and give users the opportunity to learn about design. A case of design of feedback on electricity consumption for private households serves to exemplify the central principles of user involvement and user engagement.

Section 4
Application of the Technologies in Specific Fields

The advent of Internet technologies since decades ago has propelled distance learning drastically. In this modern world, knowledge develops so fast that the amount of intellectual information that needs to be learnt before it becomes obsolete again is so huge. Distance learning through the use of Internet technologies has the advantage of being able to get across the information to the students remotely and

effortlessly. The other advantage, which is the main focus of this chapter, is that students are able to learn from their instructors on an entirely new media platform - the Internet-enabled and tangible user interface. This chapter discusses how to use two main new media: multi-modal Internet technologies, namely remote physical interface and remote augmented reality technology in distance learning.

Social and psychological theories have provided a plethora of evidence showing that the physical difficulty to express appropriate social interactions between drivers expresses itself in aggression, selfish driving and anti-social behaviour. Therefore there is a need to improve interactions between drivers and allow clearer collective decision making between them. Personal characteristics and the driving situations play strong roles in driver's aggression. Our approach is centered around the driving situation as opposed to focusing on personality characteristics. It examines aggression and manipulates contextual variables such as driver's eye contact exchanges. This chapter presents a new unobtrusive in-vehicle system that aims at communicating drivers' intentions, elicit social responses and increasing mutual awareness. It uses eye gaze as a social cue to affect collective decision making with the view to contribute to safe driving. The authors used a driving simulator to design a case control experiment in which eye gaze movements are conveyed with an avatar. Participants were asked to drive through different types of intersections. An avatar representing the head of the other driver was displayed and driver behaviour was analysed. Significant eye gaze pattern difference where observed when an avatar was displayed. Drivers cautiously refer to the avatar when information is required on the intention of others (e.g. when they do not have the right of way). The majority of participants reported the perception of "being looked at". The number of glances and time spent gazing at the avatar did not indicate an unsafe distraction by standards of in-vehicle device ergonomic design. Avatars were visually consulted primarily in less demanding driving situations, which underlines their non-distractive nature.

Preface

It is not possible to image our lives today without technology. From the moment we get up in the morning till we go to bed again at night, technology is present in almost every moment, even if we are not aware of it. Also, some of the tasks / activities we need to perform regularly, could not be carried out without technology. For instance, booking a ticket for the train, flight or even a concert, making bank transfers, communicating or interacting with other people, buying books, music or even clothes, looking for information regarding certain symptoms or disease, paying at any store any kind of product, consuming information, searching for news, driving a car, using a mobile phone, just to mention a few. We are already so used to technology that we do not even think about it, about its presence, impact, problems and aspects in the relationship between the technology and humans. Aware of that fact, in this book we decided to bring to the discussion two particular aspects of technology and human interaction: sociological and philosophical aspects.

When we read about technology and information systems, we always hear how good and nice they are and how they can change our lives always towards a positive way. However, we forget that technologies and information systems, in order to be useful, must be used in the correct way, knowing how to make the most profit of it. This means that if people are not prepared (or well prepared) for this situation, technologies will be useless. Furthermore, we also need to think about the relationship that is established between the user and technology. This relationship must be established taking into consideration that technology needs to be user-friendly, intuitive, have the correct design (means that the designer must have a good understanding of how humans learn and work with computers including envisioning new modes of work), and meet the expectations of the user, just to mention a few issues. Also need to say that these relationships can be more complex than expected since human behavior is greatly influenced and governed by social, religious, cultural and legal guidelines.

Aware of the importance of the interactions between human and technology, papers are dealing with aspects related with trust, communication, data protection, usability concerning organizational change and e-learning as well as the importance of voices of users. Furthermore, and as we believe that models, frameworks, theories also help the scientific field of human and computer interaction to advance, we selected a set of researches that present and discuss precisely philosophical aspects related, for instance, with the open access to networks, the risk of surveillance in the internet and the strategies that can be (or are) developed to avoid them, the development of models for technology adoption, the evaluation of systems and the measurement of expectations and behaviors of users just to name a few. The book ends with the presentation of two examples of the application of technology in innovative fields.

This book was designed either for practitioners and academic professionals. Papers present a nice blend of conceptual, theoretical and applied researches. Furthermore, I sincerely hope that the examples presented in this book will stimulate further research in technology and human interaction and related

topics. It is also my wish that this book will serve as a valuable source of inspiration for managers and researchers concerned about human and computer interaction.

Section 1: Sociological

The first two chapters deal with trust. Chapter 1, *Involvement, Elaboration and the Sources of Online Trust* by Russell Williams and Philip Kitchen acknowledges that establishing trust in online encounters has attracted significant recent research interest. The authors discuss that factors related to trust can be manipulated on a website to influence consumers' trusting beliefs. A notable part of the research concerns the influence of website infrastructure and attributes on consumers' assessment of vendor trustworthiness in the absence of knowledge- based transactional experience. The authors develop their work and introduce marketing concepts of 'involvement' and 'elaboration'. In the context of this research, consumer involvement describes the relevance of a situation or decision for an individual and the importance of this concept lies in the fact that it influences an individual's information search and processing strategies. Having this in mind, authors suggests that the infrastructure and attributes that individuals use as informational cues may in fact influence assessments of trusting beliefs differently, according to whether individuals face high or low involvement situations.

Chapter 2, *Defining Trust and E-Trust: From Old Theories to New Problems* by Mariarosaria Taddeo, provides a selective analysis of the main theories of trust and e-trust advanced in the last twenty years, in order to prepare the ground for a new philosophical approach to solve the problems facing them. The chapter is divided into two parts: 1) the author analyses e-trust - she focuses on trust and its definition and foundation and describes the general background on which the analysis of e-trust rests; 2) the author discusses e-trust, its foundation and ethical implications. At the end a synthesis of the analysis of the two parts is provided.

After trust, there are another two chapters discussing communication. Chapter 3, *Using the Social Web Environment for Pattern Engineering* by Pankaj Kamthan, aims to address the communication requirements of the elements of pattern engineering (namely, actors, activities, and artifacts) in general and the pattern realization process in particular. In order to attain this objective, a theoretical framework using the Social Web as the medium is proposed and its implications are explored. The prospects of using the Social Web are analyzed by means of practical scenarios and concrete examples. The concerns of using the Social Web related to costs, decentralization and distribution of control, and semiotic quality of representations of patterns are highlighted. The directions for future research including the use of patterns for Social Web applications, and the potential of the confluence of the Social Web and the Semantic Web for communicating the elements of pattern engineering are also briefly explored.

Chapter 4, *Organizational Communication: Assessment of Videoconferencing as a Medium for Meetings in the Workplace* by Bolanle Olaniran explores and presents an account of videoconferencing use in a governmental organization and addresses implications for meetings and general communication process. It is possible to find in the literature significant research focusing on e-mail, face-to-face (FTF), and other asynchronous mediated communication as the communication media of choice within organizations. However, modern organizations have alternative tools at their disposal such as videoconferencing which is now an affordable medium of choice because it precludes travel and is accessible on demand. As such research is needed on order to study the impact of its use in organizations.

Usability is the third issue discussed under the topic of sociological aspects of technology and human interaction. Chapter 5, *User-Centered Systems Design as Organizational Change: A Longitudinal Action*

Research Project to Improve Usability and the Computerized Work Environment in a Public Authority by Jan Gulliksen, Åsa Cajander, Bengt Sandblad, Elina Eriksson and Iordanis Kavathatzopoulos, presents a longitudinal case study in which six Human-Computer Interaction (HCI) researchers worked extensively in an action research cooperation with a public authority over a period of four years. The purpose of the cooperation was to increase the focus on usability in the authority, and the main research question was how do users introduce usability and user centered systems design issues into a public authority? Authors adopt and approach of action research and the data used in this paper is derived from an evaluation performed at the end of the project, as well as through the experiences of the authors from working with the project. The results involve aspects related to organizational issues, management support, strategic documents and end-user participation. Moreover the results include methodological support for bringing users and developers closer together and individual and organizational attitudes to development. The aim of this paper is to make some general conclusions on how to bring about change when approaching a large public authority with the purpose of introducing usability and user centered systems design.

Chapter 6, *Usability in the Context of E-Learning: A Framework Augmenting 'Traditional' Usability Constructs with Instructional Design and Motivation to Learn* by Panagiotis Zaharias, presents a framework in the context of e-learning. The topic of e-learning quality remains important in the end users' (the learners') agenda. It is no surprise that many non-motivated adult learners abandon prematurely their e-learning experiences. This is attributed in a great extent to the poor design and usability of e-learning applications. This paper proposes a usability framework that addresses the user as a learner and extends the current e-learning usability practice by focusing on the affective dimension of learning, a frequently neglected issue in e-learning developments. Motivation to learn, a dominant affective factor related with learning effectiveness, has been similarly neglected. Usability and instructional design constructs as well as Keller's ARCS Model are being employed within the framework proposed in this work upon which new usability evaluation methods can be based. This framework integrates web usability and instructional design parameters and proposes motivation to learn as a new type of usability dimension in designing and evaluating e-learning applications.

The last five chapters of the Section 1 deal with privacy and data protection, the need to listen to users in the field of software development and the use of storytelling in location.

Chapter 7, *Humans and Emerging RFID Systems: Evaluating Data Protection Law on the User Scenario Basis* by Olli Pitkänen and Marketta Niemelä, discusses some aspects related to Radio Frequency Identification (RFID) technology. As a matter of fact, RFID offers a lot of promises and in order to redeem them, RFID applications have to respect privacy and need to be supported by the legal system. The article evaluates how the current EU directives on data protection support emerging applications that are based on RFID tags using user scenarios that illustrate human needs in relation to technologies and applications. The article builds on earlier analyses and uses more realistic and state-of-the-art applications and scenarios. It concludes by pointing out further research needs in the field of RFID and data protection.

Chapter 8, '*Listening to the Voices of the Users' in Product Based Software Development* by Netta Iivari and Tonja Molin-Juustila, critically examines the practice of 'listening to the voices of the users' in particular how it is accomplished in product based software development. First literature addressing users' role in the product development context is reviewed. Afterwards, empirical analysis in three IT companies involved in product business but with different degrees of productization is carried out. In the analysis, the focus is on: 1) Where do the users' voices come from? 2) When are the users' voices listened to? 3) What happens to the users' voices; whether and how do they affect the development? 4) What are the challenges and particularities of each case? Results show similarities but also clear differences between the cases. Finally, implications both for theory and practice are discussed.

Chapter 9, *Location-Based Mobile Storytelling* by Jennifer Stein, Scott Ruston and Scott Fisher, describe a research in location-based mobile storytelling entitled Tracking Agama. Using a combination of SMS messaging, voice calls, and web log entries, Tracking Agama leads its participants, through a narrative-based exploration of Los Angeles, in the pursuit of a fabled urban researcher: "Agama." Participants act like a detective in order to discover the keywords allowing access to Agama's voice-activated and phone-accessible audio diary entries; they also send and receive SMS messages from Agama and his assistant and receive calls from the virtual characters.

Section 2: Philosophical Aspects

Chapter 10, *The Case for Open Access Networks* by Don Flournoy, Rolland LeBrasseur and Sylvie Albert discusses the importance of keeping the access to the networks opened. To set the stage, authors start by examining some of the publicly stated arguments and positions being taken in the articulation of "net neutrality" and "open source" practices and principles. Then, they explore the difficult technical challenges present in maintaining "open access" telecommunications networks using proprietary technologies. Incentives to work together to adopt universal technical standards are also discussed. It is also argued that with more open technical standards, open source applications and products can be accelerated and made more pervasive. In this context, collaboration among businesses, national governments and public sectors is seen as a key issue to implement policies that lead to public participation in economic and social development, both locally and globally. The authors conclude that the principal means by which all these approaches can be sustained is to keep the Internet accessible, free and open for all.

Chapter 11, *Counter-Surveillance Strategies Adopted by Child Pornographers* by Marie Eneman discusses how ICT in combination with technological advances facilitates the downloading, distribution and exchange of child abusive material. One can argue that ICT provide a perceived anonymity for people downloading and distributing child abusive material (child pornography). Furthermore, technology offers powerful surveillance mechanisms to monitor these activities and thus constitutes a powerful tool for law enforcement. This article aims to explore how offenders manage the risk of surveillance when downloading, distributing and exchanging child abusive material. Critical research with a focus on panopticon is used as a theoretical framework. The data is drawn from interviews with offenders, convicted of child pornography. The findings show that a new theoretical concept better adjusted to surveillance practices that allow the many to watch the many is needed since offenders claim having developed technological and social strategies to reduce the risk of surveillance.

Chapter 12, *A Multi-Facet Analysis of Factors Affecting the Adoption of Multimedia Messaging Service (MMS)* by Judy Lin and Chin-Lung Hsu, introduces a multi facet model for MMS adoption. Mobile applications such as multimedia messaging service (MMS) promise a new way to share rich content of information that enhances its users' personal connectivity experiences as well as productivity. However, the adoption of MMS seems to be unexpectedly slow. As mobile phones become ever smarter (or complex) in functions, understanding the adoption behaviors of complex mobile services such as MMS turns to be important to both practitioners and academic. This paper introduces a model for MMS adoption by integrating the well-known behavioral models such as Theory Acceptance Model and Theory of Planned Behavior with other factors including intrinsic motivation, personal innovativeness and critical mass. An internet survey of 213 subjects with prior experience in MMS usage found strong support for the proposed model. The results show that the adopter's attitude toward MMS is the most dominating factor in shaping his/her intention to use MMS, followed by subjective norm and perceived

behavioral control. Moreover, the results further suggest adopter's intrinsic motivation is the most important motivating factor for attitude toward using MMS. Implications of these findings are discussed both for researchers and practitioners.

Chapter 13, *The Benefits of (Automated) Dialogue* by Robert Hurling, Marco De Boni and Alannah Richardson, compares user evaluation of an automated text based dialogue system with a simple pick list for the same task. The authors matched the systems in terms of key factors, such as design for Usability, and took into account individual differences between participants that might have influenced their perception, such as Locus of Control, Experience and Personality. They found participants rated the text based dialogue system as being more informative, more credible, less frustrating and more persuasive than the simple pick list system. Participants' ratings were dependent on their Personality, Locus of Control and reported level of physical activity. Participants did not differentiate between the systems in terms of their ease of use, indicating that the other observed differences were not due to a simple difference in Usability. This study demonstrated the benefits of including automated dialogue in a system designed to help people find solutions for their exercise barriers. Further work is required to establish in what other situations dialogue provides a benefit.

Chapter 14, *On User Experience Measurement Needs: Case Nokia* by Pekka Ketola and Virpi Roto discusses the importance of measurements related to user expectations, behaviors and experiences and how they can provide useful data to many roles and teams in a company. Each role provides different views to the question "what should be measured, and why?". The authors conducted an empirical study on user experience (UX) measurement needs at different units and levels in one corporate – Nokia - and asked which kinds of UX measurements would be useful for different functions. The authors identified common UX measurement needs on 8 different themes.

Section 3: The Case of Design in Technology, Concept and Learning

Chapter 15, *A Motive Analysis as a First Step in Designing Technology for the use of Intuition in Criminal Investigation* by Ingerid Rodseth, deals with intuitive feelings and its role in crime solving. Author alerts to the fact that there are no technological tools targeting directly on mediating this investigation factor and so a technology that encourages the sharing and alerting of hunches seemed to be needed. A motive analysis of interviews with criminal investigators was performed as part of an investigation aiming at adding hunches to the criminal investigators' visualization tools. The purpose of the study was to explore how a motive analysis (by revealing the criminal investigators' motives and attitudes) could contribute in the first phase of the design. Based on the results a technological concept for using intuition in criminal investigation is proposed.

Chapter 16, *Designing Ubiquitous Content for Daily Lifestyle* by Masa Inakage, Atsuro Ueki, Satoru Tokuhisa and Yuichiro Katsumoto, presents a design theory for an emerging genre in digital content called Ubiquitous Contents (contents for living people, those which link closely with daily life). The article introduces the design concept using examples to illustrate how people, artifacts and environment can be seamlessly connected to create emotional and entertaining experiences through the interaction.

Chapter 17, *Asymmetrical Learning Create and Sustain Users' Drive to Innovate, When Involved in Information Systems Design* by Anne Kanstrup and Ellen Christiansen, positions user-driven innovation vis-a-vis participatory design and Scandinavian systems by identifying the defining characteristics of user-drive as the relationship between power over interaction, and learning in interaction. A case of design of feedback on electricity consumption for private households based on user-driven innovation serves

to exemplify core principles of user involvement and user engagement. Taking into consideration what is meant by being innovative, authors explain how letting users take the innovative lead can contribute to a positive outcome, and how the approach to user-driven innovation can be regarded as a way to combine classic Scandinavian values of democracy with new economy calls for innovation in systems design. The article stresses the importance of designers taking a genuine interest in learning from users while also giving users the opportunity to learn about design.

Section 4: Application of Technologies in Specific Fields

Finally, in Section 4, two cases of application of technologies in two different situations are presented and discussed. Chapter 18, *Internet-Enabled User Interfaces for Distance Learning* by We Liu, Keng The, Roshan Peiris, Yongsoon Choi, Adrian Cheok, Charissa Mei-Ling, Yin-Leng Theng, Ta Nguyen, Tran Qui and Athanasios Vasilakos discusses how to use two main media in distance learning: multi-modal Internet technologies, namely remote physical interface and remote augmented reality technology in distance learning. The advent of Internet technologies has since decades ago propelled distance learning drastically. In this modern world, knowledge develops so fast that the amount of intellectual information that needs to be learnt before is huge and becomes obsolete quickly. Distance learning through the use of Internet technologies has the advantage of being able to get across the information to the students remotely and effortlessly. The other advantage is that students are able to learn from their instructors on an entirely new media platform - the Internet-enabled and tangible user interface.

Chapter 19, *In-Vehicle Avatars to Elicit Social Response and Change Driving Behavior* by Andry Rakotonirainy, Frank Feller and Narelle Haworth, presents the use of avatars to teach people how to drive a car expressing appropriate social interactions between drivers and avoiding aggression, selfishness driving and anti-social behavior. It is known that personal characteristics and the driving situations play strong roles in driver's aggression. The approach presented is centered around the driving situation as opposed to focusing on personality characteristics. It examines aggression and manipulates contextual variables such as driver's eye contact exchanges. It presents a new unobtrusive in-vehicle system that aims at communicating drivers' intentions, elicit social responses and increasing mutual awareness. It uses eye gaze as a social cue to affect collective decision making with the view to contribute to safe driving. The authors used a driving simulator to design a case control experiment in which eye gaze movements are conveyed with an avatar. Participants were asked to drive through different types of intersections. An avatar representing the head of the other driver was displayed and driver behavior was analyzed. Significant eye gaze pattern difference was observed when an avatar was displayed. Drivers cautiously refer to the avatar when information is required on the intention of others (e.g. when they do not have the right of way). The majority of participants reported the perception of "being looked at". The number of glances and time spent gazing at the avatar did not indicate an unsafe distraction by standards of in-vehicle device ergonomic design. Avatars were visually consulted primarily in less demanding driving situations, which underlines their non-distractive nature.

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Section 1
Sociological

Chapter 1
Involvement, Elaboration and the Sources of Online Trust

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ABSTRACT

Establishing trust in online encounters has attracted significant recent research interest. A large part of this work focuses on those factors that can be manipulated on a website to influence consumers' trusting beliefs. A notable part of this research concerns the influence of website infrastructure attributes [design and interaction elements] on consumers' assessment of vendor trustworthiness in the absence of knowledge-based transactional experience. Developing this work further, we introduce the established marketing concepts of 'involvement' and 'elaboration'. Consumer involvement describes the relevance of a situation or decision for an individual. In the marketing literature, the importance of this concept lies in the fact that it influences an individual's information search and processing strategies. Noting this, propositions are advanced suggesting that the infrastructure attributes that individuals use as informational cues may in fact influence assessments of trusting beliefs differently according to whether individuals face high or low involvement situations.

INTRODUCTION

The important role of trust in the development of successful relationships has long attracted the attention of business academicians, a notable number of whom have come from its marketing domain. For example, trust has been examined in relation to bargaining (Schur and Ozanne, 1985), buyer-seller relationships (Ganesan, 1994; Doney and Canon, 1997; Hawes et al., 1989), marketing research (Moorman, et al., 1993) and relationship marketing (Dwyer, et al., 1987; Morgan and Hunt, 1994). Whilst these and other research works have undoubtedly contributed to an understanding as

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to how trust can be established and developed between parties, the additional and distinctive challenges of relationship development via the web has led to the recent emergence of a dedicated body of research considering online trust (Aiken and Boush, 2006).

The most obvious challenge of Web based relationships is the fact that the parties are physically separated with the result that the quality and nature of the goods bought cannot be immediately verified (Gefen and Straub, 2004). Consumers are moreover not able to process those familiar human network attributes that they might typically use as cues for the assessment of trustworthiness (Riegelsberger et al., 2003). Challenges such as these would perhaps only have a limited impact on actual trade and exchange if established rules and conventions existed governing transactions. However, at present, this is not the case. Indeed, even where rules and conventions do exist, there is still some ambiguity as to their interpretation [see for e.g. Frynas, 2002; Zugelder et al., 2000].

In addition to those uncertainties which arise out of a lack of proximity and a lack of established conventions, norms, rules and regulations, online consumers face two further sources of uncertainty. Firstly, consumers are dependent on the actions of parties other than the vendor. Consider for example how the purchase of a good or service online frequently involves a payment and/or delivery intermediary. Secondly, online consumers are also dependent on the technology. Online, this creates uncertainties arising from transacting on an open-network, in turn resulting in privacy and/or security related issues. Web-based transactions therefore create additional transaction-specific risks as well as system-specific risks and uncertainties for consumers; risks and uncertainties that they do not often encounter in offline relationships (Grabner-Kraeuter, 2002).

The prospect that perceived transaction and system-specific risks and uncertainties might forestall transactions, or at best only permit low trust transactions being pursued online, provides the impetus to develop new and more appropriate models of trust for this domain. Logically, a large part of this modelling has focussed on those factors that can be directly manipulated by vendors seeking consumer trust. A significant part of this modelling research reports on factors that might be categorised website infrastructure attributes – *design and interaction elements*.

Existing research on the influence of website infrastructure attributes on consumer trust undoubtedly advances our understanding of how trust may be developed more effectively in online interactions. However, drawing on the long established marketing concepts of involvement (Kugman, 1965) and elaboration (Petty and Cacioppo, 1981; 1983), the proposition forwarded here in this paper is that the modelling undertaken to date ignores one crucial element in an understanding of how website infrastructure attributes may influence consumer trust. Simply stated, the concepts of involvement and elaboration acknowledge that the type of information consumers seek, as well as the time, effort and cognitive resources they may deploy to obtain them, depends on their degree of involvement in a decision. Accordingly the influence of website infrastructure attributes on consumer trust may be different according to the degree of consumer involvement.

Given the role acknowledged within marketing for involvement influencing consumer motivation to seek out and process different amounts and types of information this paper is interested in two main questions regarding consumers' perceptions of website trustworthiness: (a) Does the level of consumer involvement matter in terms of consumer attitudes towards vendor websites? (b) How does the level of involvement interact with different website design and interaction attributes? Based on findings and theories from the consumer behaviour and trust literatures the paper sets out: (1) an integrated model of online trust linking involvement with those infrastructure attributes, positing a positive answer to the former

question and (2) research propositions towards understanding the latter question.

The paper is organised as follows into five sections. Following on from this introduction, the next section reviews the trust literature. The section focuses on the interpersonal dimension of trust where website infrastructure effects are located. The literature advanced is summarised under a number of broad headings and presents the current state of knowledge. The third section introduces the concept of involvement and the elaboration likelihood model. Developing this, the next section sets out to link the antecedents of interpersonal trust with the involvement concept and the elaboration likelihood model, forwarding an integrated model of trust and seven propositions for further research. A summary and conclusion follows in the final section.

LITERATURE REVIEW

A Conceptual Multi-Dimensional Model of Trust

Given the importance of trust in agency relations trust has received considerable attention across a variety of disciples. Whilst each of these disciplines presents a view on trust based on their own research context, in extracting commonalities for the online context researchers have set out a interdisciplinary multidimensional model of online trust comprising dispositional trust, institutional trust and interpersonal trust (McKnight and Chervany 2002, Lee and Turban 2001, Tan and Sutherland 2004).

Drawing on personality theory, dispositional trust is conceptualised as; '*…a belief, expectancy, or feeling deeply rooted in the personality and originating in the individual's early psychological development'* (Lee and Turban 2001: 77). Broadly, individuals are held to be more or less psychologically pre-disposed to perceive others as trustworthy across a broad spectrum of situations and persons. With institutional trust, trust is characterised as; *'...the expectations and willingness of the trusting party in a transaction, the risks associated with acting on such expectations, and the contextual factors that either enhance or inhibit the development or maintenance of trust'* (Ibid. 76). In other words, the focus here are the factors in the environment [laws, regulations, conventions, habits…] that lead to trust, rather than factors within the individual as is the case with dispositional trust (McKnight and Chervany 2002). Specifically, the focus is on the trust the individual places in such institutions. Finally, drawing on social-psychology, interpersonal trust has as its focus the factors that relate to the development and maintenance of trust between specific others (Lewicki and Bunker 1995). Generally, within this perspective trust is characterised in terms of the expectations and/or willingness to act of a trustor in a specific transaction. Illustrative of this characterisation trust has been defined variously as:

The confidence a person has in his or her favourable expectation of what other people will do, based in many cases, on previous inter-actions. (Gefen, 2000)

Consumer's willingness to rely on the seller and take action in circumstances where such action makes the consumer vulnerable to the seller. (Jarvenpaa et al., 2000)

Consumer's willingness to accept vulnerability in an online transaction based on positive expectations of the future behaviour of an e-retailer. (Kimery and McCord, 2002)

Willingness of a consumer to be vulnerable to the actions of an Internet merchant in an Internet shopping transaction, based on the expectation that the Internet merchant will behave in certain agreeable ways, irrespective of the ability of

the consumer to monitor or control the Internet merchant. (Lee and Turban, 2001)

Belief that allows consumers to willingly become vulnerable to Web retailers after having considered the retailers characteristics. (Pavlou, 2003)

These and other similar definitions of trust illustrate two important elements to trust; a 'comportmental' element and a 'cognitive element' (Casalo et al., 2007). The comportmental element denotes a willingness to rely or depend on the other party [illustrated above in the definition of Jarvenpaa et al., 2000]. The cognitive element on the other hand denotes a set of beliefs about the other party [illustrated above in the definition of Pavlou, 2003]. Importantly, for accuracy, it is held that this comportmental element may be redundant as it is the logical consequence / an outcome of the cognitive element (Morgan and Hunt, 1994).

On the basis that trusting beliefs about potential vendors shape consumers' willingness to depend on them, as well as subsequently intentions and actions towards them, the offline and online literature has set out to identify those characteristics of vendors that have strong construct validity. Whilst no universal agreement exists as to which characteristics comprise assessments of vendor trustworthiness competence, benevolence and integrity are repeatedly cited [See for e.g. Mayer et al., 1995; Bhattacherjee 2002; Chen and Dhillon, 2003; Cheung and Lee, 2006]. Indeed, many of the alternative attributes proposed in various works can be reconciled within this three- pronged generic typology of trust (Bhattacherjee, 2002).

Within the competence, benevolence, and integrity typology, competence [*aka* ability] refers to the trustor's perception of the trustee's competencies and knowledge to fulfil the expectations for behaviour placed on them (Mayer et al., 1995). Benevolence on the other hand refers to the trustor's perception of the extent to which the trustee wants to do things in the interest of the consumer, beyond the innate profit motive (*Ibid.*). It is a perception that the trustee will not act opportunistically. Finally, integrity refers to the trustor's perception that the trustee will adhere to an expected and accepted set of principles and to make good faith agreements (*Ibid*.). For example, the trustor will fulfil the inherent promise to deliver the goods on time, and keep private information secure.

Whilst the competence, benevolence, and integrity typology of trust is widely cited in the trust literature, and moreover considered parsimonious enough to be easily understood and useful to practice by virtue of its adoption in several empirical works, research, most notably that of McKnight and Chervany (2002) and McKnight *et al.,* (2002), has added predictability to the typology. Here, predictability refers to the perception that the trustee's actions are consistent enough that they can be forecast. The potential significance of this last point lies in the fact that it is not just the perceived characteristics of trustees that are likely to be important, for example, their competence, benevolence, and integrity, but also the consistency of these.

Taking vendor trustworthiness as logically constructed from consumer judgements about their competence, benevolence, integrity, and possibly [following the various works of McKnight above] predictability, it has been noted that assessing the exact contribution of each of these to trusting beliefs presents the researcher with some difficulties. First, in some situations, especially where the trustor knows little about the trustee, attributes are likely to complement each other, or alternatively merge together. Integrity and benevolence, for example, may merge in initial encounters as both imply that the trustee will do the trustor good rather than harm (McKnight and Chervany 2002). Only when the trustor gets to know the trustee can they differentiate more clearly amongst the trusting beliefs (Lewicki et al., 1998).

Initial Trust

In addition to the weight attached to individual characteristics of potential vendors changing at different stages of a relationship, the overall level of trust is also likely to change over time (Rousseau et al., 1998). Indeed, online trust is noted as a dynamic process, developing, building and even perhaps retreating or disappearing through time (Cheskin and Sapient 1999). Following this line of thought, in an 'Online Trust Building Model', Head and Hassinein (2002) assert how trust changes as the conditions of perceived risk and interdependence between trustor and trustee change as a result of both individual interactions with each other and with third-parties.

As a dynamic process, trust has to begin somewhere. Logically, it begins when an individual first interacts with an organisation's website and draws inferences from what he/she perceives. This is 'initial trust' and describes those situations where individuals do not yet have credible and meaningful information (McKnight et al., 1998). Moreover, any trust at the initial stages of a relationship follows 'goal-based' or 'calculative-based' trust, rather than knowledge-based or respect-based trust (Koehn 2003), concepts not dissimilar from the three sequential and linked stages of calculus-based trust, knowledge-based trust, and identification-based trust identified in Lewicki and Bunker's (1995) trust-building model.

Goal-based or calculative trust is the most fragile type of trust and relies on assessments of benefits versus cost (Koehn, 2003). By way of contrast, knowledge-based trust develops only gradually through experience/familiarity. The best position for both parties to be in though is however 'respect-based' trust. This is defined as existing and being reinforced when trustor and trustee poses '*… a similar love of virtue, excellence, and wisdom and are willing to engage in dialogue and ongoing conversation with a view to understanding each other better'* (*Ibid.* 6). Respect-based trust is however only obtainable via experience. It is therefore not quickly formed, and whilst it offers the highest form of commitment in a relationship it is; '*…undoubtedly more onerous than securing calculative or knowledge-based trust*' (*Ibid.* 9). Logically, this highest form of trust, and indeed its precursor knowledge-based trust, must follow initial trust.

Whilst consumer personality or disposition to trust can be noted and understood by vendors seeking their trust, it cannot be directly manipulated by them (Yousafzai et al., 2003). Likewise, factors in the environment, both within and between organisations as well as between organisation and institutions [i.e. institutional trust], cannot easily be manipulated by vendors. They are impersonal structures and situations (McKnight and Chervany 2002). By way of contrast, vendors are able to manage their interaction with potential customers by providing cues that will shape trusting beliefs formed about them. Given this possibility, it is little wonder that much of the online trust literature has indeed focussed on the antecedents of interpersonal trust. Here, as the examples in Table 1 illustrate, significant research has already discussed and/or tested a diverse set of factors likely to shape online trusting beliefs.

In addition to the types of infrastructure and content effects cited above, the role of several other factors in consumer trust have also received notable attention. Following on and developing the work of Doney and Canon (1997) one area of this research concerns vendor characteristics. For example, Jarvenpaa et al., (2000) reports trustworthiness, perceptions of risk, and willingness to purchase as all influenced by perceived store size. Elsewhere the role and influence of vendor type and vendor reputation on trusting beliefs has also been investigated [see for e.g. Merrilees and Fry, 2003; Nöteberg et al., 2003]. It should be noted however that in situations of initial trust, the consumer will simply not know many of these

Table 1. Antecedents of interpersonal trust

Antecedents of Interpersonal Trust	Literature Sources
Usability & navigability	Cheskin and Sapient 1999; McKnight et al., 2002; Roy et al., 2001
Website design, likeability & attractiveness	Kim and Moon (1998); Chen and Dhillon (2003); Wakefield et al., (2004); Yousafzai et al., (2005)
Familiarity (structure of the interaction / interface)	Gefen, (2000)
Interactivity	Merrilees (2001); Merrilees and Fry (2003)
Social presence	Head et al., (2003); Gefen and Straub (2004); Luo et al., (2006)
Security, privacy & returns disclosures	Belanger *et al*. (2002); Murphy and Blessinger (2003); Pennington et al. (2003); Gauzente, (2004); Wang *et al*. (2004); Yousafzai et al. (2005); Kim and Benbasat (2006)
Third-party endorsements	Houston and Taylor (1999); Belanger, et al., (2002); Kimery and McCord (2002); Cook and Luo (2003); Kaplan and Nieschwietz (2003); Nöteberg et al., (2003); Zhang, (2004); Wakefield and Whitten (2006); Lee and Lee (2006)
Peer recommendation & Testimonials	Smith et al., (2005); Yousafzai et al., (2005)

vendor characteristics. Indeed, unfamiliar vendors are likely to have no reputation rather than a good or bad one. In initial trust situations it seems logical to assume therefore that website design and interactions effects are likely to be particularly pertinent in the formation of trusting beliefs.

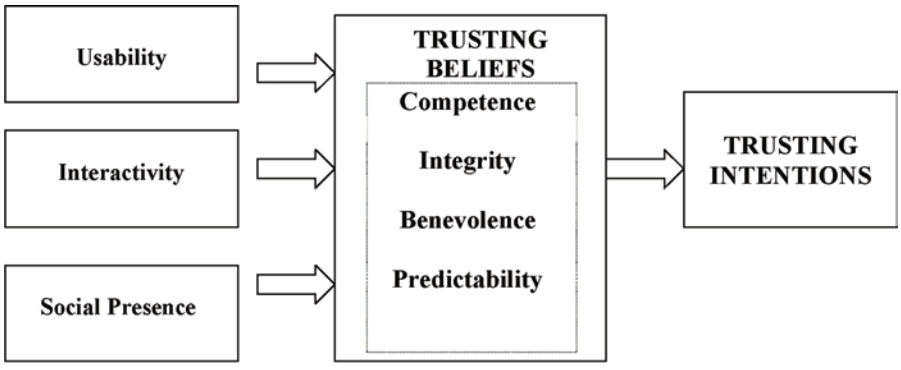
Categorising trusting beliefs as the dependant variable, noting as well the schematic difference between trusting beliefs as a cognitive element and trusting intentions as a comportmental element, the general relationship between website infrastructure attributes as independent variables and the dependant variables can be seen in Figure 1.

Factors Influencing Interpersonal Trust

Acknowledging the importance of managing an appropriate interaction with consumers, especially in situations of initial trust, the online trust literature has already hypothesised and tested the significance of a considerable number of different website infrastructure attributes on trust. These attributes act as knowledge/experience surrogates, which in turn may, or may not, generate trusting beliefs.

One of the design attributes that has received attention is the influence of 'ease of navigation'; a

Figure 1. Website design and interaction effects and trust in initial encounters



factor identified early on in the now widely cited e-Commerce trust study of Cheskin and Sapient (1999). Illustrating the depth of study on the influence of website of navigation is the work of Roy et al., (2001). Testing the influence of usability [comprising navigation, consistency, learnability, user guidance, and perception] on trusting beliefs [comprising ability, integrity, and benevolence], their results report varying significant positive correlations between many of the elements of usability and the attributes of trust. For example, the trust attribute perceived ability is reported as the most strongly influenced by the different usability elements, with three of these - ease of navigation, perception and support - having a significant impact. For the authors, this link between usability and perceived ability is intuitive given that; '…competence and authority in a given field should translate into competence in designing a Web site appropriate for the given field' (*Ibid*. p.395). Similarly, perceived benevolence was also found to correlate with the elements ease of navigation, perception, and support. However, additionally, ease of learning was also found to be a significant factor. This is explained by the fact that; 'the vendor may be perceived as more motivated to accommodate the user if it makes the customer's experience with the interface less cognitively demanding'. The result of this accommodation being that the vendor is 'more willing to establish a mutually satisfying relationship'. Of the three dimensions, perceived integrity was found to be least influenced by the elements of usability. Moreover, only perception [relating to the general presentation and design of the website] was found to have a significant impact on perceived integrity. As perception is the only significant factor for all of the attributes of trust, this one factor may, the authors conclude, be 'the most important determinant of trust'. Indeed, as perception relates to the general presentation of a website, it is likely to have the biggest impact in initial encounters on the first impression of a browser.

Later studies provide further support for the findings of Roy et al., (2001) regarding the role of usability in trust. For example, McKnight et al., (2002) report a positive relationship between website quality [operationalised as ease of navigation and user friendliness of the user interface] and trusting beliefs in the e-retailer. Similar significant usability-trust relationships are reported in Koufaris and Hampton-Sosa (2004) considering the ease of use of a website, as well as in Kim and Ahn (2007) considering ease of use, search function and navigation.

Further illustration of the depth of analysis regarding the role of website design on consumers' trusting beliefs can be seen in the work of Kim and Moon (1998). Investigating the role of four design categories [title, menu, main clipart and color] on target feelings in consumers, their results show that the two design factors that were most important in deciding trustworthiness related to the categories of main clipart and overall colour layout. For example, from the main clipart category, to enhance trustworthiness an interface should be designed with three-dimensional, dynamic clipart that covers half of the total screen size. However, as interaction effects between the categories are also shown, it is also noted that interface design should take into account the net effect of the design factors.

Beyond usability and website cosmetics, a second example further illustrating the breadth of work on web vendor interventions likely to influence trusting beliefs is that on 'interactivity' and 'social presence' [categorised as 'social cues' by Wang and Emurian, 2005]. Interactivity has been indicated in a number of studies as having the potential to be an important influence in building relationships. For example, interactivity has been explored in terms of its part in generating 'flow' in web users, flow being a positive sense of well-being and engagement [see for e.g. Chen, et al., 1999; Novak et al., 1999; Rettie, 2001; Williams and Dargel, 2004]. A link between perceived interactivity and the attitude towards a website

is also reported. For example, for Merrilees and Fry (2001), interactivity has an effect because it allows in-depth experience which in turn reduces the perception of security risk for those with high levels of security risk. Later research by the authors develops this work further, reporting: (1) a combination of e-trust and interactivity are important in the generation of favourable attitudes towards a site (Merrilees and Fry, 2002); and (2) a high positive relationship between interactivity and e-trust (Merrilees and Fry, 2003).

Positive results from interactivity/response are also demonstrated in Fogg et al., (2001). Here, quick responses to customer service questions and email confirmation of transactions are shown to increase website credibility. Supporting the overall significance of interaction [i.e. communication], are results from the GVU 10th online user survey where 54% of Internet users report one of the most important features when shopping online [a trusting outcome], is ease of contact with the vendor. Similarly, McKnight et al., (2002) show a positive relationship between the clear display of contact details of the e-retailer and trust in that retailer.

A somewhat broader concept than interaction and communication in establishing trust is 'social presence'. For Gefen and Straub (2004), trust in another is 'nourished through interactions with them'. Whilst websites lack the obvious nourishment of human, face-to-face, interaction, they are able nevertheless to create a sense or perception of personal, sociable and sensitive human contact [i.e. social presence]. For example, this might be achieved by embedding photos of people and/or the personalising of responses. Indeed, as part of a constructive interaction aligned with trustor expectations for them, trustees can contribute towards the building of trust with the creation of social presence. Simply, as social presence is a part of what consumers expect in a service, a lack of personal, sociable and sensitive contact is likely to signal a lack of integrity, benevolence and ability. Moreover, if signals regarding these attributes are not being provided now, trustors are not likely to predict they will be any different in the future. Online social presence contributes therefore to the dimension of trusting beliefs, a general conclusions arising out of Gefen and Straub's findings (*Ibid*.).

Along similar lines to social presence, Head et al., (2003) report the influence of 'humanized website design' on trust. A humanized website incorporates human-centric elements in addition to mere product listing. These emotive elements might take the form of emotive textual descriptions, relevant pictures of people, appropriate audio and video clips, virtual communities, virtual and real shopping agents etc. Testing these elements in an online experiment involving clothing – a product purported to lend itself well to the application of humanization – the researchers report relationships suggesting a positive influence on product trust, company trust, and referee trust. That is, humanized elements had a positive impact on perceived trust of the websites. Similarly, Luo et al., (2006) suggest that human-like [as opposed to cartoon-like] characters are more trustworthy in general terms, although cartoon-like characters have a greater impact on the persuasiveness of the website interface than human-like characters, especially in the context of the payment process where a human-like character could arguably be regarded as a form of surveillance and a threat to user privacy. Importantly, Head et al., (2003) note that humanization is a factor largely ignored in usability guidelines in spite of its influence.

INVOLVEMENT AND ELABORATION

One of a number of factors identified as influencing the consumer decision making process is the concept of 'involvement', a term originating in marketing following research by Krugman (1965) in relation to television advertising and learning, but 'popularised' largely through the works of Petty and Cacioppo (1981, 1983, 1986). Making the distinction between high and low involvement,

the concept has come to offer an explanation as to why consumers behave differently, most notably in terms of search behaviour and information processing. In short, when involvement is high, as opposed to low, consumers process information more actively, paying greater attention to advertisements in terms of time and cognitive effort. Involvement also influences the direction of their attention (Krugman 1965, Celsi and Olsen 1988, Warrington and Shim 2000). Involvement is therefore a 'motivational construct' (Dholakia 2001), having a role in consumer attention and comprehension processes.

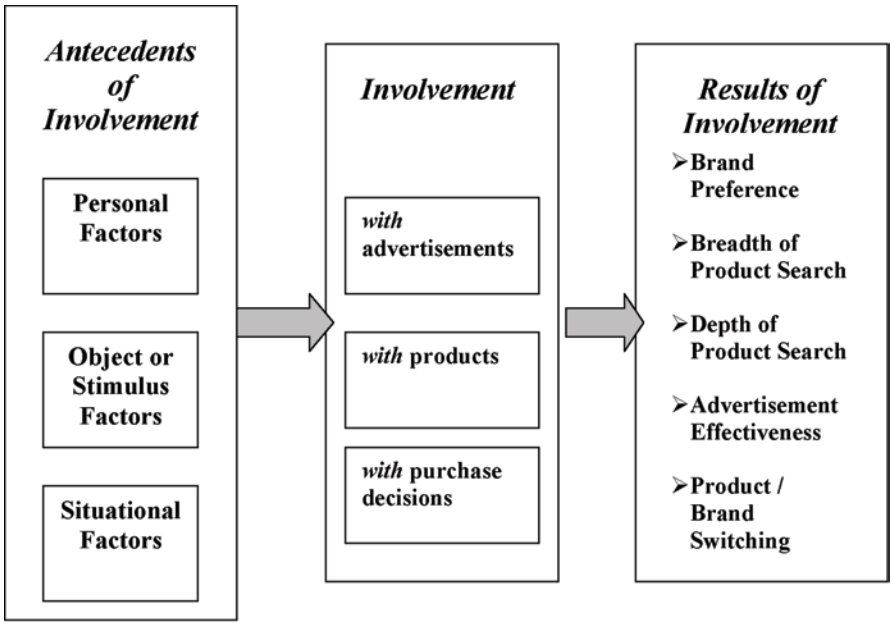
Whilst involvement in Krugman's (1965) research focussed on advertising, the scope of involvement research now stretches beyond processing marketing communications. Indeed, following the different research streams in consumer behaviour, involvement is also held to be relevant in two further areas: (1) Product Classes, describing the relevance of the product/service to the needs and values of consumers and therefore their need and interest in product information; and (2) Purchase Situations, describing decision relevance and therefore the motivation to make careful decisions (Zaichowsky 1986) [Figure 2].

The Antecedents of Involvement

Involvement is widely held in the marketing literature (Bloch and Richins 1983; Andrews *et al*., 1990; Laurent and Kapferer 1985; Zaichowsky 1986) to be a function of three factors: (1) Individual characteristics [e.g. needs, interests, goals]; (2) Situational factors [purchase occasion or perceived risk associated with the purchase decision]; and (3) Characteristics of the object or stimulus [e.g. the type of media or the product class].

Whilst involvement with marketing communications, products and situations is influenced by any one or a combination of the three antecedents, the unifying theme across them is always 'personal relevance' (Zaichowsky 1985; 1994, Park and Young 1986). Elsewhere this has been labelled 'felt involvement' by Celsi and Olsen (1988) suggesting that; '*…the personal relevance of a product [read concept] is represented by the perceived linkage between an individual's*

Figure 2. Conceptualizing involvement



needs, goals, and values (self knowledge) and their product knowledge (attributes and benefits)' (p.211). If the perceived linkage is strong, then the individual is highly involved with the concept. Conversely, if it is weak, then their involvement is low. Motivation is therefore a positive function of personal relevance / felt involvement.

Product involvement is held to exist when a product category is related to a person's centrally held values and actual or ideal self concept (Houston and Rothschild 1978), and may be further categorised as either enduring or situational (Bloch and Richins 1983). Both situational and enduring involvement relate to the feeling of self relevancy towards a product. Enduring involvement is however based on the relationship of a product to a consumer's centrally held values across all purchase situations (Celsi and Olsen 1988; Houston and Walker 1996). Its level is dependent on the perceived importance of the product with regard to personal benefits (Venkatraman 1989); for example, benefits such as enjoyment, esteem, and self-fulfilment. Whilst enduring involvement is likely to be a general predictor, linking enduring attitudes with behaviour, indeed some longitudinal empirical evidence does exist suggesting that stability is the norm for many of the facets of enduring involvement (Havitz and Howard 1995), involvement is also likely to influenced by the situation. Therefore, situational involvement describes the temporary feelings that accompany a situation (Houston and Rothschild 1978). Indeed, for Celsi and Olsen (1988);

...personal relevance for an object or event is an acute state that only occurs at certain times or in certain situations. Even objects or events that are extremely important to an individual are not experienced as personally relevant at all times' (p.211). Conversely, 'situational involvement can also occur when the consumer has little enduring interest in the product. (Dholakia 2001, p.1345)

In the evaluation of advertising communication it has been noted that consumer responses can be both cognitive and affective (Park and Young 1986). That is, the personal relevance of an advertisement can, following a utilitarian or cognitive perspective, depend upon the brand's functional performance, or, alternatively, relevance can depend on emotional states or aesthetic appeals that are derived from an individual's self concept. Logically, these two types are likely to interact, and indeed may occur simultaneously. Understanding and measuring involvement, capturing the true relevance of the object to inform action, should therefore capture both the thinking [cognitive] and the feeling [affective] elements of involvement (Zaichowsky, 1986).

The Elaboration Likelihood Model

Felt involvement, arising from one or a combination of the three antecedents that generate personal relevance, influences both information search and information processing. The Elaboration Likelihood Model (ELM) of persuasion (Petty et al. 1983) captures the nature and extent of this information search providing a dual-process theory. In this theory, highly involved consumers are more likely to seek out, pay attention to, and cognitively process detailed [usually written/verbal] information. The consumer devotes more energy, taking an effortful and deliberative/ systematic approach towards processing information and judgement formation. They take what is known as the 'central route to persuasion'. In the case of advertisements, the premium placed on forming accurate assessments by high involved consumers means that they are willing to devote resources to information processing and in doing so they focus on brand-related content and claims in the advertisements.

Consumers making low involvement decisions lack the motivation to actively seek out and process detailed issue-relevant information. They take a 'peripheral route', relying on heuristics

such as imagery, music, endorser-characteristics etc. to arrive at their decision. That is, they take a heuristic processing strategy and do not elaborate much on, for example, brand-related claims (Gorn 1982, Petty and Cacioppo, 1981, Petty et al., 1983). The consumer's low involvement means that they are only interested in producing a judgement that suffices, rather than one that can be held with complete confidence. The resources that are deployed tend to correspond to those needed to process the heuristics and derive a convenient basis for judgement (Meyers-Levy and Malaviya 1999).

Interestingly, highly involved consumers are unlikely to utilise the peripheral route in their decision making, whilst those with a low degree of involvement are unlikely to utilise the central route (Petty et al. 1983, 1986). Moreover, the results of motivation, as operationalised by the central or peripheral routes, are not the same. Attitudes based on a systematic, cognitive, consideration of the central arguments are relatively enduring and resistant to change. In contrast, attitudes based on peripheral aspects of an argument are likely to be less enduring and open to change (Petty and Cacioppo 1986). Subsequently, attitudes held in low motivation may result in less predictable behaviour.

Central and peripheral routes of persuasion describe the way that individuals search for and process information, with the degree of involvement determining which of the two routes is adopted. In turn, the degree of involvement is held to be influenced by perceived risk (Chaffee and McLeod 1973, Laurent and Kapferer 1985, Rothschild 1979). The link between involvement and perceived risk is predicated first on a notion that risk is seen to be a function of: (1) The perceived importance of avoiding negative purchase outcome; and (2) The subjective feeling about the occurrence of such outcomes (Mitchell 1999). It is therefore a function of the amount at stake and the subjectivity of outcomes. Thus, for each decision, for which the consumer has a set of goals, or expected outcomes, the risk is an assessment of the possible variance from these goals. The decision goals are in turn comprised of a number of components, each of which in actuality could deviate from that desired. These risk components could include any or all of the following [see for e.g. Jacoby and Kaplan 1972, Peter and Tarpay 1975].

- Financial risk [e.g. hidden costs]
- Performance risk [e.g. inferior durability]
- Physical Risk [e.g. the purchase results in physical harm]
- Psychological risk [e.g. the product does not fit with own self image]
- Social risk [e.g. the product does not fit with the way that the buyer perceives others to see them]
- Convenience risk [e.g. the product takes a long time to be delivered]
- Overall risk [e.g. the product may result in general dissatisfaction]

Following on from the notion that perceived risk is a function of the amount at stake, derived in terms of the risk components as well as the subjective certainty of outcomes, it is logical to see how perceived risk could affect involvement in that; '…the amount of uncertainty and/or the possible consequence of a decision would involve the individual to a greater or lesser extent' (Rothschild cited in Venkatraman 1989). In other words, risk and involvement both incorporate the notion of importance of a product class to the consumer (Bloch and Richins 1983).

In an abstract sense, the importance of a product class for a consumer is equivalent to its enduring involvement for them. That is, importance arises from the product's ability to satisfy consumers' enduring and self identity needs. However, away from the "abstract", importance and perceived risk are also determined by the situation. Embracing notions of product and situational involvement, as well as adopting the sources of risk similar to

those of Jacoby and Kaplan (1972) and Peter and Tarpay (1975), a model for consumer involvement can be derived onto which the routes of persuasion may be added [Figure 3].

A key implication of the ELM is the need to match executional/informational cues to consumer information-processing levels (Petty and Cacioppo 1986). As Figure 3 illustrates, low involvement consumers are unlikely to deeply process brand information in messages/adverts [websites]. Here, the peripheral route is followed and the use of affect-laden heuristics is more likely to have a positive influence on brand (website) attitude. In contrast, highly involved consumers are likely to deeply process the advertised message/adverts [websites]. Strong message arguments and cues are likely to have a positive influence on brand [website] attitude. Crucially, when motivation is low, the consumer's attention is 'voluntarily allocated to stimuli other than the brand or the ad' (MacInnis et al., 1991).

The research model now introduced in Section 4 integrates the concepts of involvement and elaboration with website infrastructure attributes to extend the interpersonal initial trust building model. This model provides a platform for investigating the relative importance of website infrastructure vis-à-vis two already established factors regarding information search and processing strategy.

INVOLVEMENT, ELABORATION AND THE SOURCES OF INITIAL TRUST

For Jarvenpaa et al., (1999), a website with trust-inducing features can operate as a skilled salesperson for the company, moderating the disadvantages of an impersonal website (Wang and Emurian, 2005). The research model depicted in Figure 4 extends the research already reported on the trust-inducing features of website infrastructure attributes. Significantly, the model incorporates the construct of involvement as a potential additional explanatory variable in consumers' assessment of vendor trustworthiness.

The consumer behaviour literature asserts that the level of involvement motivates consumers to a greater or lesser extent to seek out and process informational cues. Given this, and the fact in the

Figure 3. A model of consumer involvement and elaboration

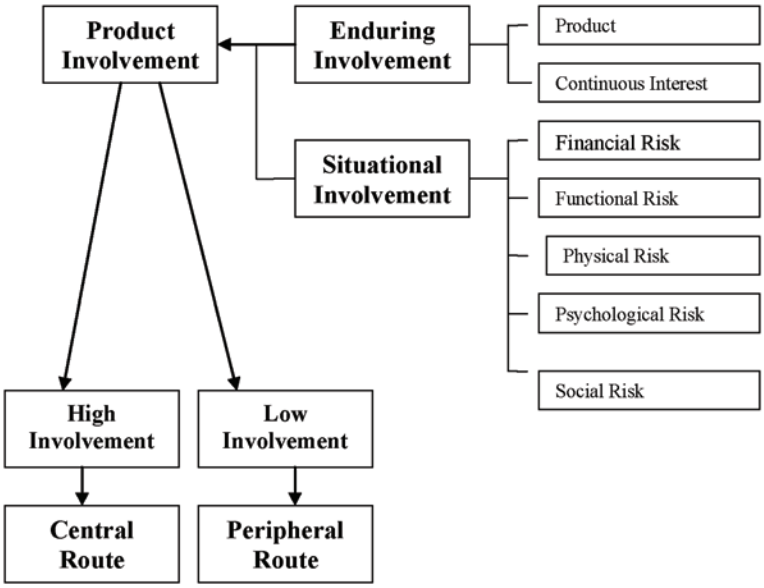
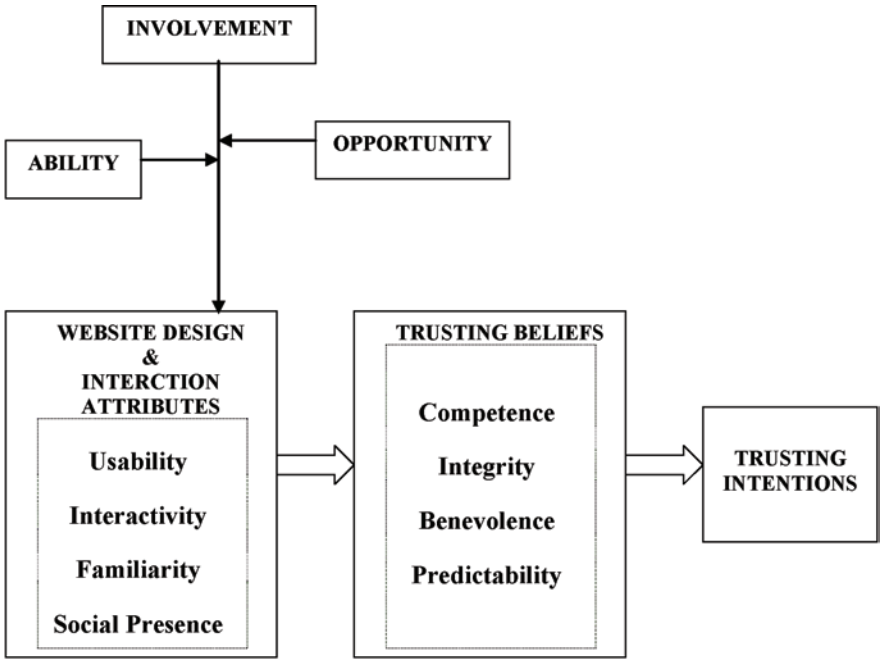


Figure 4. Conceptual research model of trust formation towards online vendor



absence of experience-based knowledge, consumers have been found to form their assessments of vendor trustworthiness on website infrastructure attributes the model suggests a number of substantive propositions.

On the basis that involvement as a motivational construct has a role in consumer attention and comprehension processes, the first proposition is that:

P1: *The level of involvement influences consumers' online information search and processing strategy.*

As low involvement consumers take a peripheral route to decision making; one where they are unlikely to deeply process brand information in messages/adverts (Petty and Cacioppo, 1986), but instead pay attention to stimuli other than the brand or the ad (MacInnis et al., 1991), the second proposition is that;

P2: *Website infrastructure attributes are processed as peripheral cues by low involvement consumers.*

This second proposition is intuitively supported when considering the scenario of consumers who are early on in the decision making process. Early on in their decision making process, consumers may, for example, be browsing as opposed to actively screening and evaluating alternative products/sites. In this low involvement situation, the immediacy of the actual ability, integrity, benevolence and predictability of any vendor is low. By way of contrast, as consumers approach the point where they are getting nearer to an actual decision [e.g. the selection of a store into their consideration set], the personal relevance of the ability, integrity, benevolence and predictability of a potential vendor increases. In these higher involvement situations consumers will take a central route to decision making deploying more resources in terms of search and processing to come to a decision. In the case of high involvement situations, the logical third proposition is that;

P3: *Website infrastructure attributes are substituted for other cues for high involvement consumers.*

Returning to the literature cited in this work on the influence of usability, interactivity, familiarity and social presence on consumer assessments of a vendor's trustworthiness, P2 may be more specifically written as:

P4(a): *Usability attributes are processed as peripheral cues by low involvement consumers.*

P4(b): *Interactivity attributes are processed as peripheral cues by low involvement consumers.*

P4(c): *Familiarity [in terms of the structure of the interface] attributes are processed as peripheral cues by low involvement consumers.*

P4(d): *Social presence/humanized design attributes are processed as peripheral cues by low involvement consumers.*

Whilst consumer motivation to attend to informational cues and process them is logically linked to the involvement-personal relevance construct, additional important elements in the formation of judgements are the *opportunity* and *ability* to process cues (MacInnis et al., 1991). Opportunity reflects the extent to which a situation is conducive to that which consumers are motivated to achieve (Gruen et al., 2005). Indeed, it can be considered from both a positive perspective of availability or from a negative perspective of impediments (MacInnis et al*.,* 1999) Given the obvious role of website design and interaction attributes in providing opportunities to elaborate, and the fact that highly involved consumers are more motivated to engage in active, more deliberative search for information [from whatever source], one further proposition is that infrastructure attributes remain important in consumer assessments of vendor trustworthiness in high involvement situations, but not directly as the informational cue. Thus;

P5:*Consumer opportunities to elaborate are positively linked to website infrastructure attributes.*

More specifically;

P6: *Opportunities to elaborate interact positively with consumer involvement [motivation] to influence assessments of vendor trustworthiness.*

Ability denotes the extent to which consumers have the resources required to achieve that which they are motivated to pursue (Hoyer and MacInnis, 1997). The IT skills of consumers and their ability to interpret the information provided on a website [rather than the competency of the information] represent two such resources. Logically, for a given level of motivation and for determined opportunities, individuals with greater resources will be better able to achieve their goals. As such:

P7: *Ability to elaborate interacts positively with consumer involvement [motivation] and opportunities to influence assessments of vendor trustworthiness.*

To summarise the general implications for online vendors, the argument advanced here is one based on the marketing concepts of involvement and elaboration which suggests that consumers search out and process informational cues differently according to the level of involvement. Specifically, in situations of initial trust, where there is an absence of knowledge-based experience, consumers are motivated to varying degrees to base their assessments of a vendor's trustworthiness on those informational surrogates available to them. Prior research suggests that these information surrogates include website infrastructure attributes. However, these attributes are only likely to be processed as informational cues in low involvement situation. In high involvement situation, infrastructure attributes will be substituted for alternative cues as consumers take a central route to decision making. That said, attributes such as usability are likely to remain important in the elaboration process.

IMPLICATIONS

Prior empirical research has suggested that a link exists between website infrastructure attributes and consumer assessments of vendor trustworthiness, the apparent logic being the 'more' infrastructure in its various guises, the better. However, facing decisions as to whether or not to invest more in design etc. vendors are likely to be facing a trade-off. Firstly, providing additional interaction through design involves costs (Tractinsky and Lowengart, 2007). Indeed, these cost may be both direct [design and implementation] and indirect [maintenance]. Secondly, as this work has identified, the contribution of website infrastructure attributes to assessments of vendor trustworthiness are defined by the level of involvement. Indeed, as the consumer moves from low to high involvement situations infrastructure attributes may be substituted for other [central] informational cues.

Given the influence of involvement on both information search and informational processing strategies, a logical starting place to further advance an understanding of the role of website infrastructure attributes on assessments of vendor trustworthiness is to return to the antecedents of involvement identified in section 3. These centre on the individual, the situation and the object or stimulus.

As previously noted, product involvement is related to a person's centrally held values and actual or ideal self concept and may be further categorised as either enduring or situational. Enduring involvement describes the relationship of a product to a consumer's centrally held values across all purchase situations and is likely to be a general predictor linking enduring attitudes with behaviour. Several characteristics of goods may be relevant in considering this relationship. For example, speciality goods, in contrast to convenience goods, may create greater felt involvement by the consumer as these types of goods might require more concentrated information gathering. That said, consumers seeking convenience goods are always likely to require a certain minimum level of efficiency from the infrastructure attributes of a website. A second further categorisation of product that might also warrant research is that of hedonic versus utilitarian products. Utilitarian products may generate lower levels of consumer felt involvement as consumers might be characterised as task orientated, requiring as such a certain level of efficiency, rather than looking for enjoyment and pleasure from the process. Further potential avenues of research regarding product categories might also include experience vs. search products or durable versus non-durable products.

Whilst enduring involvement levels might vary across different product categorisations, influencing in turn firms' decisions regarding the quantity and quality of website infrastructure they invest in, the other key factor generating consumer involvement is the situation. Consider for example the purchase of a fondue pot, on the face of it an item generating a relatively low level of involvement. As an apparently low risk, low involvement, purchase the apparent logic given the ELM is that the decision would be arrived at relatively quickly without too much effort being expended. However, the purchase of a fondue pot needs to be considered more closely. A closer look at the situation may reveal the item to be more involving. For example, if the fondue pot was to be a gift for a loved one, then the decision carries more risk than might first be assumed. Indeed, there is likely to be greater social risk: Does the fondue pot reflect well on the purchaser? In other words, does it fit with the way that the buyer perceives others to see them? Here, a product with apparently low levels of enduring involvement may in fact have a heightened level of situational involvement. This being the case, the decision maker needs to be able to elaborate. They need to have the option to engage in more deliberate information search and processing. This might mean that they desire more product information in the form of product descriptions and/or possibilities to ask questions.

Clearer contact details and the ability for interaction [i.e. enhanced website infrastructure] may therefore have greater importance.

In contrast to a fondue pot, the purchase of a financial product [e.g. a unit trust] appears to present a situation of greater risk and be more involving. However, whilst this suggests that the central route of persuasion is followed, with more deliberative and systematic searching and processing of information, the perceived risk and involvement is likely to vary according to the stage of the decision making process. For example, if the purchaser is merely placing a company/ product website into a consideration set the level of searching and processing will be less than it is for the purchaser who is in the final stages of the evaluation of alternatives within the set. The individual might in this 'screening scenario' look to peripheral cues as short-cuts. Logically, interactivity and ease of navigation may be amongst those used to form initial attitudes. Again, the situation is likely to change the level of involvement, even in the case of what for many is a product with relatively high enduring involvement.

Further substantive research based on the model of trust and propositions forwarded here would address the need for firms to overcome the trust hurdle for consumers in initial encounters. Conducting this research however presents some considerable challenge. Notably, researchers need to establish methods for varying the level of involvement for respondents in any experiments [the research method used in the majority of existing empirical works on online trust]. The issue is that in a lab, as respondents, individuals may not face the level of involvement they face in a real situation. Accurately capturing the level of involvement and its impact on decision makers' assessments of vendor trustworthiness therefore remains a challenge to be resolved in any future work directed at propositions such as those in section 3.

SUMMARY AND CONCLUSION

Trust frequently has to be placed in others in order for people to be productive in their daily lives (McCole and Palmer 2002). Acknowledging this, much endeavour has been directed at understanding the antecedents of trust. More recently, the different challenges in establishing and developing trust via Internet-based technologies have seen the emergence of a dedicated body of research considering online trust. In terms of the interpersonal dimension of trust this online research has reported on a number of the website infrastructure attributes that can be manipulated by web vendors. Ultimately, for consumers in initial encounters making assessments of vendor trustworthiness these attributes act as surrogates for missing experience-based information.

Whilst the existing online trust literature marks a notable step forward in understanding what factors lead consumers to make assessments of vendors' trustworthiness the literature has not yet considered how consumers search for information and process it. This paper set out to establish how an understanding on online trust might be furthered through incorporating the influence of the marking concepts of involvement and elaboration on the informational cues consumers look to in the formation of judgements in initial encounters. Describing the personal relevance of a decision, involvement motivates individuals to follow either a central or peripheral route to attitude change. In other words, it influences the search and information processing strategies they employ in different situations. Given that different strategies are likely to be employed in different situations, the propositions forwarded in the paper are that website infrastructure attributes as antecedents of trust will have a differing impact on assessments of trustworthiness according to the level of consumer involvement.

On the basis that involvement influences consumer search and elaboration on a website, and that infrastructure attributes are important in

assessments of vendor trustworthiness, one apparently obvious implication is the more website infrastructure attributes the better. However, there are both direct and indirect costs involved with infrastructure attributes. Given this, the paper suggests a more credible implication is that vendors should look to understand better the sources of consumer involvement. This understanding is likely to come from a consideration of the product(s) involved as well as the situation.

Marking a first attempt to incorporate the concepts of involvement and elaboration into a model of online trust building in initial encounters this paper clearly does not provide an exhaustive view. Additional avenues of research might include for example the influence of involvement on other of the previously identified interpersonal antecedents of trusting beliefs such peer recommendations or security and privacy statements. There are as well notable challenges ahead for researches in pursuing investigations in this area, not least in establishing how to vary respondent involvement levels in the experiments they conduct. Through the integrated model and propositions advanced here this paper therefore offers only a preliminary step forward in an attempt to understand how vendors might help consumers get over the often elusive trust hurdle.

As a footnote, a 'warning' accompanies this and other research works that look to understand how perceptions of trustworthiness can be manipulated by vendors through the utilisation of particular website design and infrastructure attributes. The warning is that those design and infrastructure attributes that can usefully be manipulated by vendors to serve their ends could also be manipulated by fraudsters to serve their ends if they have the incentive to do so. This being the case, the trust hurdle is unlikely to be removed completely.

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Chapter 2
Defining Trust and E-Trust:
From Old Theories to New Problems

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ABSTRACT

The paper provides a selective analysis of the main theories of trust and e-trust (that is, trust in digital environments) provided in the last twenty years, with the goal of preparing the ground for a new philosophical approach to solve the problems facing them. It is divided into two parts. The first part is functional toward the analysis of e-trust: it focuses on trust and its definition and foundation and describes the general background on which the analysis of e-trust rests. The second part focuses on e-trust, its foundation and ethical implications. The paper ends by synthesising the analysis of the two parts.

INTRODUCTION

Although trust is largely recognised as an important issue in many fields of research, we still lack a satisfactory definition and foundation of it. Moreover, in recent years, the emergence of trust in digital contexts – known as *e-trust* – has created new theoretical problems. So the first part of this paper, dealing with the old problems of trust, is functional toward the analysis of e-trust and it is meant to describe the general background on which the analysis of e-trust rests. The second part focuses on the new problems posed by e-trust. Their investigation is meant to prepare the ground for a new philosophical approach that might overcome the highlighted difficulties. Let me now provide a more detailed summary.

I first briefly describe Luhmann's contribution to the analysis of trust and then focus on the definition of trust provided by Gambetta. This definition has provided a general understanding of trust and influenced much of the literature. As we shall see, it stresses two aspects: the decision that an agent takes to trust and the relation between

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trust and risk. I will argue that, despite several valuable features, the definition still faces two main problems: the specification of the parameters that determine the decision to trust, and the explanation of the reasons why an agent should decide to take the risk of trusting another agent. These are problems that affect the analysis both of trust and of e-trust.

In the second part of the paper, I discuss the problems that affect e-trust more specifically. The first problem is whether e-trust is possible at all. Some of the literature has denied that trust in digital environments may ever occur. This position rests on the assumption that "trust needs touch" – that it needs to be based on direct physical interaction, which of course does not exist in digital contexts. In the next two sections, I draw attention to two other problems: the role of e-trust in the dynamics of a distributed artificial system, and the relation between e-trust and the ethical values that AAs might be endowed with.

In the last section, I conclude by pulling together the different threads of the analysis in order to summarise the problems left unsolved.

TRUST: A DECISION MAKING PROCESS

Trust is often understood as a relation between an agent (the *trustor*) and another agent or object (the *trustee*). The relation is supposed to be grounded on the trustor's beliefs about the trustee's capabilities and about the context in which the relation occurs. This is a generalisation of the definition of trust provided by (Gambetta, 1998). Before exploring in more depth Gambetta's analysis, however, let me briefly recall some of the more relevant points in Luhmnann's analysis of trust, (Luhmann, 1979). This analysis should be considered the starting point for the modern approach to trust and its cognate concepts.

Luhmann examines the function of trust and the social mechanisms through which trust is generated. He specifies the reason why society in general needs trust. Such a need rests on the fact that trust is a starting point for the derivation of rules for proper conduct, or for ways of acting successfully by reducing complexity and uncertainty in a given social system. Following Luhmann "trust is an effective form of complexity reduction", (p. 8).[1]

For Luhmann, trust is a decision taken by the trustor on the basis of the following parameters: familiarity, expectation and risk. Familiarity is the acquaintance of the trustor with the potential trustee and with the systems. It is the variable that provides a reliable background for the trustor's choice to trust. Expectation is the reason for which an agent decides to trust. For Luhmann, trust is present only when the expectation to trust makes a difference to a decision, otherwise what one has a simple hope. Trust is a risky investment. Following Luhmann, this is so because to trust is to take a decision and risks are a component of decision and action.

This brief overview of Luhmann's analysis underlines the main issues present in any attempt to investigate trust: (a) trust as a result of a decision process, (b) the need of a reliable background as a necessary requirement to trust, (c) the expectation and (d) the risk related to the choice to trust. All these issues have been addressed in the theories analysed in the rest of this paper; particular attention to trust as a result of a decision process has been paid by Gambetta's analysis.

Gambetta defines trust as follow: "trust (or, symmetrically, distrust) is a particular level of the subjective probability with which an agent assesses that another agent or group of agents will perform a particular action", (p. 216).

According to Gambetta, trust is grounded on the probabilities attributed by the trustor to her own beliefs about the trustee's behaviour and abilities. Once calculated, the probability is compared with a threshold value and placed on a probabilistic distribution, where complete distrust is equal to 0, complete trust is equal to 1, and the mid-point

(0.50) represents uncertainty. It is only if the level of probability is equal to, or higher than, the threshold value, that a trustor *a* starts to trust a trustee *b*. This is because the probability is also a measure of the risk for *a* that *b* will not act as *a* believes (or perhaps merely hopes) *b* will. The higher the belief's probability, the lower the risk of the trustee's misbehaviour. A high probability of belief guarantees a low risk for the trustor.

At first sight, Gambetta's definition may seem satisfactory. A deeper analysis, however, uncovers its limitations. Gambetta's definition focuses only on the decision process behind trust, missing other relevant aspects, like how trust affects the behaviour of the agents involved and the effects of their performances. When an agent *a* trusts, *a* not only holds some beliefs about the trustee *b*, but also *behaves* in a specific way towards *b*. Most importantly, if *a* relies on *b* to perform some action, then *a* might, because of her trust, not supervise *b*'s performance of that action. Thus, trust can benefit the trustor by allowing her to save resources in achieving a goal, or harm her if the trustee fails to behave as expected, impeding the trustor in achieving that goal. This deficiency of Gambetta's definition limits its explanatory power. Gambetta is right in emphasising the correlation between trust and risk, and between risk and the probabilities attached to the trustor's beliefs. However, without considering the possible advantages of trusting, it remains unclear why one agent would decide to trust another and accept the risk of doing so. So, it appears that Gambetta's definition provides a starting point in the analysis of trust, but that it is not a fully satisfactory analysis.

One might object that, for Gambetta, trust is directed towards cooperation, so that the aspects of trust unaccounted for, in the definition, might be explained by referring to the proprieties of cooperative relations. However, trust and cooperation are different kinds of relations, and one cannot explain the features of the former by reducing them to features of the latter. Consider cooperation: cooperative agents distribute the tasks among themselves to reach, in the best possible way, a shared goal. This presupposes that the agents are aware of their roles in cooperation. The fact that something or someone *b* is part of a trust relation, however, does not entail that *b* is aware of it. A trustee *b* may not know that she is being trusted. This becomes trivially true when a trust relation includes a human trustor and an object as a trustee. I may trust the elevator, but we are clearly not collaborating. Indeed, trust and cooperation do not overlap and may easily give rise to different kinds of interactions. By referring to cooperative behaviour in order to explain the peculiarities of trust relations, Gambetta's analysis fails to identify the peculiarities of the latter.

The relation between trust and cooperation, described by Gambetta, leads to a second objection. According to Gambetta, whenever *a* trusts *b*, *a* is actually attempting to cooperate with *b*. If the conditions required by mutual trust are fulfilled, cooperation arises. This makes trust a necessary condition for cooperation. Yet this is untenable, for it is clear that there are both cases of mutual trust without cooperation and cases of cooperation not based on trust. Competitive situations are good examples of cases in which participants may trust each other while knowingly and purposefully refusing to cooperate. Consider two politicians from opposite parties: they may trust each other not to commit electoral fraud but, despite this, compete against each other in order to be elected, and hence refuse to cooperate to lead the country together. Likewise, it is easy to imagine examples of cooperation that do not presuppose trust. During World War II, the USA and USSR did not trust each other (e.g. on the management of the political equilibrium in Europe) but still cooperated to fight the Nazi-Fascist alliance. In such cases, common goals may lead to the creation of unusual bedfellows, who cooperate without trusting each other.

To summarise, cooperation might arise from trust, but its doing so is not necessary and depends rather on the context, goals and intentions of the agents involved. Any analysis that grounds trust

on cooperation is bound to be unsatisfactory. Further problems arise when one focuses on e-trust.

TRUST IN DIGITAL ENVIRONMENTS

In this and in the following sections I will provide an overview of the debate on e-trust and on the general understanding of this phenomenon. To do so, I will disregard those analyses of e-trust which focus only on its specific occurrences, such as, for example, e-trust in business ethics, in e-commerce, in system management.[2]

E-trust occurs in environments where direct and physical contacts do not take place, where moral and social pressures can be differently perceived, and where interactions are mediated by digital devices.[3] All these differences from the traditional form of trust give rise to a major problem that any theory of e-trust must solve: whether trust is affected by environmental features in such a way that it can only occur in non-digital environments, or it is mainly affected by features of the agents and their abilities, so that trust is viable even in digital contexts. There are different positions taken in the literature about this problem. Let me start by describing three classical arguments that connect trust to features of the environment and so deny the emergence of trust in digital environments.

All the arguments against the existence of e-trust assume that the emergence of trust requires three conditions that cannot be fulfilled in digital environments. These conditions are:

1. direct interactions between the agents;
2. the presence of shared norms and ethical values that regulate the interactions in the environment;
3. the identification of the parts involved in the interactions.

The detractors of e-trust, for example (Nissenbaum, 2001), consider the features of digital environments an obstacle to the fulfilment of these conditions.

The first obstacle concerns the definition of rules and norms that govern interactions in digital environments. According to the critics of e-trust, trust is only possible within the norms and values that regulate a community life. However, these values are culturally and geographically defined. So it does not seem possible to find them in the interactions of virtual communities, which are often de-localised and may be strongly multicultural.

The second obstacle consists in the identification of the interacting agents. In digital environments, agents can remain anonymous and can often be difficult to identify. This makes deception easier and might diminish the agents' sense of responsibility. In such environments, the risk of deceit might be higher than usual, and it might therefore be much more difficult for agents to trust one another. It seems irrational to trust someone without knowing her identity.

This brings us to the third obstacle, which can be summarised by the expression "trust needs touch". Trust needs, or at least is encouraged by, direct, visual, and physical acquaintance among the agents involved. Since, by definition, these kinds of interactions are absent in digital environments, it is argued that trust cannot occur in such environments.

Despite their *prima facie* plausibility, all of these objections against e-trust can be rebutted. Trust in digital environments is mostly associated with trust over the Internet and especially with that of e-commerce. In these cases, e-trust is often reduced to a matter of security. Consider, for example, the way e-trust is approached in trust management, see (Blaze, Feigenbaum, & Lacy, 1996) and (Jøsang, Keser, & Dimitrakos, 2005). One objection is that, even if personal identification, ethical values and direct contacts help form beliefs about a trustee's intentions, they are not necessary requirements, either for trust in general or for e-trust in particular. An agent can form the beliefs that allow her to trust an agent or object (e.g. an automated service) without interacting directly with the trustee. Consider referral-based trust in real environments. This kind of trust is

based only on communication processes. It is the kind of trust that one develops in an unknown agent by considering only the recommendations about that agent provided by other agents or by other information sources, such as newspapers or televisions. Referential trust is one of the main kinds of trust developed in digital environments in which communication processes are easily performed.

The three requirements described above can actually be fulfilled in digital environments and that is why, as a matter of fact, e-trust is becoming increasingly common. Nowadays, many tools allow users to identify the agents they virtually interact with. Consider peer-to-peer programs, mailing lists, chats and blogs and the many features or services going under the name of Web 2.0 applications. The people who take part in these interactions have to provide an email address through which they can be identified. The number of internet communities is growing, too. These communities develop shared norms to regulate the behaviour of their members, despite being spread around the world and containing different cultural perspectives. In short, the three conditions listed above are neither necessary constraints on trust nor unfulfillable requirements online. Unsurprisingly, they are not obstacles to the emergence of e-trust.

The debate about e-trust does, however, identify a major problem with the foundations of e-trust. If e-trust does not rest on direct physical interaction, it must rest on some other grounds, for instance, information or the agent's attitude. So, despite the fact that e-trust is a perfectly reasonable and common phenomenon, a theory of e-trust must explain what these other grounds are.

E-TRUST AS AN ATTITUDE

One way to explain how trust can emerge in digital contexts has been described by Weckert in (Weckert, 2005). His analysis seeks to explain the occurrences of e-trust by grounding them on agents' attitudes to trust.[4]

In quoting Baier,[5] Weckert states that trust is "the cognitive, the affective and the conative. Trust is any of these, is all three", (Weckert, 2005). Weckert considers trust a paradigm through which one acts with another agent and with the environment. Generally speaking, for Weckert, to trust an agent is to see her as if she were trustworthy. In this sense, trust is an agent's attitude. The cognitive aspect, namely the trustor's beliefs, plays only a complementary role in defining a trustee's trustworthiness. What grounds trust in the first place is an attitude of the trustor. This one comes from the natural inclination of the trustor and can be facilitated by her moral values.

Weckert considers the trustor's attitude to be a crucial condition for the emergence and preservation of trust. He claims that, once an agent has a trusting attitude, she will still trust, even after being deceived.

According to Weckert, if trust were a purely cognitive state, defined only by a trustor's beliefs and expectations, then it would be difficult to explain why someone would take the risk of trusting agents whose trustworthiness is not evident. In support of his thesis, he cites the emergence of trust in digital environments. According to him, e-trust is based on the trustor's tendency to see other agents as if they were trustworthy rather than on the rational evaluation of the trustees' behaviour. In this case, the trustor *a* chooses to act as if she trusts, delaying the rational evaluation of beliefs and risks: *a* will evaluate the outcomes of her choice at a second stage. If it turns out that the virtual environment favours positive outcomes, then genuine trust, based on the trustor's beliefs, will emerge.

Weckert's argument highlights some important features of trust online, but faces one difficulty. In acting as if she trusted, the trustor *a* actually *does trust* another agent *b*. This much is acknowledged by Weckert: *a* actually interacts with *b*, and takes what is presumably a higher risk, given the lack

of information about *b* and the environment. This is not a problem *per se*, but it leaves unexplained a crucial issue: why any agent should decide to engage in the very dangerous behaviour of unjustified trust. For this reason, considering the emergence of e-trust to be a consequence of an agent's attitude does not provide an explanation of why e-trust emerges in the first place. Empirically, we know that it is often the case that, before trusting, an agent considers (or tries to consider) all possible variables that could affect the outcome of her trusting.

In defence of Weckert's position, one might argue that e-trust emerges in environments in which the decision to trust cannot be based on the probabilities of the beliefs or on the calculation of the outcomes, because the parameters, to which an agent would refer in making these calculations, are not available in digital environments. Given this premise, Weckert's analysis may seem to provide the best explanation of trust in digital contexts, yet this is only partly true. Consider e-commerce. E-commerce is a diffuse phenomenon, which has grown exponentially in recent years and which continues to expand even though the risks that accompany it are high and largely well known. Users of e-commerce trust the websites, the companies, the pay systems, and sometimes other users whom they have never seen or met before. Weckert would explain these occurrences of e-trust by referring to a non-rational choice, made by the pioneers of e-commerce, which has later been reinforced by positive outcomes. However, recent studies[6] contradict Weckert's position, for they show that on-line purchases, especially when made for the first time, are based on carefully determined calculations. There are well-defined parameters – such as the brand, the technology of the web site, the seals of approval, and previous experiences made by other customers – that have to be fulfilled to make users develop a level of e-trust high enough to decide to purchase something on-line. Hence, although Weckert's analysis acknowledges the importance of on-line contexts, it fails to give an explanation of e-trust, and leaves open both the problem of its emergence and the problem of the role that trust can play in on-line interactions.

E-TRUST IN ARTIFICIAL DISTRIBUTED SYSTEMS: AAs

So far, I have considered the occurrence of e-trust in hybrid contexts, in which both human and artificial agents interact. I will now consider a different occurrence of e-trust: that between the AAs of a distributed system.

Although the term AAs is used in different areas of research, there is not a single universally accepted definition. Therefore, before proceeding further in the description of the analyses of e-trust among AAs, I will briefly recall two of the more common definitions of AAs provided in the literature. The goal of this section is not to review the literature on AAs but to provide the reader with some guidelines in the understanding of the use of AAs in the rest of the paper.[7]

There are several factors to take into consideration in defining AAs, the environment, the flexibility, the autonomy and the reactivity of the agent. All these parameters are taken into consideration in the definition provided in (Wooldridge & Jennings, 1995). The authors state that "a hardware or (more usually) software-based computer system that enjoys the following properties:

- autonomy: agents operate without the direct intervention of humans or others, and have some kind of control over their actions and internal state;
- social ability: agents interact with other agents (and possibly humans) via some kind of agent-communication language;
- reactivity: agents perceive their environment, (which may be the physical world, a user via a graphical user interface, a collection of other agents, the Internet, or per-

haps all of these combined), and respond in a timely fashion to changes that occur in it;
- pro-activeness: agents do not simply act in response to their environment, they are able to exhibit goal-directed behaviour by taking the initiative." (p. 2)

Another definition, which includes all the parameters mentioned above has been provided by (Floridi & Sanders, 2004). The authors define AAs as an entity that is interactive (able to respond to the environmental stimuli); autonomous (able to change its states according to its own transaction rules and in a self-governed way independently from the environmental stimuli), and adaptable (able to change its own rules of transaction according to the environment).

AAs often operate within distributed systems in which the constituent components are spread throughout a network, and are subject to constant change throughout the system's lifetime. Examples include peer-to-peer computing (Oram, 2001), the semantic Web (Berners-Lee, Hendler, & Lassila, 2001), Web services and e-business, autonomous computing and the grid (Foster & Kesselman, 1998). Distributed systems can be modelled as multi-agent systems (MAS) that are composed of autonomous agents that interact with one another using particular mechanisms and protocols. In such a system, e-trust plays a fundamental role, because both the system and the agents may have limited computational and storage capabilities that restrict their control over interactions. Moreover, the limited bandwidth and speed of communication channels limit the agents' sensing capabilities in real-world. Thus, in practical contexts it is usually impossible to reach a state of perfect information about the environment and the interaction partners' properties, possible strategies, and interests, see (Axelrod, 1984) and (Russell & Norvig, 1995). AAs are therefore necessarily faced with significant degrees of uncertainty in making decisions. In such circumstances, agents have to trust each other in order to minimise the uncertainty associated with interactions in open distributed systems.

Having described AAs and the importance of e-trust we can proceed further to the analysis of e-trust among AAs of distributed systems.[8]

E-Trust among AAs

An analysis of trust among AAs in multi-agent systems (MAS) has been provided by Castelfranchi e Falcone in (Castelfranchi & Falcone, 1998). Its purpose is to prove, first, that e-trust is a mental state of an AA and, second, that e-trust is the mental background of delegation.

According to the authors "trust is a *mental state*, a complex *attitude* of an agent *x* towards another agent *y* about the behaviour/action *a* relevant for the result (goal) *g*", (Castelfranchi & Falcone, 1998). The "mental state" of e-trust is based on the trustor's beliefs about the trustee's attitudes concerning the relationship between the trustee and the trustor.

Castelfranchi and Falcone take e-trust to be a threshold value that is the result of a function of the subjective certainty of the beliefs held by an AA. Only if the level of trust is higher than a given threshold will the trustor decide to delegate the execution of a given action to the trustee. By assuming this premise, the authors state that e-trust is the "mental counter-part of delegation", (p.74) because the trustor chooses to delegate a given action by relying on her own beliefs. Finally, they claim that if trust occurs between two agents, then the trustee will be "committed to *x* [the trustor] to do *a*." There is "an (explicit or implicit) promise to do so which implies interpersonal duty." (p. 78)

Let us now consider three shortcomings of the analysis provided by Castelfranchi and Falcone.

First of all, the definition of e-trust as a mental state of an AA is incorrect. It is anthropomorphic, for it attributes to AAs features – such as self-confidence, a complex attitude, willingness and the capacity to make promises – that are incompatible with our current and foreseeable technology and

the classic definition of AAs, according to which an AA is "a computer system that is situated in some environment and that is capable of autonomous actions in this environment in order to meet the design objectives", (Wooldridge, 2002).[9]

A second objection concerns the relationship between e-trust, trust, and delegation. Like the definition provided by Gambetta, the analysis provided by Castelfranchi and Falcone turns out to be too reductive. It does not account for proprieties related to interactions based on trust, but mistakenly takes them to be forms of delegation. The authors describe e-trust as a measure of the beliefs that *a* holds *when a* intends to delegate something to *b,* another agent or an object. Yet cases in which trust occurs without delegation are perfectly possible and indeed common. Recall the examples of the politicians introduced above: they might trust each other, but neither of them would delegate the task of leading the country to the other. It is true that if someone has to delegate something, then she will prefer to choose someone she trusts. But this does not entail that trust always has delegation as its final or defining goal.

One could respond by observing that an agent trusts when she needs another agent or object to perform a given action, and hence that some form of delegation is the obvious and necessary consequence of trust. This argument is indeed offered by Castelfranchi and Falcone. It assumes that a trustor has a "dependence belief": the trustor *a* needs the trustee *b* and believes that "[she] depends on the trustee' to achieve her goal" (p.75).

This argument, however, is based on the erroneous assumption that the trustor is dependent on an agent or object to perform an action, and that, given this necessity, she will delegate this action to someone whom (or something that) she trusts. By assuming dependence, delegation follows straightforwardly. But it is not true that the trustor always depends on the trustee. Let us consider again the example of the two politicians: the politicians trust each other but they do not depend on each other. Or consider a process in which *a* negotiates with *b* to purchase an item, as this might happen on eBay: *a* trusts *b* to be an honest seller and hence not to sell a damaged item. The trust of *a* in *b* does not entail a dependence of *a* on *b*. Hence, dependence on the trustee is not necessary for trust. But if dependence is not entailed by trust, then neither is delegation.

The last criticism concerns the trustee's promise to satisfy the trustor's needs. The promise is based on two assumptions. First, that *b* is aware that it is being trusted and, second, that trust influences *b*'s behaviour. The first assumption is false. The trustee's awareness is a possible but unnecessary feature of trust: one can be trusted without being aware of it. As for the second assumption, this conflicts with the uncertainty of the outcomes of trust assumed by the definition. If trust can bias the trustee's behaviour, and if it can influence the trustee in order to make it satisfy the trustor's needs, then the outcomes of trust can no longer be uncertain, or must at least be much less so. Because of its trust, *a* is confident that *b* will fulfil its expectations. On the basis of these two assumptions, the trustee's promise to act according to the trustor's expectations is not justified.

From the argument of Castelfranchi and Falcone it follows that the trustee abides by some ethical principles – at least the principle to respect promises. Even if the objection shows that trust does not presuppose the commitment of the trustee, the question arises whether e-trust needs to be based on ethical requirements. The role of moral values on the emergence of trust is an important issue, so I will examine it further in the next section.

NORMATIVE E-TRUST[10]

The theory of e-trust examined in this section has been provided by Tuomela and Hofmann in (Tuomela & Hofmann, 2003). The authors' analysis grounds e-trust in the ethical principles of the AAs of a distributed system. Like Gam-

betta, they consider e-trust to be necessary for the development of cooperation and the formation of groups, i.e. MAS.

The authors concentrate on rational social normative trust (hereafter *normative trust*), distinguishing it from *predictive trust* and *predictive reliance* between agents. They describe trust as a relationship based on the trustee's trustworthiness but claim that it also requires the trustor's belief about her dependence on the trustee's performances.

Normative trust presupposes existing relationships among the agents based on mutual respect, social rights and moral norms. Given these conditions, the trustor *a* decides to depend on the trustee *b* performing an action, and feels comfortable with this dependence because she believes that *b* is committed to that action by the moral relationship that exists among them. In saying that *a* feels comfortable about depending on *b*, the authors mean that *a* does not feel that she is taking a risk in trusting *b*. Normative trust is distinguished from predictive trust in that the latter is said to be the trustor's expectation that the trustee's actions will be beneficial to the trustor unintentionally, and not owing to any social or moral normative value. In this kind of trust, the trustor relies on the context and only some of the trustee's features.

According to Tuomela and Hofmann, only normative trust deserves the label of trust *tout court*: predictive trust and predictive reliance should be described in terms of the more general notion of reliance.

Let us now look at normative trust in more detail. Tuomela and Hofmann describe a set of necessary and sufficient conditions for the occurrence of normative trust. They are as follows. First, *a* does not intend to perform an action *x* by herself. Second, *a* is interested in *b*'s performing *x*. (In this sense, she depends on *b*'s performances.) Third, *b* can be influenced in her performances by knowing that *a* depends on her.

Tuomela and Hofmann then specify five necessary and sufficient conditions for normative trust, including requirements on the beliefs of the trustor about the trustee's performances, skills, and goodwill. They also include the requirements that the trustor holds "positive feelings" about her dependence on the trustee and that she has the "attitude" to depend on the trustee to achieve a given goal.

The condition about the trustor's belief in the goodwill of the trustee is the normative aspect of normative trust. The trustor expects the trustee's goodwill based on their relationship of mutual respect. Goodwill does not mean that *b* is generally good-willed towards *a*; rather, it means that *b*'s behaviour towards *a* is biased by genuine caring and by moral reasons. In normative trust, the social or moral grounds justify the trustor's expecting good-willed behaviour from the trustee. The authors claim that social and moral duties are "a glue made of strong ingredients", (Tuomela & Hofmann, 2003) which commits the trustee to performing a given action. They identify the social and moral ground with the mutual respect that must occur in the interactions of the agents. Based on mutual respect, the trustor accepts her dependence.

The authors stress that, in the case of normative trust, there is no longer any uncertainty: the outcomes of trust are the consequences of the social and moral norms that govern the pre-existing relationships of the agents.

Two criticisms can be moved to this analysis. By formulating them I will reject Tuomela and Hofmann's claim that normative trust is the only relevant type of trust and argue, instead, that normative trust is only one aspect of a more general notion.

The first criticism turns on the connection between trust and dependence. Like Castelfranchi and Falcone, Tuomela and Hofmann consider the main feature of trust to be some kind of dependence and, more specifically, the attitude with which an agent views her dependence on another. But this

explanation is too restrictive, for we have seen that there are many, genuine instances of trust without any dependence.

One may object that the main trait of trust is not dependence, but the way the trustor deals with her interaction with the trustee. What distinguishes trust from the more general idea of reliance is that, owing to social and moral relationships, the trustor is justified in "feeling comfortable" about interacting with the trustee.

The second criticism allows one to overcome this objection. The trustor's decision to trust depends on her beliefs and the context in which the interaction occurs. It is arguable that, whenever an agent decides to trust, she is comfortable with the idea of interacting with the trustee, even if there are no norms that guarantee the trustee's respect.

In conclusion, it is possible to have trust-based interactions even when social and moral norms are not present. Hence, social and moral norms cannot be considered a necessary requirement for the development of trust in relationships. The authors' claim that only normative trust deserves to be called trust remains unsupported.

CONCLUSION: OLD AND NEW PROBLEMS

In the previous sections, I provided an overview of the theoretical literature on trust and e-trust. I showed that, though important aspects of these phenomena have been explained, such as the relation between trust and risk, many other features need to be clarified. I focussed on four problems affecting current theories of trust and e-trust:

1. the definitions of trust and e-trust. Trust and e-trust have been defined in the following ways: (i) as a probabilistic evaluation of trustworthiness, (ii) as a relationship based on ethical norms, and (iii) as an agent's attitude. All of these definitions focus only on the trustor's beliefs, and so give a partial explanation of the phenomenon of trust. They leave many questions unanswered. They do not clarify what the effects of trust on the involved agents' behaviour are, nor for what reason an agent decides to trust. All the analyses of trust provided agree in considering trust necessary for the development of a social system, but none of them explains the reasons why trust has such an important role;
2. the occurrences of e-trust. Some of the literature questions whether it is possible for trust to develop in digital environments. The belief that it is not rests on the assumption that "trust needs touch" – that it must be based on direct physical interaction. For those who hold this assumption, trust cannot arise merely from the information that the trustor holds about other agents and about context. Yet, this is clearly false, for we witness e-trust daily, when we use the Internet and other the digital devices. Some further explanations is required;
3. the role that e-trust might have in the dynamics of distributed artificial systems. The question is whether e-trust gives any kind of advantage to the AAs that trust;
4. the relation between e-trust and ethical principles. On the one hand, e-trust seems to rest upon some ethical principles, insofar as an agent's loyalty or honesty online begets her trustworthiness. On the other hand, e-trust seems to be more related to an agent's capacities to perform a given task, and trust relations seem to be grounded on practical rather than ethical principles. A theory of trust and e-trust, even if not ethically biased, should explain what the role of ethical and practical values is.

These four problems will need to be solved by any satisfactory theory of trust and e-trust.

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ENDNOTES

1 Luhmann defines complexity in very abstract terms, as "a distinction between system and environment and in terms of a system's potential for actualization" (Luhmann 1979, p. 6).

2 For more details the interested reader is referred to: for business ethics, (Alpern, 1997), (Solomon & Flores, 2001), (Berg & Kalish, 1997), (Brenkert, 1998), (Flores & Solomon, 1997); for e-commerce, see (Ba, Whinston, & Zhang, 1998), (Cantrell, 2000), (Fukuyama, 1998), (Gefen, 2000), (Stahl, 2004), (Stahl, 2006); and for system management, see (Bhattacherjee, 2002), (Dribben), (Hosmeh, 1995),

3 See for example (Rousseau, Sitkin, Burt, & Camerer, 1998) and (Rutter, 2001)

4 A similar approach has been also described in (Jones, 1996).

5 (Baier, 1995)

6 (Archetype/Sapient, January, 1999, http://www.gii.com/trust_study.htmlhttp://www.gii.com/trust_study.html#77http://www.gii.com/trust_study.html#77) and (Corritore, Kracher, & Wiedenbeck, 2003).

7 For a more in depth description of the debate on the definition of AAs see (Russell & Norvig, 1995), (Russell & Norvig, 1995), (Maes, 1990), (Schmitt, 1987)

8 In this and in the following sections I will use the words trust and e-trust in the same way they are used in the literature provided in this paper. Trust and e-trust will mean a decision taken by an AA that determines the circumstances of its actions. The parameters according to which this decision is taken, and its effects are specified time by time following the different analyses reviewed. In the same way the distinction between trust, trustworthiness, calculative trust and initial trust will be mentioned only when they appear in the reviewed analysis.

9 See section E-Trust In Artificial Distributed Systems: AAs for more details about the debate on the definition of AAs.

10 In this section I follow the terminology used by the authors, and refer to 'normative trust' and not to normative e-trust. This account concerns trust in MAS and seeks to explain occurrences of e-trust.

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Chapter 3
Using the Social Web Environment for Pattern Engineering

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ABSTRACT

There are a number of disciplines that depend on the lessons based on history and human creativity while solving problems. In the last two decades, patterns have emerged as a notable problem-solving approach in various disciplines, including science and engineering. The relationships between people, patterns, and technology have evolved over the years. In particular, the changes in the technological environment affect communication, education, production, publication, and management of patterns. This chapter proposes the use of the Social Web in supporting the human and social aspects of pattern engineering. In doing so, the prospects of integrating the technologies/applications underlying the Social Web in the activities and artifacts of pattern engineering are illustrated by a variety of examples, and the concerns in doing so are highlighted.

INTRODUCTION

The reliance on the time-invariant knowledge garnered from experience can be important for any creative endeavor. A *pattern* is one such type of conceptually reusable explicit knowledge (Buschmann, Henney, & Schmidt, 2007b).

The origins of patterns came in urban planning and architecture in the 1970s (Alexander, Ishikawa, & Silverstein, 1977; Alexander, 1979), followed by object-oriented software design in the late 1980s and the early 1990s (Gamma et

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al., 1995). In the past two decades, patterns have found applications in various domains of interest (Rising, 2000; Henninger & Corrêa, 2007).

The use of patterns has become increasingly pervasive. For example, patterns have been used for the construction of high-quality distributed software architectures (Buschmann, Henney, & Schmidt, 2007a), electronic commerce applications (Kamthan, 2009c), electronic learning applications (Derntl, 2005), mobile interaction design (Ballard, 2007; Tidwell, 2011), secure systems software (Schumacher et al., 2006), use case models (Kamthan, 2009a), Web Applications (Kamthan, 2008; Van Duyne, Landay, & Hong, 2007), and social media applications (Crumlish & Malone, 2009; Tidwell, 2011), to name a few. For novices, patterns are means of guidance; for experts, they are means of reference.

There are anthropological and sociological aspects of patterns (Coplien, 1996; Iba, 2007) that can flourish by an appropriate involvement of technology. The Social Web, or as it is more commonly referred to by the pseudonym Web 2.0 (O'Reilly, 2005), is the perceived evolution of the Web in a direction that is driven by 'collective intelligence', realized by information technology, and characterized by user participation, openness, and network effects. The purpose of this chapter is to assess the viability of the Social Web environment in serving as an ecosystem for pattern engineering. For the sake of this chapter, the Social Web environment includes Social Web technologies, applications based on those technologies, and tools for managing them.

The rest of the chapter is organized as follows. The background necessary for the discussion that follows is first presented. This is followed by stating the human-centric activities and artifacts of pattern engineering, and the implications of the Social Web environment. Next, directions for future research are outlined. Finally, concluding remarks are given.

BACKGROUND

This section presents the necessary terminology related to patterns, people involved in patterns, and a perspective of the Social Web.

A Model for the Pattern Domain

The *pattern domain* is the universe of discourse for all things related to patterns. The *pattern body of knowledge (PBOK)* is the set of fundamental concepts, activities, and results that characterize the pattern domain. In the last two decades or so, the PBOK has grown and the scope of concepts in it has broadened.

There is currently no single source, reference model, or standard for the PBOK. Therefore, this section relies on selected publications (Appleton, 1997; Meszaros & Doble, 1998; Buschmann, Henney, & Schmidt, 2007b) that can be considered as authoritative.

Basic Concepts

There are certain basic concepts in PBOK that are of interest.

Pattern. A *pattern* is an empirically proven solution to a recurring problem that occurs in a particular context.

Anti-Pattern. An *anti-pattern* suggests a 'negative' solution to a given problem. It occurs when the context of the problem is not understood or the underlying forces are not optimally balanced.

Pattern Language. It may not be feasible to provide a single solution to a 'large' problem. In such a case, the problem can be partitioned into a manageable collection of smaller problems. A *pattern language* is a collection of patterns that are closely related to each other through their individual contexts and contribute towards a common goal. Thus, a pattern language solves a larger problem than that possible by any individual pattern.

Other Concepts

There are a number of other concepts in PBOK that are of interest.

Pattern Complements. If P_1 and P_2 be two patterns that address the same problem, then P_1 and P_2 are *pattern complements*.

Pattern Description. A *pattern description* is a set of indicative statements that specify a pattern. A *pattern element* is a labeled placeholder for information that accentuates a certain aspect of a pattern. A pattern description, if structured, typically consists of a number of elements. For instance, these elements may be labeled as (pattern) name, author, context, problem, forces, solution, examples, and related patterns. The labels of elements can vary across the pattern community and other (optional) elements, such as those related to metadata, may be included to enrich a pattern description. The name element of a pattern often such that it reflects the nature of the solution; the author element gives the identity of the pattern author(s); the context element provides the situation or pre-conditions within which the problem occurs; the forces element provides the constraints that are resolved to arrive at a solution; the solution element provides an abstract, general, and reusable solution to the problem and is shown to work in practice via an examples element; and the related patterns element outlines any other pattern(s) to which a pattern is related to in some way. It is this explicit structure that makes patterns more than a mere collection of 'problem-solution' pairs, and makes them unique and more practical in their applicability among other types of experiential knowledge such as guidelines and heuristics. A pattern is usually referred to by using its name. In this chapter, the name of a pattern is listed in uppercase in order to distinguish it from the surrounding text.

Pattern Form. A *pattern form* is a prescription of a specific set of pattern elements that are expected to appear in a pattern description.

Patlet. A *patlet* is a 'simplified' description of a pattern, providing only a short statement of the problem and solution, and does not include other elements. The purpose of a patlet (and a pattern thumbnail) is to briefly introduce a pattern (without engaging in details) so that a pattern reader can make an informed decision whether or not to read any further. This can be particularly significant when there is a large collection of patterns to select from.

Pattern Thumbnail. A *pattern thumbnail* is similar to a patlet except that it is usually accompanied with a picture of the solution.

Pattern Language Map. A sequential reading through the text of a lengthy pattern language may not be sufficient to gain an overall picture that is necessary for its understanding and subsequent use. A compact graphical representation can be useful in such a case. For a given pattern language, a *pattern language map* is a visual presentation of patterns and their relationships.

Pattern Collection. A *pattern collection* is a set of patterns that are specific to some pattern application domain and correlated in some manner. For example, a pattern language is a pattern collection; however, the converse is not necessarily the case in general.

Pattern Sequence. An arbitrary subset of patterns in a pattern language may not lead to a desirable solution to a problem. A *pattern sequence* is a successful path through a pattern language.

Pattern Story. A *pattern story* is an instance of a pattern sequence.

Pattern Management System. A *pattern management system* (PMS) is an interactive software system similar to a content management system (CMS). A PMS has a number of responsibilities that include archiving a selected collection of patterns that could evolve (say, added, deleted, or modified), facilitating the discovery of those patterns (say, via navigation or searching), and rendering those patterns on a user agent. For example, a PMS could reside in a distributed computing environment such as the Web (Kamthan, 2008).

Pattern Production Process. A *workflow* is a high-level organization unit that consists of one or more activities. An activity can either be individual or social. A *pattern production process* (P3) is a collection of workflows and their interrelationships for producing a pattern (Kamthan, 2009a; Kamthan, 2010) independent of any particular domain.

Pattern Engineering. In the current literature (Ackerman & Gonzalez, 2011) there are multiple meanings of pattern engineering. For the sake of this chapter, *pattern engineering* (PE) is a systematic and disciplined approach to (1) the definition, subsequent use, and maintenance, and (2) interface to humans, machines, and other entities of knowledge, of a pattern within the given constraints of available resources. For example, P3 is a part of PE.

A Model for Pattern Stakeholders

It follows from the Clear Target Audience pattern (Meszaros & Doble, 1998) and the Consistent "Who" pattern (Harrison, 2003) that the external entities that are related to a pattern in some manner need to be identified. The rest of this section presents a pattern stakeholder model (PSM).

The *pattern community* consists of pattern stakeholders. A *pattern stakeholder* is a person who has interest in a specific pattern for some purpose (Kamthan, 2010). The possible stakeholders of patterns can be identified and classified into *pattern producers* and *pattern consumers* based upon their roles with respect to a pattern. The union of the set of pattern producers and pattern consumers is equal to the set of pattern stakeholders.

Pattern Producers

There are four essential pattern producers that can be identified.

Pattern Author. A *pattern author* is a person responsible for authoring a pattern.

Pattern Evaluator. A *pattern evaluator* is a person responsible for evaluation and feedback on a pattern.

Pattern Engineer. A *pattern engineer* is a person responsible for providing means for describing a pattern.

Pattern Administrator. A *pattern administrator* is a person responsible for maintenance and management of patterns.

Pattern Consumers

There are four essential pattern consumers that can be identified.

Pattern Perceiver. A *pattern perceiver* is a person targeted for perceiving a pattern.

Pattern Browser. The notion of for browsing (or scanning) has become especially relevant since the ascent of the Web. A *pattern browser* is a person targeted for browsing a pattern.

Pattern Reader. A *pattern reader* is a person targeted for reading a pattern.

Pattern User. A *pattern user* is a person targeted for using a pattern. It could be noted that a pattern user is always a pattern reader; however, the converse is not necessarily the case in general.

Properties of PSM

There are a few salient characteristics of PSM. It could be noted that the same person can take upon different roles, and the same role can be taken upon by different persons. For example, a person reading a pattern plays the role of a pattern reader, however, given the write permission, can (at least in part) play the role of a pattern administrator.

The Social Web has made the boundaries among stakeholders increasingly fuzzy as a professional pattern consumer can become a voluntary pattern co-producer, or a *pattern prosumer*. For example, a pattern reader can to a certain extent be a pattern administrator for a pattern published on a Wiki system.

The stakeholders are not necessarily homogeneous. For example, goals, educational background, experience, skills, personal preferences, and mental and physical abilities of the stakeholders vary. In this chapter, it is assumed that, as appropriate, the pattern producers and consumers have the means necessary to acquire the knowledge and skills related to technologies/applications underlying the Social Web.

The heterogeneity of pattern consumers is especially relevant. A *digital native* (Palfrey & Gasser, 2008) is a person who was born at the time digital technologies were taking shape and/or has grown up with digital technologies. These digital technologies include those that underlie the current non-stationary computing devices, and the Internet in general and the Web in particular. The new generation of pattern consumers is likely to include digital natives and is also likely to embrace the Social Web.

Extensions of PSM

It is possible to extend PSM in different directions (Kamthan, 2010) by increasing the granularity of some of the classes identified above, of which some are relevant to the Social Web. For example, a *pattern educator* is a person responsible for the pedagogy of a pattern, a *pattern evangelist* is a person who writes about a pattern on a blog or a social network and, as per the Pattern Languages of Programming (PLoP) 'family' of conferences, a *pattern shepherd* and *pattern Writers' Workshop participant* are persons responsible for review and feedback on a pattern. For another example, a pattern reader and a pattern user could both be categorized further into *novice* and *expert*, or into *putative*, *potential*, and *future*.

The foregoing classes of pattern stakeholders are based on the relationships between a person and a pattern. It is also possible to identify structural and other relationships between pattern stakeholders, of which some are relevant to the Social Web. For example, a pattern educator and a pattern evangelist are a kind of pattern user; a pattern shepherd is a kind of a pattern evaluator; a pattern author is an apprentice of a pattern shepherd and, conversely, a pattern shepherd is a mentor of a pattern author. Furthermore, if there are two or more pattern authors of the same pattern, then they are collaborators. It is possible (Kamthan, 2009b) to represent these relationships using Resource Description Framework (RDF) vocabularies such as Friend of a Friend (FOAF) and Relationship.

The Social Web in Perspective

There are prospects and concerns of a commitment to the Social Web. These are discussed next.

Prospects of Committing to the Social Web

The notion of the apparent 'humanization' and 'socialization' of the Web dates back to the early days of the Web (Engelbart, 1995). However, there are certain primary factors that have brought the vision of the Social Web to a mainstream realization:

- **The Enablement of a Many-To-Many Communication Paradigm.** The convergence of social and technical networks has created unprecedented potential for many-to-many communication among people. It has opened new vistas for collaboration and participation. For example, the Social Web, by necessitating collaboration among professionals with diverse background, has the potential to reduce the apparent 'compartmentalization' in cultures, including the pattern community.
- **The Broad Availability and Affordability of the Underlying Computing Devices.** The availability and affordability of an appropriate computing device by a person is a necessary condition for accessing the Social Web. In the last decade, there has

been an influx of computing devices such as notebook and tablet computers that provide more choice for the consumers in a number of ways. For example, the underlying characteristics of these devices, such as physical size, options for data input/output, screen capabilities, memory, disk space, and processing power, vary considerably. The cost of these devices has also, in general, reduced over time.

- **The Maturation of the Information Technology Infrastructure.** The Social Web can reuse the basic distributed networking infrastructure, including the necessary protocols and addressing schemes, established during the evolution of the Web. The technologies in form of languages for information description (such as markup languages) and information processing (such as scripting languages) have remained relatively stable.
- **The Availability of Technological Implementations as Open Source.** The availability of an open environment in form of OSS and open content has played a critical role in the success of the Web, and the same applies to the Social Web. These include but are not limited to an increasing number of implementations for Asynchronous JavaScript and XML (AJAX) and Ruby on Rails. This is important for the development of small-to-medium size projects with budgetary constraints. Indeed, there are a number of such projects in the works listed at Go2Web20 (http://www.go2web20.net/).
- **The Awareness, followed by Immense Interest and Significant Participation, by the Public At-Large.** The Web provides limited opportunities for interaction and participation: the communication is largely unidirectional and users are merely receivers. In contrast, the participatory nature of the Social Web has been a major attraction to the general public. Like electronic mail in the past, there are a number of general-purpose Social Web applications with a relatively low learning curve, which are inviting to those that have minimal technical background. In particular, the Social Web applications such as the Delicious (formerly del.icio.us), Facebook, Flickr, Twitter, and YouTube have set the precedence for others to follow.

The Social Web marks an era of better connecting people, process (say, P3), and product (say, a pattern resulting from P3), as suggested by Figure 1.

Concerns of Committing to the Social Web

There are certain inherent limitations of a commitment to the Social Web (Kamthan, 2009b). Indeed, the Social Web inherits, as well as, adds to some of the limitations of the Web that are perceived as being non-transient.

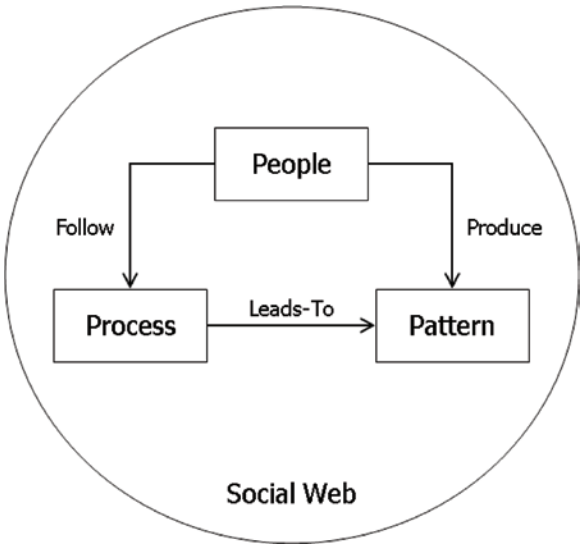
For example, the mere use of a Social Web application creates a dependency, and there are no a priori guarantees that it will be available when needed. There are certain Social Web technologies that have unresolved accessibility and/or usability issues (Cooper, 2007), and there exist Social Web applications, especially those labeled as 'Rich Internet Applications' based on these technologies.

In the sections that follow, limitations specific to the Social Web technologies and/or applications relevant to the scope of this chapter are highlighted.

ON THE INTEGRATION OF THE SOCIAL WEB ENVIRONMENT IN PATTERN ENGINEERING

Figure 2 shows the workflows in P3, namely *WF-1 Planning*, *WF-2 Developing*, *WF-3 Describing*, *WF-4 Evaluating and Revising*, *WF-5 Publish-*

Figure 1. The social Web environment brings closeness between people, process, and pattern



ing and Outreaching, and *WF-6 Maintaining*. The workflow *WF-0 Internalizing Knowledge and Assessing Viability* is a prerequisite to the workflows that follow. These workflows are not necessarily mutually exclusive.

Properties of P3

P3 is human-centric and evolutionary. In particular, P3 is iterative and incremental, the resulting product of which is the pattern itself.

The subsequent sections describe the details of each workflow and in doing so highlight the need for integration of the technologies/applications underlying the Social Web. The integration of any technical infrastructure in P3 must preserve the characteristics of a pattern and P3 must be feasible to its stakeholders. The same applies to the use of the Social Web in P3.

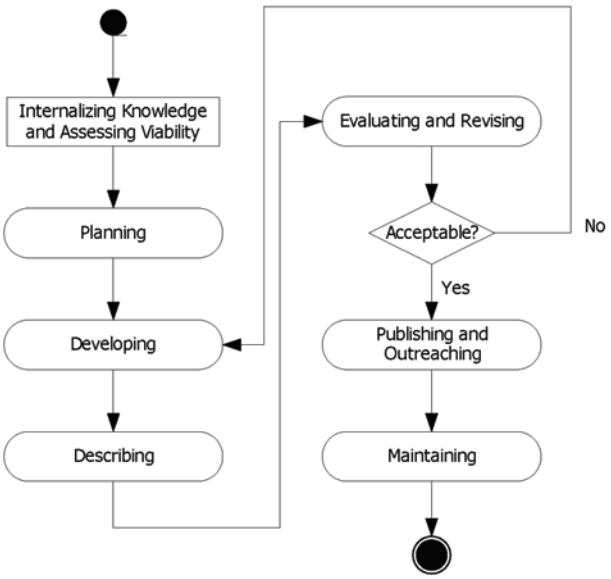
P3 is essentially independent of any specifics of the Social Web. It should become apparent in sections that follow that the mapping between the set of P3 workflows and the set of the technologies/applications underlying the Social Web is many-to-many.

WF-0 Internalizing Knowledge and Assessing Viability

The epistemological perspective adopted in this chapter is *empiricism*, which asserts that knowledge arises from sense experience. There are a number of approaches for internalizing experiential knowledge. The common sources of experiential knowledge are *individual* and *sociological* (Kerth & Cunningham, 1997). In an individual approach, there is a single (potential) pattern author who relies on retrospection arising from personal experiences *and* extrospections (observations) based on others' experiences, and in a sociological approach, there are multiple (potential) pattern authors relying on each other's experiences.

The (potential) pattern authors need to determine the viability of proposing a 'candidate' pattern, or the *proto-pattern*, to the pattern community at-large, including target pattern readers and potential pattern users. For that, they rely on the expertise gained from on retrospections based on personal experiences and extrospections based on others' experiences, and research of existing base of patterns. In particular, the (potential) pat-

Figure 2. The collection of workflows in P3 and their interrelationships



tern authors check for the existence of patterns that may be similar or variants of the one being proposed. This workflow concludes with a favorable decision to proceed with the definition of a proto-pattern.

Implications of the Social Web for Researching

The research in this workflow can be of two kinds: (1) seeking instances of the solutions and (2) seeking existing descriptions of patterns that are similar or variants of the one being proposed. The Web has become an indispensable means for conducting research by means of navigating and/or searching. There are search engines such as Google and its variants like Google Scholar, and listing of pattern repositories, can serve as a starting point.

It can be useful to keep a record of the research conducted. In particular, bookmarking has traditionally been one of the most common ways of remembering the resources of interest visited while browsing on the Web. However, conventionally, the bookmarks reside on the user's computer and are not accessible by other devices and therefore can not be shared by others. In this respect, the Social Web can be an aid in conducting research.

The notion of *social bookmarking* enables management (for example, storage, organization, search, and sharing) of bookmarks residing remotely at third-party services. The idea was pioneered by itlist.com in the mid-1990s, brought into mainstream by Del.icio.us around 2003, and since then other services such as Google Bookmarks have spawned. In the course of assessing the viability of a proto-pattern, social bookmarking can help pattern authors communicate the bookmarked resources more effectively by unifying their knowledge base, annotating, and avoiding duplications.

WF-1 Planning

In order for P3 to be effective, the definition of a proto-pattern requires appropriate planning by the pattern authors. The planning needs to include an assessment of the resources including time, effort, expert body of knowledge (such as guidelines and patterns for authoring patterns), pattern form,

examples, and tools. In case of multiple pattern authors, schedules for meetings also need to be decided upon.

Implications of the Social Web for Planning

There are a few Social Web applications that offer directions for effective planning, particularly if the pattern authors are geographically dispersed and a physical meeting is not always a viable option.

A face-to-face meeting, whether it is for sociological approach to elicitation of domain knowledge or for Writers' Workshop, requires scheduling. A schedule that is agreeable to all, particularly as the number of persons involved increases, can become difficult to manage. The use of Social Web applications that facilitate calendar sharing, such as Doodle or the Google Calendar, can reduce some of the tedium involved in scheduling an agenda for a meeting. For example, the event calendar can, given appropriate permissions, be modified by any one, at any time, from any place, using any device.

In a sociological approach to authoring a pattern, there are multiple authors involved that need to be aware of each others' contact information. There are Social Web applications for an address book such as Plaxo that can archive contact information on the Web, enable listing of connections between contacts, and provide automatic updating of contact information.

There are social networking services, such as Facebook, LinkedIn, and MySpace, that can help pattern authors to asynchronously communicate with each other. Furthermore, services such as Google Chat can be used by multiple pattern authors for 'conversing' in real-time. These conversations are recordable and searchable.

WF-2 Developing

For the purpose of referencing, communicating, and locating, the pattern authors assign an evocative, pronounceable, and findable name to the proto-pattern. Then from an analysis of the given information, the pattern authors then abstract the problem and, guided by previous personal experiences and extrospections based on others' experiences from WF-0, explicitly place the problem in a specific context that reflects the scope of the problem.

This is followed by the formulation of a solution for the problem. In case of inductive reasoning, this is achieved via abstraction of instances of the solution from personal experiences and extrospections based on others' experiences from WF-1. It is likely that the problem has more than one solution. The selection of an 'optimal' solution is governed by the desirable quality attributes of the solution (Lea, 1994). In particular, the solution should be general, conceptually reusable, and provide an optimal balance of forces.

It is evident that there are limitations of a solution to any problem. Therefore, the pattern authors examine the implications (or consequences) of applying the solution. These consequences could include forces that are not entirely resolved as well as new forces that may arise. This may lead to the need for other pattern(s) and set the foundation of a pattern language.

The solution proposed by the pattern must be demonstrably proven to work. Therefore, the pattern authors, based on the 'Rule of Three,' elicit three solution instances or examples (Meszaros & Doble, 1998) that provide corroborating evidence and best demonstrate the feasibility of the proposed solution. The examples could be derived from earlier personal experiences and extrospections based on others' experiences from WF-0. For instance, these examples could originate from classroom teaching practices, from interactions with students, from the feedback provided by students, and so on. However, to lend some degree of objectivity, these examples should not be all from pattern authors' personal experiences. In other words, there must be at least one *external* example.

Finally, the proto-pattern is placed in its social context. To do that, related patterns, if any, along with their relationships to the proto-pattern are listed.

Implications of the Social Web for Development

The Social Web presents a range of options that can assist during development. In a sociological approach to P3, the pattern authors often engage in brainstorming for collectively organizing their thoughts and recall, for collaborative decision making, and so on.

There a number of ways to brainstorm, one of which is through visualization, and mind mapping is a graphically-oriented approach to realize it. A mind map is a graph where nodes represent sub-ideas (or sub-goals or sub-tasks) at different levels of granularity and vertices represent 'semantic' relationships, all of which are arranged radially around a central idea (or goal or task, respectively).

There are mind mapping applications on the Social Web such as bubbl.us and Mindomo that the pattern authors and pattern shepherds can benefit from. The pattern authors can share these mind maps over the Web and, depending on the permissions, read and/or edit others' maps.

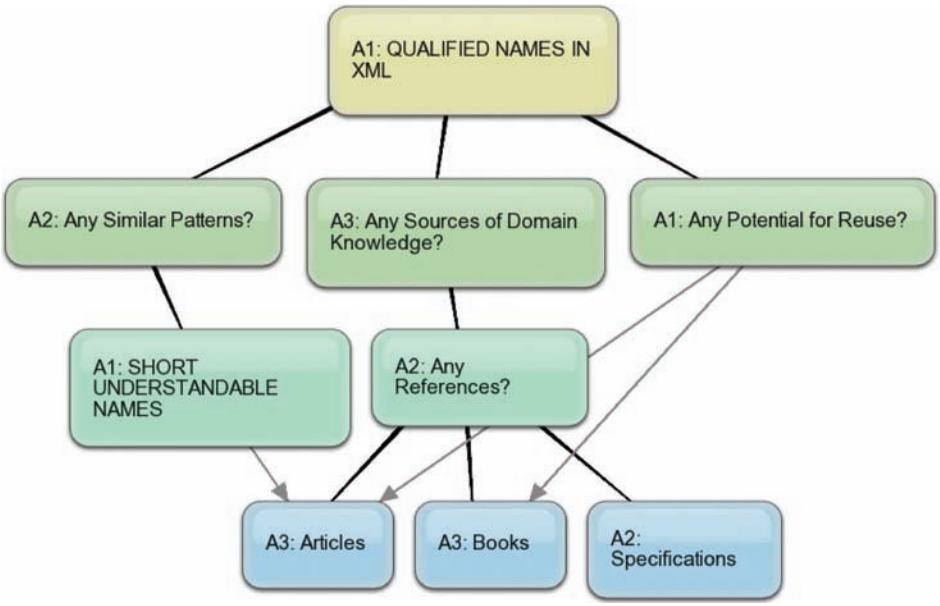
Example 1. Figure 3 illustrates a snapshot in time of a mind map using bubbl.us. In it, three authors, namely A1, A2, and A3 are in a brainstorming session on the viability of a proposed pattern. The 'bubbles' reflect respective inputs by pattern authors.

WF-3 Describing

In order for the information in WF-2 to become explicit, a suitable means of pattern description is needed. In fact, during earlier days of patterns as well as that of the Web, it was pointed out (Gamma et al., 1995) that 'finding patterns is much easier than describing them.'

The requirements for pattern description, a detailed discussion of which is beyond the scope

Figure 3. An example of a partial mind map reflecting a brainstorming session on the viability of the 'new' qualified names in XML pattern



of this chapter, should determine the selection. In this workflow, the pattern authors select one of the available means, such as a predetermined pattern form, for describing the proto-pattern (that are made possible by a pattern engineer), keeping the concerns of the pattern readers (Harrison, 2003; Meszaros & Doble, 1998) and pattern administrators into consideration. These concerns include readability and longevity of the notation, respectively. The possible means for describing a proto-pattern can vary across the spectrum of formality, modes, technology, and so on.

The representation and presentation are two distinct aspects of a pattern description, and need to be considered *separately*. A representation can be presented in one or more ways, in one or more sensory modalities, so that it is perceptible to a stakeholder. For example, proto-patterns (and even an entire proto-pattern language) may be represented in a markup language based on the Extensible Markup Language (XML) and, depending on the target device, transformed to one of the presentation languages suitable for the desktop, the Web, a mobile device, or a printer. This marks the end of the first iteration of P3.

Implications of the Social Web for Description

The Social Web presents a suitable environment for collaborative authoring of patterns using various means including Wiki. The concept of Wiki was invented in the 1990s as a group communication utility. It allowed open editing of information (like patterns) as well as the organization of the contributions and, with various enhancements, continues to serve well in that role (Weiss & Birukou, 2007; Spinellis & Louridas, 2008). A properly administered Wiki assists pattern authors, pattern shepherds, and pattern readers. Indeed, it enables a person to play the dual role of a pattern reader and a pattern administrator.

There are several, opens source implementations of Wiki available today addressing different target groups and organizational needs. Most implementations of Wiki, including TinyWiki (for small-scale publishing) and MediaWiki (for large-scale publishing), can be relatively easily acquired, installed, and administered under commonly-deployed computing platforms (Ebersbach, Glaser, & Heigl, 2006). For example, Perl Design Patterns (http://perldesignpatterns.com/) and Asynchronous JavaScript and XML (AJAX) Patterns (http://ajaxpatterns.org/) are collections of patterns based on TinyWiki and MediaWiki, respectively.

There are multiple functional and non-functional factors in selecting a suitable Wiki. These include cost of acquisition, client- and server-side system and software requirements, maturity, stability, nature of the description of a pattern (including use of special symbols such as mathematical symbols and graphics) and its mapping to features available in a Wiki, ease of installation, available support, degree of control, license, and ease of maintenance. The WikiMatrix (http://www.wikimatrix.org/) provides a side-by-side comparison of a subset of these criteria for a number of Wiki implementations.

The description of a pattern typically includes terminology of a primary domain and, optionally, of one or more secondary domains. For example, an interaction design pattern (Tidwell, 2011) will include terms from human-computer interaction and design, and perhaps other domains such as cognitive psychology, and so on. Then, for definitions and/or further details on topics in it, a resource under Wiki containing the description of a pattern can make use of the knowledge of resources from the projects of the Wikimedia Foundation (such as Wikibooks, Wikipedia, Wiktionary, and so on) and, in doing so, point to resources in the aforementioned projects. This enables reuse and situates the description of a pattern in a larger context.

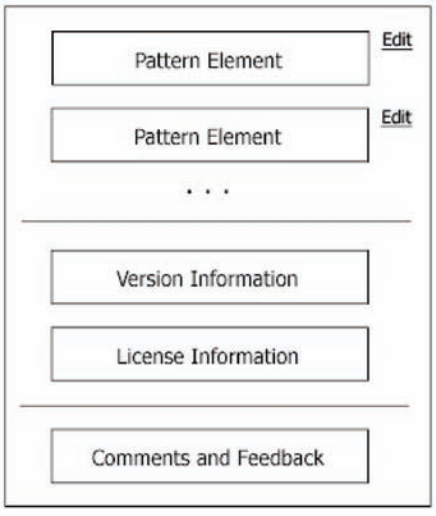
Example 2. Figure 4 presents a simplified view of the description of a pattern within the Wiki environment. The mandatory elements of

a pattern can be presented where they can be progressively disclosed and edited; the details of history of the document can be automatically highlighted through version information; licensing terms can be made explicit; and pattern reader's feedback can be solicited and included. The figure could, for example, be extended by the addition of a block for the table of contents (in case the document is lengthy).

Example 3. Figure 5 illustrates an abstract description of the Strategy pattern (Gamma et al., 1995) in a Wiki environment. It shows that the description includes the names of a couple of design principles that form the basis of the pattern. Using the support for hypertext in Wiki, the names of these design principles can point to appropriate external resources residing under projects of the Wikimedia Foundation that provide further details.

There are certain social and technical limitations of using a Wiki for WF-3. The constructs and capabilities of the input/output syntax system vary across Wiki implementations. Therefore, a commitment to one Wiki creates indirections for transition including those towards learning (for humans) and interoperating (for machines). A transition from one Wiki to another may be by choice or by necessity. For example, SnipSnap ceased further development in 2007. The issue of transformation can be particularly acute if a representation of a rich set of mathematical symbols is required, as currently there is a lack of such support on many Wiki systems.

Figure 4. A glimpse into an abstract, partial view of the description of a pattern within the Wiki environment

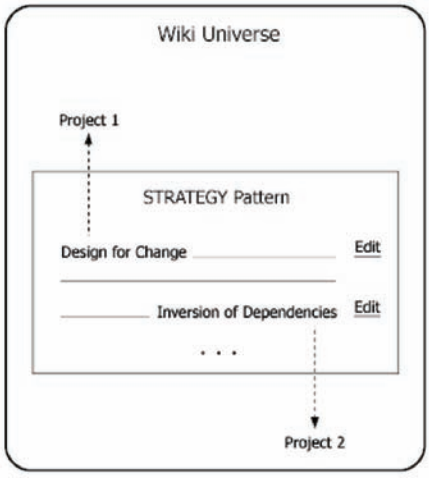


WF-4 Evaluating and Revising

This workflow is about reflection, and thus makes P3 nonlinear. The proto-pattern may go through an informal evaluation to evaluate the characteristics of the proto-pattern.

The prime, but not the only, means of evaluation includes submission of the proto-pattern to one of the members of the *PLoP 'family' of conferences. This leads to *shepherding* (namely, one-on-one mentoring of the pattern authors by the pattern shepherd who is familiar with the underlying domain and is experienced in describing patterns) followed by participation in a *Writers' Workshop* (namely, a face-to-face, structured, peer review process involving domain experts). This form of evaluation is usually a non-anonymous,

Figure 5. A description of a pattern using external resources in the Wiki environment



highly recommended but optional, review process. The evaluation may lead to a few iterations of the proto-pattern and thereby a revisitation of WF-2 and WF-3. At the end of the evaluation, the proto-pattern may reach the candidacy of a pattern.

The pattern authors, by themselves or as a result of the evaluation, may associate a rating reflecting the confidence or maturity level of the pattern. Furthermore, before publication, the pattern authors may also optionally include meta-information related to version control or copyright in the description of the pattern.

Implications of the Social Web for Evaluation and Revision

The Social Web lends unique opportunities for revisiting and revising the description of a proto-pattern. In doing so, it can serve as a supplement to a conventional face-to-face meeting.

For example, an early publication of a proto-pattern on a Social Web application such as a Wiki enables pattern consumers to provide feedback and comments. These in turn may lead to improvements to the description of the proto-pattern, making it more suitable to its target audience.

WF-5 Publishing and Outreaching

Up until now, the pattern is limited to internal consumption. In order for the pattern to reach a broader community, that is, beyond the pattern author(s), pattern shepherd, and participants of the Writers' Workshop, it needs to be published in a public environment.

Implications of the Social Web for Publication

A pattern needs to be published in some medium, say, print and/or electronic, that is deemed reachable to the pattern community. The Web in general and the Social Web in particular is one candidate medium for publishing patterns.

For example, a Web Application for patterns that archives and serves desirable patterns could be developed in a systematic manner (Kamthan, 2008). It has been shown (Weiss & Birukou, 2007) that Wikis can serve as a channel for publishing patterns. However, there are certain limitations of using a Wiki for WF-5. The flexibility enabled by the open editing environment of a Wiki can be misused and in turn impact the credibility of a description of a pattern as perceived by its consumers. These are more of a concern in an open (global) environment rather than a close (local) environment (such as an intranet). Therefore, some form of constraint and certain degree moderation may be necessary.

It is also possible that the author may not have complete technical control or legal rights to physically include some of the desirable information but nevertheless still needs to point to it. From a Social Web viewpoint, these considerations, if appropriately carried out, are suitable for a mashup.

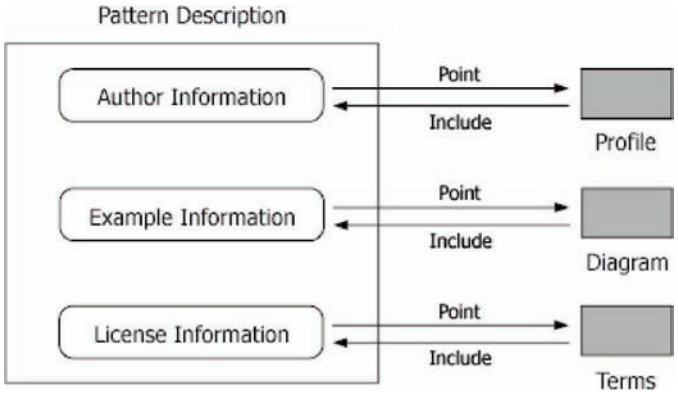
A *mashup* aggregates and reuses information from multiple sources. This is accomplished via some means such as a transclusion, which is an on-demand inclusion of one resource into another via hyperlinking and/or a programmatic mechanism like an Enterprise Mashup Service (EMS), which is a Web Service based on the Service-Oriented Architecture (SOA). It then presents information in a federated manner that is transparent to a pattern reader. Figure 6 illustrates an abstract construction of a pattern mashup in which author information, picture of an example, and licensing terms are 'transcluded' from external sources.

Implications of the Social Web for Outreaching

The publication (or any subsequent revisions) of a pattern needs to be relayed to the pattern community. The means to do that can be either synchronous or asynchronous.

There are Social Web technologies/applications available for syndication that can be used

Figure 6. A pattern mashup that points to and includes three different external sources



to reach potential pattern consumers. This can be done automatically such as by using Really Simply Syndication (RSS) or Atom, or manually such as by using a micro-blogging service like Twitter.

The pattern authors can also use podcasting services such as the Software Engineering Radio and the User Experience Podcast to announce the availability of a pattern. These services may also be used later for the purposes of pattern education (Chatteur, Carvalho, & Dong, 2008) that can be a critical concern, particularly to a beginner pattern user.

Implications of the Social Web for Organization

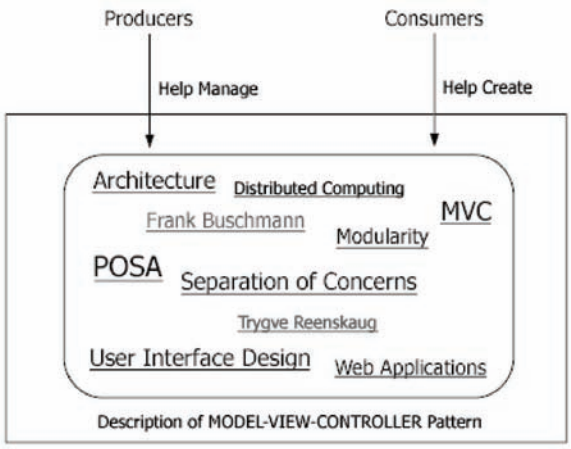
The ascent and proliferation of patterns coincides with that of the Web. The Web serves as a useful medium for patterns, however, the rapid growth (Henninger & Corrêa, 2007) of the number of patterns and pattern languages has made the task of locating desirable patterns increasingly challenging for the readers. By participating in the Social Web, the consumers can help one another (and indirectly help the producers) in somewhat alleviating the task of locating desirable patterns.

A crucial aspect of organization is classification. There is currently no universal scheme for classifying patterns: a pattern placed in one category by its author(s) can reappear as belonging to a different category in a different pattern language by another set of author(s). For example, certain pedagogical patterns (Bennedsen & Eriksen, 2006) have been classified into teaching activities and pedagogical values, while others (Derntl, 2005) have been classified into categories such as course types, project-based learning, assessment, and so on, by their respective authors. However, these patterns can be classified in multiple other different ways, including categories that are not envisioned by its original author(s) but are considered relevant by its readers and users. This is because the mental models of pattern producers and pattern consumers about the same concept can vary. Therefore, a *faceted classification* of patterns is desirable.

A 'post-publication' faceted classification of a pattern is possible by social annotation, specifically, via the notion of *folksonomy* or social tagging (Smith, 2008). Folksonomy enables readers to associate with a resource words or phrases that they deem meaningful, relevant, and significant in describing the resource. By doing so, there is an implicit assumption that other (new) readers will share and benefit from this understanding of the resource.

A collection of tags can lead to the formation of a *tag cloud*. A tag cloud is set of related tags with associated weights that represent frequency of use of each tag. The tags within a tag cloud are usu-

Figure 7. A tag cloud embedded in the abstract representation of the model-view-controller pattern



ally ordered lexicographically and the frequency of use of each tag is illustrated by visual cues such as distinct font color and size. The human dimension of the Social Web — as personified by mutual collaboration among the stakeholders in locating desirable patterns through navigation — can be realized in the following manner: by proper organization of tags and representation of weights in a tag cloud, administrators and engineers can help the readers, and by a careful selection of tags, readers can help each other. For example, the Pattern Language Network provides a tag cloud of tags related to patterns for education. There are Social Web applications such as MediaWiki that allow adding tags by registered users.

Example 4. Figure 7 shows a tag cloud for the MVC pattern. The tags in the tag cloud are aimed at different things: some are about concepts, others are about disciplines, and yet others are about people. For instance, Separation of Concerns is a software engineering principle, POSA is the acronym for Patterns for Software Architecture, Frank Buschmann is one of the authors of the book that describes MVC, and Trygve Reenskaug is the person who is ascribed for first introducing MVC.

Example 5. Figure 8 shows a tag cloud for the Repost and Comment pattern (Tidwell, 2011). It is generated using Wordle, a tool that outputs word clouds based on the input text. The input text in this case is "You see the role of your social media presence to partially be that of an aggregator: you find good stuff out there that you know your audience will enjoy, and you post it for them". The common words have been removed.

The provision for including tags in support of the description of a pattern presents a dilemma for a pattern producer. A collection of tags forms an uncontrolled vocabulary subject to linguistic constraints (such as the presence of homonyms, synonyms, and polysemes) inherent to a natural language. For example, the term 'scroll' occurs in the description of the CAROUSEL pattern (Tidwell, 2011). However, this term has multiple meanings, some of which are unrelated to the pattern. It is possible for a pattern producer circumvent such issues by a moderation of the tag cloud. However, doing so may be perceived as against the freedom of a pattern consumer enabled by the Social Web.

WF-6 Maintaining

The description of a pattern may need to evolve for a number of reasons including discovery of errors that need to be rectified, 'discovery' of an example that better illustrates the solution of

Figure 8. A tag cloud for a part of the description of repost and comment pattern

a pattern, variations in technologies illustrating the solution, presentation on a device not targeted originally, and so on. Furthermore, a given collection of pattern(s) may also be integrated (say, into a larger collection) and organized (say, classified and indexed) in some way. A pattern administrator carries out corrective and/or adaptive maintenance of pattern(s) on a timely basis.

Implications of the Social Web for Maintenance

The Social Web provides flexible prospects for maintaining a pattern. For example, in a Wiki environment located anywhere, it is possible for any registered user to make modifications to a pattern description at any time by using virtually any device. A Wiki-based system may also maintain a history of modifications, which can be useful if reverting back to a past version of a pattern description is necessary. This incidentally is a realization of the Auditable Documents pattern (Correia et al., 2009). The changes, if any, can be announced to the channel subscribers using the technologies for syndication indicated earlier.

Sustenance

A pattern continues its life until it ceases its use by the pattern community. In this period, members of the pattern community may need to communicate and collaborate in different ways. For example, some members may decide to write an article or a book, or teach a course, that includes a pattern, while others may decide to conduct an ethnographic study on the use of that pattern and share their results publicly.

Implications of the Social Web for Sustenance

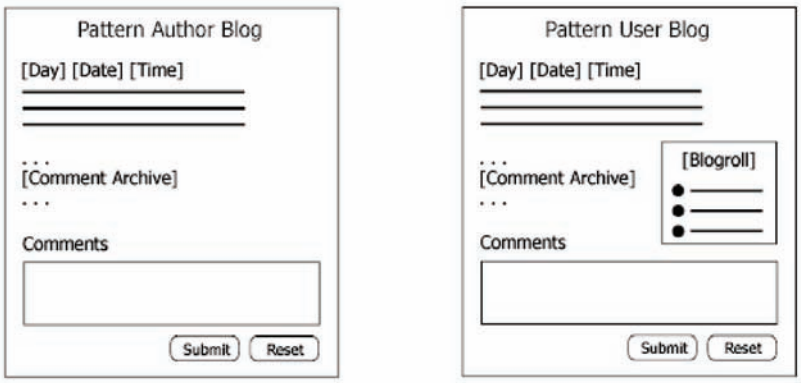
There are Social Web technologies/applications that can play a role during the period of sustenance. If necessary, they could be combined with the technologies/applications for outreaching.

A *blog* is a personal journal that serves as an outlet for anybody to publicly express opinion, in writing, on just about any subject. In side bar of a personal blog, a blogger can provide a list of other blogs (or a blogroll). The universe of all blogs along with their relationships has been termed as blogspace or blogosphere. There are a number of blogging services available including blogspot and Blogger.

There are benefits of blogging for pattern stakeholders. Figure 9 provides an illustration.

For example, blogging gives pattern authors to reflect their current position, such as on the state about the apparent (mis)use of patterns and pattern sequences; respond to concerns of pattern consumers in an informal environment; or inform others of their scholarly activities related to pat-

Figure 9. An abstract representation of a pattern author blog and a pattern user blog intended for different purposes and different audiences



terns, like relevant presentations at events. Furthermore, blogging gives pattern readers an opportunity to ask questions and gives pattern users an opportunity to share their pattern stories with others. It also makes their agreements and disagreements known in a public forum. There are potential side-effects of blogging, especially those related to legality; however, it is anticipated that their impact on PE is minimal.

There are plenty of opportunities for *social networking*, both during and after the P3. A variety of different types of social relationships can exist among the actors including pattern author-to-pattern author, pattern author-to-pattern shepherd, and pattern reader-to-pattern reader that can be made explicit.

The XHTML Friends Network (XFN) is a specification for explicitly indicating social networking relationships using rel attribute values in The Extensible HyperText Markup Language (XHTML) on blogroll links. The social networking relationships expressed in XFN could be exploited by programs like bloggers, search engines, or spiders. For example, XFN values can be added to the rel attribute by a pattern author to indicate that John Smith is the shepherd, is a colleague, and is someone the author has met, using the following markup:

```
<ul>
 <li>
  <a href="http://john.smith.ca/"
    rel="colleague met shepherd">John
Smith</a>
 </li>
</ul>
```

DIRECTIONS FOR FUTURE RESEARCH

It is still early to predict the outcome of the Social Web phenomenon in general and its impact on patterns in particular. The work presented in this chapter can be extended in a few directions that are briefly discussed next.

Social Network Analysis of the Pattern Community

The diversity and visibility of participants in public appearances such as events (conferences, meetings, and workshops) in different countries, postings on blogs, mailing lists, and newsgroups, and so on, indicates that the pattern community is thriving. A *social network analysis* (SNA) of the pattern community, as it continues to grow and

morphs into a dedicated social network, would be useful.

In particular, quantitative properties of the resulting graph such as centrality, closeness, clustering coefficient, cohesion, density, eigenvector centrality, and radiality, could be analyzed. This could help reveal certain relevant qualitative aspects of the network such as the relationships between actual stakeholders; frequencies of use of specific patterns and pattern languages by certain stakeholders; publications related to patterns and pattern languages recommended by people; demographical use of patterns; new domains of applicability of patterns; and so on.

Using Patterns for Social Web Applications

The relationship between patterns and the Social Web, as shown in Figure 10, is *symbiotic*, one direction of which is explored in this chapter.

The support for the other direction, namely the use of patterns for developing Social Web applications, has been steadily increasing. This is especially interesting in the light of developing a PMS as a Social Web application.

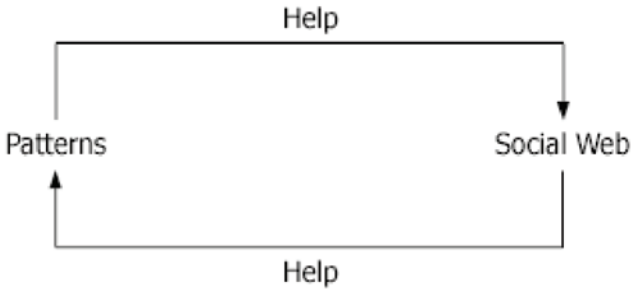
There are patterns for both general and specific problems related to Social Web applications. There are patterns available for computer-mediated communication in general (Schümmer & Lukosch, 2007) and for the design of Social Web applications in particular (O'Reilly, 2005) that can assist in the other direction. For example, Application Sharing, Collaborative Session, Shared Annotation, Shared Browsing, Shared Editing, and Shared File Repository are patterns applicable to the Social Web context. The macro-architecture design of Social Web applications typically corresponds to the Publish-Subscribe pattern. There are interaction design patterns for social media (Crumlish & Malone, 2009; Tidwell, 2011), an appropriate use of which can lead to better support for acceptability of Social Web applications in general and usability in particular. There are patlets (Decker et al., 2006), patterns, and anti-patterns (Mader, 2008) available for making proper use of Wikis, which in turn could improve the collaboration between patterns authors and pattern readers. Finally, there are design patterns for writing new microformats (Allsopp, 2007).

However, the producers of pattern-oriented Social Web applications are likely to face a number of challenges similar to those in other forms of pattern-oriented development. These challenges include effective location, optimal selection, and suitable composition of patterns. This only signifies the other direction of the aforementioned symbiotic relationship, namely an appropriate use of Social Web applications for patterns.

Patterns on the Mobile Social Web

In the last decade, the ability to access the Web via a wireless device has been remarkably successful.

Figure 10. The symbiotic relationship between patterns and the social Web



The potential of mobile access to the Social Web has evidently inspired the notion of Mobile Social Web, or more commonly known by the pseudonym Mobile Web 2.0 (Jaokar, 2006; Golding, 2008).

In a mobile environment, there are inherent constraints of both hardware and software (Tarasewich, 2003). Therefore, it is unlikely that the Mobile Social Web could ever become 'de facto' environment for PE in general or a basis for a PMS in particular. However, it could still serve as a means to facilitate collaboration in the P3, dissemination of patlets, pattern thumbnails, and small pattern language maps, and for syndication. Further exploration of the interplay between patterns and the Mobile Social Web, particularly from the viewpoint of an extension to Figure 8, would be of interest.

CONCLUSION

For the benefit of the pattern community as a whole, the human and social aspects of PE need to be acknowledged, embraced, and cultivated. The Social Web provides means for doing that by opening new vistas for PE. It provides new opportunities for collaboration among pattern producers, participation by pattern consumers, and dissemination of patterns and other artifacts, all of which are necessary for a successful realization of PE.

However, a commitment to the Social Web entails costs. There are certain limitations of the Social Web as it pertains to PE and, although some of the concerns outlined in this chapter can be avoided by appropriate use of technologies/applications, others are more fundamental. Therefore, an optimistic but cautious use of the Social Web is an imperative.

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Chapter 4
Organizational Communication:
Assessment of Videoconferencing as a Medium for Meetings in the Workplace

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ABSTRACT

Significant research has focused on e-mail, face-to-face (FTF), and other asynchronous mediated communication as the communication media of choice within organizations. Modern organizations, however, have other unconventional tools at their disposal. While the economy of scale has made videoconferencing an affordable medium of choice because it precludes travel and is accessible on demand, the suitability of the videoconferencing for organizational meetings is scarce in the literature. As such, this paper explores and presents an account of videoconferencing use in a governmental organization and address implications for meetings and general communication process.

INTRODUCTION

The trend toward globalization and the growing concern over travel security has caused an increase in videoconferencing technology usage. Videoconferencing is a communication medium that allows real-time and visual interactivity among users separated by distance. While significant research has focused on e-mail, face-to-face (FTF), and other asynchronous mediated communication as the communication media of choice in organizations (e.g., Berry, 2006), modern organizations have other tools at their disposal. Research has focused on e-mail instead of videoconferencing due to its convenience and commonplace in most settings (Berry, 2006; Simon, 2006). Even when

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videoconferencing is studied, attention has primarily been given to its selection based on travel costs and efforts to promote adoption (Fitchard, 2003; Palmquist & Mahan, 2003; Panteli & Dawson, 2001; Wegge, 2006). That is, economy of scale has made videoconferencing an affordable medium of choice because it precludes travel and is accessible on demand. According to Orubeondo (2001), trying economic times lead organizations to focus on strategies that accomplish more tasks with fewer resources while keeping quality customer relations high. Benefits and limitations of using videoconferencing in organizations, however, have not been fully studied.

The overarching question guiding this study, thus, is "why should organizations care about using or adopting videoconferencing?" The question is important for three reasons:

1. Learning about some of the challenges and benefits offered by the technology, one can adapt the medium to the needs of different organizations
2. Findings from this research can be used to offer specific guidelines regarding successful implementation and use of videoconferences
3. Addressing communication issues such as the appropriateness of different videoconferencing protocols (e.g., point-to-point to single location vs. multi-point to multiple sites, or both, fixed, and portable units), managers and business communication scholars can determine how best to utilize the technology in applied settings and for theoretical development.

Although this particular study looks at videoconferencing in a government setting, each of these issues transcends government organizations and can apply to most public and private organizations interested in adopting videoconferencing communication strategies.

LITERATURE REVIEW

It is important to answer the question of why an organization might use videoconferencing. The increased need for speed in the global economy provides good incentive. Specifically, the demand for collaboration and the ability to communicate visually with people who are geographically dispersed represents a major reason for using videoconferencing (Bekkering & Shim, 2006; Wegge, 2006). Such a tool can assuage distance challenges to communication, and it is considered a highly valuable tool when the communication requires audio and visual cues. In order to align both audio and video cues, videoconferencing has to function either over a network environment (i.e., internet protocol or IP) or in an integrated services digital network (i.e., ISDN) of telephone lines. These two environments allow videoconferencing to operate at the industry standard rate of 30 frames per second, which is the rate at which both video and audio occurs without a lag in time. However, the decision to incorporate videoconferencing into an organization's use is complex and should be approached with care.

Potential benefits and organizational implications of videoconferencing systems extend beyond mere cost cutting and decreased time spent in meetings (Agius & Angelides, 1997; Bekkering & Shim, 2006; Panteli & Dawson, 2001). The technology provides organizations the opportunity to engage in key day-to-day activities, including information gathering and dissemination, training, brainstorming, interviews, distance collaboration, and distance learning (Bekkering & Shim, 2006; Fetterman, 1996; Moridani, 2007; Raby, 2001; Wegge, 2006).

Organizations deploying video technology have experienced different results depending on existing relationships with participants (Stuart, 1998). Some studies have found videoconferencing system to be as effective as FTF interactions, and video conferencing systems to be more effective than audio only systems (e.g., Abel, 1990,

Valacich, Mennecke, Watcher, & Wheeler, 1994). Other researchers have found no significance in difference between effect in videoconferencing and FTF (e.g., Dennis & Kinney, 1998; Yoo & Alavi, 2001, Wegge, 2006).

A similar result was found for task participation. Compared to FTF interactions, for instance, Yoo and Alavi's (2001) found desktop videoconferencing video channels lowered task participation, while group cohesion based on prior history improved task participation. Conversely, they found that neither social cues nor task participation influenced the communication outcome of group consensus among members who had no prior relational history as a group. This finding implies that video cues have little effect on communication outcomes, and each of these findings are intriguing when compared to the results in traditional FTF interactions where immediacy, feedback, and interactivity have been found to be beneficial (Ellis, 2004; Gorham, 1988).

The idea of immediacy (i.e., verbal and nonverbal), for instance, is one that interpersonal communication scholars have found to effect satisfaction and the motivation to participate in discussion. For example, Houser (2005) showed that instructors who displayed immediacy behavior influenced students' motivation to learn. Verbal immediacy behaviors included interjecting examples, using humor, encouraging others' inclusion in conversations, using inclusive comments such as "we" or "our," and making self-disclosure comments (see Ellis, 2004; Glynn, Aultiman & Owens, 2005; Gorham, 1988). Nonverbal immediacy behaviors included eye contact, physical gestures, direct body posture, smiling, vocal expressiveness, and proximity (Gump, 2004).

With desktop videoconferencing, Alavi, Wheeler, & Valacich (1995) found an increased level of commitment by students to stay in groups among geographically remote participants rather than maintain locally-based videoconferencing groups. These researchers attribute increased commitment in geographically dispersed videoconferencing groups to the lack of immediate access to FTF communication. Thus, videoconferencing is considered an unsuitable "surrogate" when FTF interaction is feasible (Alavi et al., 1995). Still, the video capability in videoconferencing may give meetings and interactions a "human feeling," such as the ability to see people on the other side and hearing them talk helps to develop personal relationships. Alavi, et al. (1995) concluded, "you can see the body language of the other meeting participants, and this helps make you feel more connected to them" (p. 307). While increased connectedness and participation may be the case especially among the students and peers, it is hard to tell whether the same connectedness is valuable in organizations where status between employees and their supervisor is present and important. For instance, Nandhakumar and Baskerville (2006) found that junior managers felt senior management participated in ways which enabled them to exert their authorities in global virtual teams. Consequently, junior managers/subordinates found it difficult to participate freely or contradict senior management's ideas.

From the literature, it appears that communication via videoconferencing might enhance or impede communication openness, depending on the setting. Therefore, communication experiences may differ significantly in videoconferencing from FTF interaction due to how the medium is used and the purpose for which it is used. For instance, some scholars (e.g, Alavi et al., 1995; Nandhakumar & Baskerville, 2006) have argued that videoconferencing should be restricted to situations with simple visual cues and with little discussion, especially when convening speedy meetings for physically dispersed people, and for communicating progress reports on ongoing projects where there are established relationships. At the same time, individuals are cautioned against

the use of videoconferencing in those situations where creative interaction is of primary importance or where the consequence of miscommunication is high and interactions are unstructured (Panteli & Dawson, 2001).

According to the review of the literature, reasons for using videoconferencing include cost cutting productivity issues such as travel, and the idea that technology can enhance communication interactions. For instance, videoconferencing can allow communication to be personal (i.e., immediacy) and effective when participants are able to hear the nuances of tone and see nonverbal gestures, expressions, and cues normally found in FTF interactions. The possibility for international collaboration is another factor. That is, the tendency to coordinate communication and collaborate on tasks without having all representatives physically present at a given location. Interaction in videoconferencing is synchronous, and feedback is instantaneous. Therefore, it appears that organizations may have different reasons for using videoconferencing. As a result, it is beneficial to explore videoconferencing in terms of the organizational goals for deployment and whether goals are accomplished.

Thus, three important research questions this paper examines are:

1. To what degree is an organization accomplishing its goals with videoconferencing?
2. What is the ratio or proportion of multi-point videoconferencing in relation to point-to-point connections within an organization?
3. What are some advantages and disadvantages of using videoconferencing in an organization?

Specifically, the benefits and challenges with videoconferencing are worth analyzing in order to determine how to move forward with the use of the medium.

METHOD

Organizational Background

The organization which is examined in this study is a large government organization that engages in extensive data collection and analysis. Its headquarters are located in the northeastern part of the United States. The organization has thirteen major divisional branches or field operational units located across the United States (i.e., Atlanta, Boston, Charlotte, Chicago, Dallas, Denver, Detroit, Kansas City, Los Angeles, Philadelphia, New York, and Seattle), and there are two processing centers in Indiana and Maryland. The organization is also involved in cooperative programs that support business development and ethnic related research in underserved communities, which include 47 national, regional, and local non-profit organizations. The organization's primary activities involve the collection of data about the U.S. economy, geography, people, housing, communities, and education using surveys. The organization also publishes 32 monthly surveys, which require coordination to ensure procedural consistency in all regions. It engages in frequent ad hoc meetings, administrative review meetings with the regional centers, and information sessions for budget planning and coordination. The organization is headed by a director and a deputy director to which divisional directors/chiefs report directly. The organization is especially appropriate for this study since it utilizes more videoconferencing than any other government organizations in the U.S. (Corporate Strategic Plan, 1999).

The corporate strategic plan directly includes the use of videoconferencing. According to directors in interviews, as well as the organization's own strategic plan, the decision to use videoconferencing was to coordinate activities with the regional offices that are responsible for collecting field data through surveys (Corporate Strategic Plan, 1999). The procedure for analyzing the collected survey data is disseminated via videoconferencing.

At any given point in the organization there are about 3,000 field workers administering questionnaires. During a major project, the field staff can expand to 250,000 people who work from home and interact virtually with other employees at headquarters.

Data Collection

Specific data for this study were collected using the methodology of case study, including the methods of interviewing, direct observation/participant observation, and corporate documentation (see Yin, 2003 on the use of multiple evidence in case studies). Thus, this study employs qualitative analysis in order to describe and explain videoconferencing in its natural context (see Merriam, 1988). The study does not test hypotheses as an experimental or quasi-experimental design might.

Participants or interviewees included divisional directors and associate directors (N=9) of different functional units; some of their subordinates (i.e., intermediate level supervisors) (N=25); and technicians (N=5) who are contractors. A total of thirty-nine individuals, in thirty-seven hours and fifty-three minutes of interviewing, are represented in the data. The average interview time was approximately 1 hour (58.28 minutes). The directors and intermediate supervisors were appropriate candidates for the interviews because they determine how videoconferencing is used, set directions for their respective divisions, and understand how videoconferencing technology helps in accomplishing their organization's goals. The technicians' perspectives enhance the data because they reserve and set up the videoconferences and are in the best position to monitor and complete videoconferencing requests. All interviews occurred over a three month period. The researcher obtained permission prior to observations. Access to all participants was facilitated through the organization's Information Technology (IT) Division. The chief of the IT division sent out a memo to all functional units and requested the assistance of all divisional leaders and their subordinates for participation in the study. The primary motivation for participation in this study was that it provided an assessment of videoconferencing use for the organization, which would help improve or set a new direction for the organization for videoconferencing technology. The vested interest in videoconferencing logically led to more active and accurate self-reporting. Furthermore, to encourage forthcoming comments, the researcher assured participants that none of the information provided could be traced back to them. The interviews were all volunteers, and every volunteer was interviewed.

The Videoconferencing System

The organization's videoconferencing system is a Polycom Viewstation System. Each unit is equipped with voice-activated microphone pods and remote controls affixed on top of a 27-inch Sony TV monitor mounted on a mobile cart with connection cables (known in the organization as a "rollabout"). The system provides a pre-configured address book with specific sets of numbers available for users' convenience in making point-to-point connections. A "bridge" is required when more than two locations (multi-point) are used; the use of a bridge necessitates the assistance of an IT technician. While rollabouts are the most common configuration, the organization also has three fixed videoconferencing units in its large meeting rooms. Both mobile and fixed videoconferencing systems were deployed at the same time. Each system provides users with a graphical interface for making calls, including address books, phones, cameras, etc. Deployed in 1999, the organization's use of videoconference can be considered relatively new. It is also a pioneer in the large-scale deployment of videoconferencing and other technology adoptions through the early forms of video-enabled mediated meetings, such as Internet protocol television (IPTV) and voice over Internet phones.

Procedure

Interviews were conducted by the primary researcher and the interviews usually took about 58 minutes. All interview questions were generally open-ended to:

- Allow participants to provide answers and elaborate on the subject as much as possible (recommended by Straus & Corbin, 1998).
- Allow respondents to come up with their respective responses and to guard against coerced responses (see Morgan, 1997; Olaniran & Hall, 2002).

The interview questions revolved around what and how videoconferencing is used in each division, the challenges faced by divisions, the advantages of the system, and the types of improvements and changes users would like to see implemented. Other questions on cost sharing and funding videoconferencing in the organization were also asked (see Appendix 1 for the interview guide). In addition to the interviews, direct non-obtrusive observations of videoconferencing use at the organization were made. To be non-obtrusive, the researcher was able to sit in during some meetings without contributing to the interaction.

Data from both interviews and observations were gathered through note taking. Notes from the interviews were re-written and transcribed at length immediately following each interview and observation (recommended by Lindlof, 1995). The rigorous process of transcribing and contextualizing notes is done to incorporate participants' examples and to offer an exact presentation of interviewees' responses. The technique is believed to safeguard against forgetfulness or misrepresentations that may occur over time. Note taking also prevents apprehension that may occur when a recording device is in use (Yin, 2003).

ANALYSIS

A microanalysis technique, which involves a detailed line-by-line assessment to generate categories and to discover relationships among concepts (Strauss & Corbin, 1998) was used. Microanalysis compels researchers to examine the specifics of the data (i.e., the field notes) for emerging themes underlying interviewees' responses. It is prudent to examine the data for emerging themes rather than attempting to fit them into preconceived categories. In other words, the categories emerged from the interview data. While the interview guide provided general categories, interviewees' responses were useful in answering the research questions (Olaniran & Hall, 2002; Strauss & Corbin, 1998). Where appropriate, representative sample comments from interview data are offered to substantiate arguments and answer specific research questions. Data analysis exclude information from technicians unless specifically mentioned, given that they do not participate in videoconferencing directly. A specific plan for evaluating the three research questions follows.

For RQ1, the emphasis on evaluating the goals suggests that one should first identify the organizational goals leading to videoconferencing use. Thus, the researcher looked at the corporate strategic plan, and then the researchers asked management about their awareness and perception of the attainment of their goals.

For RQ2, which asks for the ratio or proportion of multi-point videoconferencing in relation to point-to-point connections, the researcher requested the total record logs of time spent by the organization in both videoconferencing protocols and then divided the time by the total hours of videoconferencing for the year.

For RQ3, which addresses benefits and problems, assessment is based on themes emerging from participants' interviews about what they believe to be the benefits and challenges with the medium.

Taken together, the findings from these research questions allow an evaluation of videoconferencing as a communication process. Finally, practical guidelines for organizational planning, implementation, and continued use are offered based on the findings.

Results

The following provides results from the data analyses. The results are presented in the order of the research questions.

RQ1: *Organizational Goals*

RQ1 asks to what degree the organization is accomplishing its goals. To answer this question, the organizational goals for videoconferencing are identified along with participants' responses and observational data. First, the goals from the organizational strategic plan for videoconferencing are:

i. To develop a diverse, effective, and skilled work-force
ii. To provide training and development programs which offer continuous learning opportunity for employees in order to keep their skills current at the level of organizational needs. The development goals include provision of timely information and a supportive work environment that communicates that employees are valued.

Respondents indicated that they were aware of these goals and they said the goals were being fulfilled. The interview data were then evaluated with respect to the degree to which the two major goals were being achieved. Approximately 90% of the interview data suggest that videoconferencing in the organization appeared to help significantly with the goal of providing training and development programs that offered continuous learning for employees to keep their skills current at the level of organizational needs and at a significant cost saving. Specific uses of videoconferencing were recounted and they included disseminating information, training on organizational policies, and holding pre-retirement training seminars. Videoconferencing was also used to facilitate continuing education, and to connect the corporate university with the organization's distance learning program. The following statements from the interviews offered support for the goal accomplishments.

The videoconferencing aids in collaboration with our field personnel to keep them on the same page as someone at headquarter and helps circumvent budget constraints for travel.

Videoconferencing helps us in the presentations of information for our technicians [programmers and statisticians].

Videoconferencing really saves us a lot of time. For example, using it for brownbag program from one location to another prevents us from traveling there for only that purpose.

The use for distance learning enhances staff commitment for class and registration in course offerings.

The goal of offering a communication strategy that keeps all employees informed, while providing valuable information for job performances to assure employees that they are valued, is a significant finding in the interviews. Specifically, the inclusion in meetings and the establishment of the corporate university through videoconferencing for continuing education, which is paid for by the organization, suggests that employees are valued and that the organization takes the initiative to invest in its employees.

Participants indicate that they use videoconferences on a regular basis (at least once a month) for information dissemination. The regularity of

use depends on the needs of different departments. For instance, participants from the field divisions who use videoconferencing to coordinate activities of the regional sites tend to have a more regularly scheduled videoconferences (e.g., twice a week or as needed) than individuals with primary duties conducted at headquarters who reported less frequent usage (e.g., monthly or seldom). Further evidence supporting increased use and demand for videoconferencing is the fact that aggregate current usage and savings have surpassed the initial projected figure of $225,600 over the first fiscal year based on direct travel cost (Corporate Strategic Plan, 1999).

The primary use of videoconferencing at the organization remains information dissemination. Among such information dissemination usage identified, for example, are the regularly scheduled monthly meetings. Thirty-two out of the thirty-four supervisors and directors (94%) specifically mentioned the information dissemination usage of the videoconferencing. The following sample statements stressed the emphasis on information dissemination use of videoconferencing in the organization.

The best use for the videoconferencing is when there is an agenda and there is no strong need for face-to-face [FTF] meeting.

The videoconferencing is an addition to face-to-face because of the need to first build relationships, such that it is not just like watching television.

The use of videoconferencing for information dissemination remains prevalent, even though there is a mention (5.9%) of other uses such as budget negotiation and the "alternative dispute resolution" - where grievance settlement, advice, and guidance are offered on policies to mediators in geographically dispersed locations. In essence, the organization is systematically accomplishing its second goal (i.e, providing training, continuous learning, timely information, and communicating that employees are valued). Due to the sensitive nature of hiring, the researcher did not observe any videoconferencing used for hiring.

Approximately 95% of the interviewees suggest that videoconferencing is used from the start of a person's employment in order to train employees to become effective members of the organization. In spite of the active use of videoconferencing in the organization, there is still the perception of a gap in the degree to which videoconferencing is accessible to employees. Approximately 60% (i.e., 15 of the 25) of the intermediate supervisors talked about this perceived gap. The following comments allude to the perception of gaps:

More equipment around the building would help more users to use the system.

One should not have to go through anybody to use the system.

Access will be easier if each department has its own videoconferencing unit.

***RQ2:** Ratio of Point-to-Point vs. Multi-Point*

RQ2 asked for the ratio of point-to-point vs. multi-point videoconferencing connection. In order to answer this question, the researcher asked for the time log of vidoconferences kept by the IT division for the current year (2001). The log was kept in two halves and it indicates that in the first half of the year, 54% vs. 46% of the videoconferencing time was spent using point-to-point connections. Specifically, 776.2 hours of videoconferencing use was logged for point-to-point while 667 total hours was logged for multi-point connection. The figure changed in the second half of the year, however, where 58% (880 hours) were logged for multi-point connections and 42% (626 hours) were logged for point-to point connections. It appears that the choice between point-to-point and multi-point connection is relatively even in the organization. The extent to which the seasonal

nature of certain tasks, or the post 9/11 affects travel, such as fear and inconvenience, influence the result remains unclear.

Organizations with both point-to-point and multi-point use options are at an advantage to organizations that do not have both options. This advantage is significant to business communications scholars for three reasons:

1. Increased choice enables more effective use of time and technology.
2. Different connections allow an organization to track task types on specific videoconferencing connections.
3. Videoconferencing planning activity can be based on assessment of different systems.

RQ3: *Benefits and Challenges*

RQ3 explores the advantages and disadvantages of videoconferencing in the organization. The data were examined accordingly, beginning with the advantages.

Interview participants and data indicate that most participants (88%) see videoconferencing primarily from the "convenience" standpoint, which was perceived from physical and cost perspectives. By convenience, participants indicated that videoconference is easier to arrange than actual travel to a particular site for meeting and that the portability of the rollabouts allow meetings to not be constrained to a particular venue as with fixed unit systems. Furthermore, the cost perspective can be divided into two: direct and indirect cost of performance or productivity within the organization. First is the physical convenience.

Physical Convenience

Physical convenience includes the ability to put together a meeting on a relatively short notice (Berry, 2006). Most of the divisional directors and their associates have the videoconference hardware (Polycom 512s rollabout) in their offices and can initiate interactions via videoconferencing at will, especially point-to-point, to dial to a remote location and have a meeting on their own with little assistance from IT technicians. On the other hand, a multi-point connection requires prior scheduling due to "bridging" (i.e., assistance from IT personnel). Apart from the provision of videoconferencing unit in each director's office, all employees still have access to videoconferencing with relative ease. Furthermore, access to videoconferencing from lower-level employees does not appear to be problematic given that the organization uses the system primarily for information dissemination. At the same time, other employees are able to request the videoconferencing rollabouts to be placed in a meeting room for their meetings. Some sample comments include:

With videoconferencing we are able to schedule a meeting on a whim with the help of IT folks and knowing that the equipment will be there and with a very short lead time. All you have to do is call and let them [technicians] know when and where.

Videoconferencing allows meetings to be scheduled with remote location relatively quickly.

The field division interviewees, who do a lot of policy training, stressed the importance of the convenience offered by videoconferencing in the following:

An average of 3-4 days per week is saved in out of office travel to regional offices.

Videoconferencing is convenient because most workers want to stay close to home and it helps them to accomplish this goal for the most part.

90% of users indicate the "portability" of the videoconferencing system a convenient advantage.

The rollabouts allow for meetings to be held in different rooms and in different parts of the orga-

nization. Videoconferencing is not restricted to a particular location. The rollabout videoconferencing system also allows for multiple videoconferences to take place within the organization at the same time, contrary to a fixed unit system. One participant put it succinctly: "More gets done in limited time with videoconference."

Getting a lot done in a limited time frame is an important benefit to organizations, because most corporate uses of videoconferencing are restricted to a fixed unit or a designated meeting room. At the same time some organizations do not have their own videoconferencing center such that they have to go through a third party provider. Thus, the rollabout units in the organization help overcome the problem of a fixed unit system.

Direct Cost Savings

Each interviewee referred to travel cost savings with videoconferencing. In the organization, the videoconferencing system can put together 15 multi-point connections over IP networks with zero direct cost other than set up and electricity. This contrasts sharply to the average travel costs of $1500.00, which is the average cost of traveling for two people from Maryland to New York at one of the divisions. At the same time, it is worth noting that the traditional cost of travel to five of those meetings has the potential to pay for the cost of one videoconferencing unit. One divisional director indicated that "videoconferencing can be attributed to a saving of four to five months costs of traveling per year." Another division pointed to the weekly scheduled three to four hours training:

Videoconferencing is more efficient and economical as it saves salaries and travels for four people.

One direct contribution of having videoconferencing is that it facilitates the chance of having "critical mass"–where more people can attend the same meeting without a significant increase in costs. According to a review of the literature and data in this study, for this organization, a critical mass can result in increased synergy for problem solving. Similarly, the choice of deciding on who should attend a meeting based on cost consideration is significantly reduced (Turner, Thomas, Reinsch, 2004). Such benefits provide organizations with opportunities to include lower-level employees or cross-sections of the organization in the meeting and decision process without increasing cost. Such employee inclusion creates an environment for active participation in the decision making process (Olaniran, 1994; 2004) and workplace democracy (Deetz, 1995). In essence, opportunity for democratic decision making can be fostered in the organization to a greater degree than in other settings.

Indirect Cost Savings

Indirect costs are non-monetary based. Associated indirect cost savings from videoconferencing include effective and efficient use of time and human resources that increase organizational productivity and performance. For instance, twenty-four (70%) of the participants mentioned how videoconferencing limits or overcomes "dead time" as alluded to in the following sample comments.

Videoconferencing helps prevent dead time that usually [exceeds] one to a few hours of productive meetings.

Videoconferencing safeguards against the wear and tear [stress] resulting from having to wake up at weird hour, catching a flight, waiting at airport lobby getting through security [which is not an easy task these days], finding time for meals.

If three to four days of traveling are saved by videoconferencing out of a 5 workday week, then the time saved is used to work on other projects. Furthermore, there is general consensus that much gets done in limited time with videoconferencing.

For instance, meetings can be arranged in less time with videoconferencing than in FTF.

Participants claimed that videoconferencing provides a close substitute for FTF though not a complete one. The ability to see participants and observe nonverbal cues such as eye contact and body language was credited with a higher rating over telephone or teleconferencing. For example, some interview comments included the following:

It makes you feel like you are in the same room with other participants so that one forgets the actual distance that separates people.

One can easily see how other people feel about ideas; all you have to do is watch their gestures.

Videoconferencing is the closest to face-to-face meeting one can get.

These comments imply that the ability to use videoconferencing tools allow users to compare the technology with other traditional communication media and to identify some advantages of videoconferencing, which is known to aid adoption decisions (Turner, et al., 2004).

In order to determine disadvantages, the data were examined for problems and challenges that the user faced in using videoconferencing. The transcripts point to two broad categories. The first involves the technology and focuses on the ease-of-use (EOU). The second is more of human aspects. Both of these are presented in the following paragraphs.

Ease-of-Use (EOU)

The ability to be able to operate videoconferencing with little assistance from the technicians seemed to be the top concern. Eighty-five percent (85%) of the participants expressed overwhelmingly that they would like to understand the dialing protocol by themselves. Users often have to call technicians to get the equipment to the right place, set it up, and help navigate the menus for dialing the numbers even in the less complicated point-to-point use. Their comments included the following:

Videoconferencing should get to the point where it is like picking up the phone.

It needs to be seamless, painless, and there should be no fiddling around.

Make the learning curve for using the system shallow.

Also, there seemed to be the perception that the videoconferencing equipment stands in the way of interactions. Twenty-two (65%) of the interviewees expressed this view. The following are sample comments from the data:

Make the equipment less intrusive i.e., not a part of the interaction.

You need the ability to forget that the medium is the focal point.

Provide more equipment around the buildings so that one shouldn't have to think much about the system to operate it.

It is too complex working with others to use the system [talking about the need to request technical assistance for scheduling and resolving problems], the preference will be for that need not to be there.

The comments above imply that the need to go through IT in order to use videoconferencing systems impedes the system's use. Consequently, participants become passive with the videoconferencing technology. This result is in direct contrast to the convenience advantage identified by the interviewees in terms of the ease with which videoconferencing can be set up.

Another area of EOU focused on is the issue of bandwidth. Nineteen (56%) of the interviewees

said that, at times, there are latencies in transmission during videoconferencing. Latency interferes with how the system is perceived during meetings and affects users' willingness to commit to videoconferencing applications. According to the interviewees, videoconferencing transmission over the IP network is best because the rate is at the industry standard of "H 323" when compared to transmission over ISDN network with the rate at "H 320." Latency involves jerkiness and low quality transmissions in videoconferencing, and using IP networks mitigates latency. While IP network transmission rates allow for up to 768kbps, ISDN lines only allow for half as much. Thus, there are two critical challenges within the organization:

1. Although headquarters has IP transmission capability, remote sites often do not.
2. The capability of the vendor's gateway that the organization uses to link headquarters to other sites does not move beyond ISDN capability.

Furthermore, employees in the organization want to have direct access to videoconferencing such that it is available to them anytime and anywhere. That is, they want videoconferencing via laptops. Due to the bandwidth challenge and other technology issues, this option is not yet possible in the organization. The IT division suggested that the technology for getting videoconferencing to desktops is available, but the funding to make it happen is not available. There is a sharp contrast between how employees report they would like to access videoconferencing and what the organization is providing. Thus, cost appears to be a concern for IT division, whereas videoconferencing users do not appear to be cost conscious as they are with the service itself.

During interviews technicians reported that aside from the corporate university setting, videoconferencing units do not have dual video capability. Such capability allows for viewing documents simultaneously with participants. The limitation means documents or brochures for a meeting must be physically delivered or faxed to other sites prior to a videoconferencing meeting. The limitation can delay meetings.

Other videoconferencing concerns include how information is transmitted or viewed. For instance, it is unanimous from the transcripts that individuals would like the screen to display all locations participating in a videoconferencing. The option is possible through what is called the "cascading effect." As is, the organization with the Polycom 512s is only able to see two sites at most, which is "picture in picture." In multipoint interaction, thus, users are only able to see themselves along with one of the other sites through the voice activated feature of the system. One director recalled a time when a multi-point videoconferencing call left out a site and that it was only after the conclusion of the meeting that she became aware of the situation. Again, the problem influences communication interaction to the extent that other sites might be completely ignored or go unnoticed during meetings; this is a situation that hinders immediacy. Some related sample comments:

The potential benefits of videoconferencing increase if Hollywood Squares [Cascade] is a possibility.

Videoconferencing makes communication more personal when you can see others [co-participants] but as it involves more sites it loses that personal effect.

The voice-activated switching, which resolves whose image is on the video screen, has its limitations. For instance, during simultaneous or out-of-turn speaking, each technician interviewed indicated that the system resolves the problem with the full duplex function–meaning it focuses on the person with the loudest audio signal.

Similarly, there is the issue of control over how users access or choose to implement videoconfer-

encing in their works. The technicians reported that all requests for videoconferencing within the organization is manually recorded or monitored. The system does not allow for automatic scheduling. Part of the challenge lies in the fact that different vendors are being used (i.e., videoconferencing units and service support gears).

The Human Side of Videoconferencing

Disadvantages from the human side of videoconferencing include the structure of the meeting along with the nature of the interaction taking place in videoconferencing. According to the analysis of the transcripts, 71% of interviewees mentioned that other videoconference attendees tend to lurk, and that attendees prefer the camera is not focused on them. Other comments reinforced these ideas:

We need more people to interact rather than lurking.

If people don't participate in the end, videoconferencing turns out that most usage end up as info dissemination.

One interviewee summed the lack of participation up in the statement "why have videoconferencing if all you get out of it is teleconferencing."

As with videoconferencing users, technicians faced some challenges as well. From the human side, each technician said that after making arrangements to get videoconferencing units into meeting rooms, it is very discouraging when non-participants turn the system off despite specific instruction on the unit to not do so. The close resemblance of the Polycom unit to a TV monitor makes it look like a TV left on by accident. Though the problem seems minute, it snowballs into greater problems and the frequent occurrence makes the technicians' jobs taxing. A similar problem is the cancellation of videoconferencing schedule without notification by users. Unexpected cancellation creates problems because, to schedule any meeting, the rollabout must be moved to the meeting room, and to do so, means advance arrangements must be made (e.g., obtaining keys from the custodian). Furthermore, the technicians report that frequent movement of Polycom units contributes to the wear and tear that leads to replacement of a videoconferencing unit, which is an expensive ordeal.

There is also fear of the unknown, especially among the intermediate level employees, 21 (84%) perceived that videoconferencing was meant to replace travel within the organization. Specifically, these individuals believed that videoconferencing needs to be complementary to travel and not serve as a replacement. The idea is reinforced in the following interview comment:

At least one out of every four meetings ought to be conducted face-to-face (FTF) instead of one out of every five meetings.

The comment appears to make intuitive sense and could help alleviate resistance based on perceived punitive potential of technology, which may occur when it replaces all FTF meetings.

DISCUSSION

With regard to RQ1, which asks whether the organization is accomplishing its goals, this study finds that the organization is accomplishing its goal of keeping employees informed by using videoconferencing primarily for information dissemination. For instance, activity such as policy and procedure are easily provided through the medium. However, there is little evidence of videoconferencing use for complex communication task that requires participants' engagement. For instance, for immediacy to occur, videoconferencing requires managers to show emotional commitment where information is communicated dramatically. That is, emotions, expression of feelings, body language,

and facts need to be communicated clearly (Boutte & Jones, 1996; Glynn et al., 2005; Gump, 2004). 94% of the interviewees identified information dissemination as the key goal and use for videoconferencing within the organization.

The two episodes of videoconferencing use for complex tasks involve such issues as budget negotiation and conflict resolution. Conflict resolution is noted in one of the thirteen divisions which use it for alternative dispute resolution. The use of videoconferencing for dispute resolution is particularly intriguing in light of prior claims about mediated communication lacking the critical "people feel" believed to be necessary in such task (see Daft, Lengel, & Trevino, 1987).

The findings regarding RQ2 on the ratio of point-to-point to multi-point videoconferencing also needs addressing. Most videoconferencing use in organizations focuses on fixed unit multipoint connections. But the relative equality in the ratio of point-to-point and the multi-point connection in this study may be attributed to the portability offered by the rollabouts. While most organizations may pit the fixed unit against the rollabouts, it stands to reason that both types may add increased versatility to videoconferencing in organizations. Therefore, both protocols should not be seeing as either/or but rather as complementary.

The portability of the videoconferencing unit holds specific implications for adoption of the technology. First, it has been shown that easy access to new technology (innovation) speeds the rate of adoption (Olaniran, 1995; Rogers, 1995). Second, the mobility of the system allows faster access and thus, information dissemination about the technology flows more rapidly throughout the organization, such that awareness and uses are fostered and reinforced. In other words, easy access fosters repeat and continuous use which is essential to successful adoption as familiarity builds competence in technology use. Third, the portability helps break a psychological barrier of "status symbol" (i.e., perception of something for the top management use only) that may accompany a fixed unit videoconferencing system. The need to be actively involved in the videoconferencing is linked to the fact that mastery of communication technology enhances users' resourcefulness and allows for on-the-job learning rather than the ones offered through technical training (Selfe & Hawisher, 2002).

The findings regarding RQ3 about benefits and challenges of videoconferencing point to a major disadvantage of poor participation in videoconferencing. It appears that the presence of visual cues in videoconferencing, in particular, is a double-edge sword. While videoconferencing has the potential for participants to enjoy interaction on one hand, it may also work against productivity. More than half of the interviewees (65%) identified this as a concern. Due to physical separation, it is impossible to touch other people to interrupt or calm them, and having a side talk with individuals in other locations is also impossible (Meier, 2000; Wegge, 2006).

The lack of interactivity also leads one to speculate there are users who are timid about the technology and perhaps view the system as an organizational surveillance tool in which one's contribution may have negative consequence at a later time. The argument is in line with those suggesting that videoconferencing results in less participation (Boutte & Jones, 1996; Needleman, 2001; Webster, 1998). Boutte and Jones (1996) argue that individuals who are shy or have natural inhibitions in group interaction are further inhibited in videoconferencing situation. Although it has been found that incorporating new technology such as videoconferencing into an organization structure often alters the organizational communication patterns, the general decision making process is impacted positively (Olaniran, 1993; 2004). It appears that the change in communication patterns may take time to develop. In order words, the cultural environment created prior to introduction of communication technology is directly related to how organizational members

treat and react to a new technology at least initially. Given the structure and culture in this organization is hierarchical and formal, it appears that the technology is reinforcing the existing patterns (see Canessa & Riolo, 2006). Furthermore, the study may point to the need for a videoconferencing facilitator. For instance, a facilitator or leader in videoconferencing can actively solicit opinions from participants (i.e., participative leadership style) to minimize passive observations and lurking tendencies (Boutte & Jones, 1996).

Implications from Videoconferencing

A surprising finding about videoconferencing in this study involves the structure and nature of the technology. Features that are touted as benefits of videoconferencing were often referred to as disadvantage of the medium. For instance, participants indicated that videoconferencing offers benefits including convenience, overcoming wear and tear that goes with traditional traveling in FTF, and providing opportunity to read facial and non-verbal cues, yet they complaint that the system's use is aimed at replacing travel. In order words, participants are not willing to relinquish traditional travel to meetings. This study is in line with those indicating that while videoconferencing represents a close substitute for FTF medium, it is not perceived as offering the same degree of personal feel or closeness attainable in FTF (Abel, 1990; Alavi et al., 1995; Baltes et al., 2002; Roch & Ayman, 2005; Valacich, et al., 1994; Wegge, 2006;). A major challenge with any communication technology is the comparison to FTF as the most natural and underlying baseline for evaluation (Kock, 2001; Simon, 2006). This challenge speaks to the need to stress the significance of "relative advantage" in innovation adoption. Individuals who perceive relative advantages in an innovation adoption are likely to adopt the innovation with ease (Olaniran, 1996; Rogers, 1995; Turner et al., 2004).

At the same time, videoconferencing, by allowing facial expressions–which are supposed to enrich interactions eliminates anonymity in meetings and, in essence, makes users uncomfortable that some do not want the system's camera to focus on them during interactions. All these factors point toward the need for attitudinal change about technology. With organizations in today's economic environment having to do more with less, organizations must help their employees to realize the need for the change and understand the process of implementing such change. The change, however, must be communicated in a manner where both management and employees (users) trust one another and the change must be gradual. Also, it is possible that organization sponsored travel, in spite of inconveniences, is a job perk that conveys to employees that they are valued members, thus, a welcome inconvenience.

A key improvement that users may appreciate is to have videoconferencing get to the point where it is as easy as using a telephone (i.e., ease-of-use). The following can help users with videoconferencing. 1. The perception of videoconferencing as a monitoring/surveillance tool must be alleviated. 2. A one page operating guide to avoid calling technicians to set up connection in order to handle emergencies; such that anyone can quickly browse and use it to start a videoconference. 3. Acceptance of videoconferencing should be improved through training on the technology capabilities and by emphasizing its relative advantages. Along this line, Table 1 is provided to offer practical guidelines for successful videoconferencing.

The idea of indirect cost savings implies that videoconferencing benefits should not be measured only in direct monetary terms when performing cost-benefit analysis. This assumption is an oversight in the use and evaluation of technologies in general. Given most organizations are concern about productivity and efficiency, it is imperative to do a cost-benefit analysis of how much each division and overall organization is saving not only in travel cost, but also in productivity that

Table 1. The roadmap for successful videoconferencing

• Ensuring that connection speed or protocol is up to industry standard and avoiding communication latency and visual problems.
• Strive to ensure that that branch office have similar bandwidth as the headquarter as much as possible. However, when this is impossible, the branch office should have no less than ISDN connection.
• Commitment by the organization to support the system financially and technically. This includes allocation of funds to update and refresh the system as frequently (e.g., 3-5 years) as possible and allocation of technical staff to help users as needed.
• Plan ahead of meeting (making sure all parties and locations are ready for the meeting, performing audio and visual checks to make sure the system is good to go) by anticipating what could go wrong and develop a process to counter them (i.e., plan the meeting and work the plan).
• Offer participants and potential participants training in videoconferencing etiquettes (e.g., turn taking, avoiding whispering and side conversations, clarity speaking etc.).
• Making the learning curve for videoconference system shallow/short
• Offer easy to access and use menu on all system units to make it easy to operate
• Reduce the need to go though IT for support & make sure the support service is there when needed, given that the need to go through IT to use videoconferencing impedes adoption and use (e.g., implement auto scheduler)..
• Making sure that the medium is not a focus or concern during interaction (i.e., as less intrusive as possible).
• For a for profit organization, emphasis should stress the system's choice as speed aiding device/tools. That is, the need for speed in communication transaction where first to market in the face of intense competition from other competitors is a must.
• Choice of system with DocuCamera and Cascading feature that allows for visual cues for participating location is an added bonus for enhancing effective participation and ensuring that all participants have access to the same information.
• It is also worth knowing that while a given unit may allow an organization to connect several multiple sites at once, the more sites one connects with, the more is loss in the personal effect (thus limit multipoint connectivity to 5 sites at the most whenever possible).
• Do not restrict systems usage to "information dissemination" perform or try exploratory problem solving activities, however begin with simple complex problems and eventually graduate to more complex activities, to encourage active participation and allow users the necessary time to adapt to the technology.
• Allow for some level of non designated (e.g., personal use) usage of videoconferencing, it may foster increase participation in actual organizational meetings
• Stress gradual over sudden adoption for videoconferencing system
• Make sure videoconferencing set up removes sense of remoteness (e.g., strive to accomplish appearance of office environment that is pleasing to the eyes).
• Empower users to take initiative in the use of videoconferencing system.
• It just as important to turn off the system at the end of the meeting as it is to turn it on ahead of meeting to avoid embarrassment and unfortunate incidence.
• Strive to purchase or use equipment from one vendor.

would have been lost due to travel time. Furthermore, this analysis may help address the issue of funding that is problematic within the organization. For example, organization standard with videoconferencing funding in University and other non profit organizations is to charge users initial fee and then structure the rest of the fee based on usage time and numbers of sites involved per connection. This funding approach may mean that this organization would have to get rid of its central fund allocation. The overall cost assessment can help organizations to identify the true value of having the system and the need for commitment to continue to provide capital to fund the service. Researcher concurs with the sentiment of one of the divisional directors that "without the cost assessment, videoconferencing will become nothing but a pretty picture on the screen."

The increasing need for convenience and coordination of efforts of different functional units in organizations' different geographical locations makes videoconferencing necessary and useful. However, one must be careful because while videoconferencing can allow dispersed location to collaborate (e.g., Berry, 2006), it is prudent to note that it is not always feasible when dealing with time zones in excess of six hours or international dateline differences. For instance, to have a videoconference between USA and Africa countries or USA and Asia countries, it would mean representatives in one of the countries would have to be up when they are suppose to be sleeping. Time difference contradicts Berry's (2006) claim because videoconferencing may be a medium of preference, its use may be impossible.

The level of participation in a videoconferencing, especially one involving larger group size, is influenced, by how individuals think they are being perceived. For instance, Bekkering & Shim (2006) suggests the need to re-assess communication interaction in videoconferencing. He found that the natural position of the videoconferencing camera (top or sideways) makes the feeling of trust lower than email such that the lack of eye contact could cause a distrust among participants rather than the need to adapt to the unique nature of trust in video interaction. This may be the case given that Western cultures place significant emphasis on direct eye contact in order to determine trust. At the same time, prior history among participants may influence the level of participation than initially thought. The lack of participation found in this study runs contrary to the argument that participants in video-mediated interaction compensate by saying more than they would in face-to-face interaction based on the perception that their communication attempts were less effective (e.g., Doherty-Sneddon, et al., 1997; Jarvenpaa & Leidner, 1999). The effect of anonymity on social loafing and poor participation in electronic media is worth noting. Social loafing or poor participation is attributed to the degree of anonymity afforded by a medium to participants (Diehl & Stroebe, 1991; Olaniran, 1994). Videoconferencing with visual cues fails to offer anonymity yet participants fail to participate.

Furthermore, poor perception in videoconferencing has been attributed to distortion in conversational acts that occur because of transmitted weak signals (Sellen, 1995). Organizations need to pay particular attention to the environment in which they operate. For instance, while government organizations or non profit organizations may have the patience to put up with weak signals and latency in transmission, for profit organizations may have "shorter fuse" especially when they operate in a volatile market where success and survival requires triumph over competitors. For example, Toffler (1990) successfully predicts that the norm in the information era is based on survival of the fastest where being second to a market is a guaranteed failure.

Along the structural usage of videoconferencing within the organization is the observation that the usage is primarily for "information dissemination." This form of usage holds true regardless of the nature of videoconferencing (i.e., whether it is one-to-one or one-to-many meetings). Though the multi-point videoconferences often range between three to as many as twenty-six sites, with an average of four sites per connection; however, the technology is used to provide valuable information to end users rather than generate active participation as in a decision making process. This result is especially noteworthy, given that the videoconferencing involves interactions between upper management and intermediate supervisors–where one might expect less status difference. The result is in line with Nandhakumar and Baskerville (2006). At the same time, the nature of the organization involvement with data gathering and analysis may come into play. One would expect statisticians to be competent in their job and more importantly are used to working alone in their respective offices, such that the culture of the organization is one where goals are accomplished for the most part on an individual basis. Hence the primary use of videoconferencing is to communicate agendas, approaching deadlines, and procedures all which require less interactivity.

On the other hand, there is anecdotal evidence that videoconferencing can be used for conflict resolution as reported earlier. The lesson here is for departments and videoconferencing moderators to decide when participation is needed and figure a way to get participants involved in the process. The author believes videoconferencing can allow true participation and can be used as a way to get lower level employees involved in an organization. Active participation and greater interactivity are within the scope and capability of videoconferencing (Needleman, 2001; Raby, 2001; Wise, 2002). Specifically, success for greater

interactivity was identified in this study by a division that uses videoconferencing for the alternative dispute resolution while another successfully used it for budget negotiations. Perhaps the reluctance to use videoconferencing for complex interactions relates to the general belief that in a complex task such as conflict, FTF interaction is better (e.g., Needleman, 2001; Panteli & Dawson, 2001). The findings in the current study challenge the claim that conflict resolution is only suitable for FTF interaction.

Limitations

As with any qualitative study, this study points to similar challenges such that the degree to which information from a case study can be generalized across settings is limited. Furthermore, the study speculates into the reasons for the lack of participation in videoconferencing in group interaction. Due to lack of willingness from videoconferencing audience to discuss their reasons for non participation, only the interviewer's view is presented. Future studies need to focus on participants' view about participation and specifically reasons for lack of participation. Also, the extent to which portable nature of the videoconferencing unit use in the organization affects access and perception may not necessarily transfer to organizations restricted to the use of fixed units. Notwithstanding these limitations, the study offers a critical assessment and empirical use of videoconferencing in an organization and a snapshot for typical activities and configuration that can best optimize videoconferencing.

CONCLUSION

Videoconferencing is not a cure all for organizational communication challenges. Challenges include technical, contextual and human application of the technology. Proper training, adaptation, and integration of the medium into organizational communication resources are needed for success in the global arena. The organization in this study provides insights in exploring videoconferencing uses for task coordination and communication process. The case study provides a significant point of departure and foundation for other organizations contemplating the use of videoconferencing.

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APPENDIX

Interview Guide

The interviewer used a general "interview guide" in order to allow interviewees to gain more control of the interview (Stewart & Cash, 2000). This approach allowed the interviewees to provide information about their understanding of the role of videoconferencing in their respective organizational divisions. The following are some questions that helped guide the interview.

Can you describe how videoconferencing is used in your division?
What activities do you use videoconference for?
How has videoconference help facilitate activities in your division?
What advantages do videoconferences offer your division?
What are the challenges you face with the use of videoconference?
What changes would you like to see with videoconferencing?
How helpful are the technicians in working with you with your videoconferencing need?
Can you describe your working relationship with the IT division when it comes to your videoconferencing needs?
How do you think videoconference should be funded in the organization?
Are you willing to contribute a portion of your travel budget to finance videoconference use in the organization?
Based on your experience, what changes have you noticed about videoconferencing in the organization?
What suggestions do you have about videoconferencing?
What changes would you like to see regarding videoconferencing?
Are there any additional comments you would like to provide?

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Chapter 5
User-Centred Systems Design as Organizational Change:
A Longitudinal Action Research Project to Improve Usability and the Computerized Work Environment in a Public Authority

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ABSTRACT

This paper presents a longitudinal case study in which six Human-Computer Interaction (HCI) researchers worked extensively in an action research cooperation with a public authority over a period of four years. The purpose of the cooperation was to increase the focus on usability in the authority, and the main research question was how user centred systems design and increased awareness on work environment in relation to computer usage could promote organizational change in a public authority. The overarching research approach in this project has been action research and the data used in this paper is derived from an evaluation performed at the end of the project, as well as through our experiences from working with the project. The results involve aspects relating to organizational issues, management support, strategic documents and end-user participation. Moreover the results include methodological

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support for bringing users and developers closer together and individual and organisational attitudes to development. The purpose of this paper is to make some general conclusions on how to bring about change when approaching a large public authority with the purpose of introducing usability and user centred systems design.

INTRODUCTION

An ever-increasing number of work tasks are performed supported by computers, technology or other IT tools. In Sweden, more than 75 % of all workers daily interact with computers and other information technology. More than 35 % uses computer more than half of their working day. More than 15 % performs their work in direct contact with computers (According to the Swedish Work Environment Authority, 2006). Within public authorities almost all work is more or less computer supported. For case handlers, administrators, management, etc. the computer is the main tool or the only tool they use. Of course this means that the quality of the computer support systems are of utmost importance for the quality and efficiency of work and in the end also for sustainability of work as well as for health and well being of workers.

Users of computers know that technology can contribute to numerous positive things. You have the opportunity of doing things that otherwise would not have been possible, at the same time as technology contributes to increased efficiency and quality. But often it may lead to various types of problems. Computer systems may be perceived as difficult to understand and use. It may be difficult to trust and rely on systems to work as anticipated. Users may become confused and otherwise bothered. It may be physically challenging to work with computer systems for longer periods, particularly if work is monotonous and includes mouse-handling work with limited variations in postures. Computer systems could make you feel controlled and with limited freedom on how to perform your tasks. Irritation and stress are common feelings. There are many reasons to believe that the computer-related problems may be contributing to inefficiency in work, irritation, stress, and increasing workload and subsequently to health problems and sickness. Quality improvements in the IT systems may be important to prevent decreased abilities to work, unhealthy work environments and sick leaves.

Another problem is related to how the technology is used in the everyday work. Often the development of work, organisation, roles and processes do not take advantage of the opportunities that new technology offer. Instead the computers are used to do the same tasks in the same ways as they were performed before. As a result of this one do not achieve any improvements or simplifications, but a number of new problems relating to deficient technology.

The process according to which the IT systems are being developed and introduced is of utmost importance for how the systems will be perceived by its users and for the organisation. The process for requirements on the new IT system, design, development, deployment, maintenance, continuous improvements and evaluation must be efficient. But, at the same time the development process must see the systems development as a part of the business development, it must show an ability to involve the future users in an appropriate way and it must be able to handle usability and work environment issues from the beginning to the end. Most commercial systems development methods do not live up to these requirements without supplying appropriate additions. Therefore, to be able to contribute to positive development there is a need to develop both the development processes and the knowledge and expertise among those involved in the development work.

So, therefore our main purpose of the project has been to investigate: *How do you introduce usability and user centred systems design issues into a public authority?* We know that it takes numerous changes all the way from processes and principles to organisational issues and human values, knowledge and attitudes, and the aim of this paper is to find some general conclusions on how to bring about such a change.

Purpose and Justification

From a research point of view the purpose of the project was to gather knowledge and experiences on the introduction of usability and user-centred design into a public authority and how this focus on improving usability and the work environment manifests itself in organizational change. But, as most action research projects, different goals from the different stakeholders involved shape the way in which the project develops and the results obtained. See Table 1 for a more comprehensive listing of the goals of the various stakeholders involved.

The effect goals from the public authority were important as they served as a guiding star and as motives for the activities undertaken in the organisation.

Table 1. A summary of the various stakeholders' goals in the project

Overall research objectives	• Improved work environment • Decreased number of sick leaves • Increased usability in the overall IT system support • Improved development methodologies when it comes to implementing usability • Increased participation from end-users • Increased skills and abilities to apply usability methods in the client organization • Increased understanding of the relationship between user-centred systems design and organizational change
Purpose of the paper	• Share experiences of introducing usability in a public authority • Capture experiences that could be generalized to other organizations • Categorize key success factors (best practices) and challenges or major pitfalls in the introduction of usability activities in the organization
CSN's overall business purpose	• Work smarter – use ICT better and adapted to humans • Better rules and rule application – a mutual interpretation of the rules • Better accessibility – particularly when they have high work load and have an openness when it comes to providing opportunities for the client to be interactive and keep track of their case • More efficient work when it comes to repayment and payment claims • Increase the commitment from the staff
Purpose according to the Development Council for the Government Sector	• The work environment at the public authority shall according to the employees have improved. • The total number of sick leaves shall decrease • The project shall have had an impact on the local union work to improve the work environment. • All this should happen by: • increasing the employees participation in the design and development of the new system, • improving the opportunities to influence the contents of work and design of the workplace, • applying and evaluating methods, • and, spreading relevant experiences to others.
Project purpose (according to the application for funding)	• to certify that the organization has a high level of usability in their IT support, in the long run, that thus can contribute to the fulfilment of their business goals about work environment and decreased health problems. • to create a foundation for developing a sustainable methodology to assure usability in the IT support systems. • to create a broad cooperation and a high level of knowledge in the field. • to make assessment and improvement of usability standard operating procedure within the organisation. • to develop and introduce an IT usability index and show that it has a positive development from 2005 to 2007. • to show a continual positive development of healthy work and low numbers of sick leaves. • to make the organization into one of the best organisations when it comes to developing usable IT systems.

THEORY AND RELATED RESEARCH

The purpose of this theoretical background is to provide an overview of some of the overarching theories that guide our work. Due to space there is not an opportunity to provide full coverage of the theories and related research that guide our work, nor can we go at any depth in these theories.

Usability Work and Organizational Change

The purpose of this paper is to makes some general conclusions on how to bring about change when approaching a large public authority with the concept of usability, usability methods and UCSD. However, organizational change is not possible to predict, or manipulate, and this study is not aiming at finding universally valid activities and principles for usability work that should or could be applied in any organisation. The context and the complexity of usability work and human activity must be taken into consideration, and therefore organizational change needs to be accompanied by improvisation, reflection and ingenuity. Organizations are characterized by diversity and differentiation, and humans create meanings and understandings of what organisations are, and what organisations do. Our stand point is that methods or advice aiming at organizational change must inform the planning of the work, but that they must be accompanied by an understanding and acknowledgement of the complexity of organizations and human activity as well as an understanding of the need for tailoring of activities as the organizational change project is launched. Hence, the conclusions drawn from our study must be seen as a material that needs to be tailored and modified according to the organizational context where it is to be applied by the reader.

Our view of organizational change is based on theories underpinning organisational theory stated above and our previous experiences when working in the area as well as related research on the introduction of usability work in organizations within the area of HCI. The related studies aim at giving advice on activities for the success of the introduction of usability work in organisation. Many studies on the introduction of usability work focuses on the developers or the system development projects, and the studies have found a number of obstacles to the introduction of usability work (as for example Boivie, 2005; Boivie, Åborg et al., 2003; Rosenbaum, Rohn & Humburg, 2000 and Swartling 2008) including resource constraints, resistance to UCD/usability, lack of understanding of usability concept, and lack of trained usability experts. Regarding a successful introduction of usability work the existing HCI literature prescribes for example education, usability champions; make a strong group of usability professionals, documentation of tools and methods, management support (Mayhew 1999; Rosenbaum, Rohn & Humburg, 2000).

Moreover, organizational change is dependent on the transition of usability methods from theoretical models to integrated activities in human activity. This transition is dependent on many things, some of which are training, knowledge and the sense making process of each individual. Studies hade illustrated that usability work as such is interpreted differently and that usability professionals adopt different strategies (Iivari, 2005).

Socio-Technical Systems, Participatory Design and Contextual Design

Socio-technical design is an alternative form of cooperative design focusing on the consideration of social and technical alternatives to problems (Catterall et al., 1991). They argue that:

Human and organizational issues cannot be considered in isolation from the technology. /.../ User-centred design implies the active participation of users in the design process /.../ should be comprehensive and not simply part of an end-

process evaluation procedure. (Catterall et al., 1991, pp. 256-258)

The socio-technical tradition has been developed through for example the ETHICS method (Mumford, 1993a) that is not only a methodology for Effective Technical and Human Implementation of Computer-based Systems, but also a clear personal statement of the philosophy of close cooperation with users that is so important for the approach (Mumford, 1993b). Eason built on this approach to develop methods that focused more on incorporating organisational considerations into the system design (Eason, 1988).

Greenbaum & Kyng (1991) coined the term Cooperative design to put even more emphasis on the social interaction between developers and users, as it is this creative process that provides the foundations for the development of the new technical and social system, and this is the approach that has come to be known as the Scandinavian tradition. Participatory Design (PD) is the term used mainly in the North-American setting to depict a design and development process involving extensive user participation in an exploratory, experience-driven design process (Blomberg, 1990) PD emphasize the dynamic learning process where designers and users are learning from each other.

PD means not only users participating in design but also designers participating in use. (Ehn 1993)

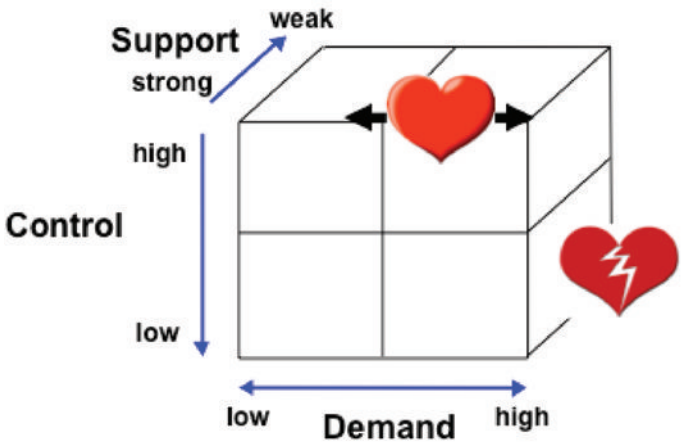
PD also has a political energy engaging people in the designs that affect the end users and their working conditions, involving everything from trade union to management and acknowledges that organisations and companies consist of different parties with occasionally contradictory interests. Routines, laws and regulations have been built up to handle situations where such interests come into conflict and to provide a way for trade unions' to bring democracy into work domains, but in the end cooperation and negotiations are the cornerstones for the approach.

The overall goal of PD is to improve the quality of work life for the users of the technology, a goal shared by both users and developers involved in the design activity. Worker empowerment is a central basic value in the approach, users act as fully empowered participants in the design process. Users are considered autonomous agents with the capacity to regulate and coordinate his or her behaviour and not as a passive element in a human-machine system (Bannon, 1991). PD consists of a common core of techniques supporting user involvement in work-oriented design (Crabtree, 1998). Future workshops, Studies of work, Mock-ups, Prototyping and Scenario construction are commonly used techniques that are employed individually at various, selective stages in the development, or in concert throughout development. PD also turns to ethnography to more thoroughly study and understand the users' work situation (Crabtree, 1998). Hence the users' work environment and context becomes central, which has provided the basis for the development of yet another set of techniques emphasising the context of use (Beyer & Holzblatt, 1998) and focusing on the customer.

Work Environment and Health

Work environment and occupational health problems are constantly increasing in computer-supported work. Most efforts to improve the work environment are focused primarily on physical aspects, and to some extent on psychosocial aspects (Sandblad, Gulliksen, Åborg, Boivie, Persson, Göransson, Kavathatzopoulos, Blomkvist & Cajander, 2003). However, society and working life of today implies an increasing level of stress, mostly produced due to psychosocial factors. Such factors can be a higher working pace, higher demands in work, lack of influence and control in work and need for social support (Karasek & Theorell, 1990). The human being is often able

Figure 1. The demand/control/support model adapted from Karasek & Theorell, describes healthy work characterized by a balance between requirements, control and social support. High requirements may be experienced positively, provided that the balance is maintained. Unhealthy or even dangerous work is when high requirements are badly balanced by low levels of control and social support. Hence the risks for stress reactions, health problems and illness in such a work situation increase.



to deal with high stress under shorter periods of time, but we now have a more constant stress load, affecting us during longer periods. Robert Karasek and Töres Theorell (Karasek &Theorell, 1990) developed an illustrative model describing aspects of healthy work that for a long time has been one of the cornerstones of our research (see Figure 1).

The model describes the work situation in relation to subjective experiences of demand, control and social support at work. Demands are the requirements laid upon the worker, what he or she is obliged to do, but also the demands the worker puts upon him-/herself. Control is the means the worker has to survey to be able to handle the work situation. Social support refers to overall levels of helpful social interaction available on the job from co-workers, supervisors and other recourses. The primary work related risk factor is the workers' lack of control over job demands and a feeling of lacking skills. High demands are not a problem, if they are combined with high control and strong social support. But, if demands become too high in relation to the control and social support the worker experience, this will cause high stress and increased health risks. According to this model, the most favourable situation is one characterised by reasonable high demands, high decision latitude and a strong social support.

It is not demands of work itself but the organizational structure of work that plays the most consistent role in the development of stress-related illness. Since this organizational structure is an eminently "designable" aspect of our industrial society, we are optimistic that new job redesign solutions can be found. (Karasek & Theorell, 1990)

Research show that increased computerization at a work place often results in experienced higher demands (Åborg, 2002). This is in itself not a critical phenomenon, but must be counterbalanced with increased control and social support. According to Åborg, today's situation is the contrary; in many working life situations experienced control together with so cial support is often reduced at the same time as the responsibility is increased (Åborg, 2002). This may lead to major problem in the work environment, as well as increased

risks for bad health and illnesses. When new work processes are designed, or when new technology is introduced, the aim must be to increase control as well as social support.

Usability and User-Centred Design

Usability and user-centred design are central concepts in our research. Usability is defined as 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction, in a specified context of use' (ISO 9241-11 1998). Please note that this definition includes the concept of utility or usefulness, often seen as separate from usability. User-centred systems design (UCSD) was originally coined by Norman and Draper (1986). They emphasized the importance of having a good understanding of the users (but without necessarily involving them actively in the process):

But user-centred design emphasizes that the purpose of the system is to serve the user, not to use a specific technology, not to be an elegant piece of programming. The needs of the users should dominate the design of the interface, and the needs of the interface should dominate the design of the rest of the system. (Norman 1986)

According to our view of user-centred system design (UCSD) it is a process focusing on usability throughout the entire development process and further throughout the system life cycle (Gulliksen et al. 2003). It is based on a number of key principles:

- **User focus.** The goals of the activity, the work domain or context of use, the users' goals, tasks and needs should control the development.
- **Active user involvement.** Representative users should actively participate, early and continuously throughout the entire development process and throughout the system life cycle.
- **Evolutionary systems development.** The systems development should be both iterative and incremental.
- **Simple design representations.** The design must be represented in such ways that it can be easily understood by users and all other stakeholders.
- **Prototyping.** Early and continuously, prototypes should be used to visualize and evaluate ideas and design solutions in cooperation with the users.
- **Evaluate use in context.** Baselined usability goals and design criteria should control the development.
- **Explicit and conscious design activities.** The development process should contain dedicated design activities.
- **A professional attitude.** The development process should be conducted by effective multidisciplinary teams.
- **Usability champion.** Usability experts should be involved from the start of project to the very end.
- **Holistic design.** All aspects that influence the future use situation should be developed in parallel.
- **Process customization.** The UCSD process must be specified, adapted and implemented locally in each organization. Usability cannot be achieved without a user-centred process. There is, however, no one-size-fits-all process.
- **A user-centred attitude** must be established. UCSD requires a user-centred attitude throughout the project team, the development organization and the client organization.

Our view of user-centred systems design is an elaborated version of the international standard for human-centred design, ISO 13407 "Human-centred design process for interactive systems" (International Organisation for Standardisation, 1999). ISO 13407 is an approach to human-centred

software- and hardware development that identifies four basic principles:

- active involvement of users and a clear understanding of user and task requirements,
- an appropriate allocation of functions between users and technology,
- the iteration of design solutions, and
- multidisciplinary design.

Human-centred design according to ISO 13407 involves: 1) Understanding and specifying the context of use, 2) Specifying user and organisational requirements, 3) Producing design solutions, and 4) Evaluating designs against requirements, to determine how to further pursue the development (c.f. Figure 2).

User Involvement

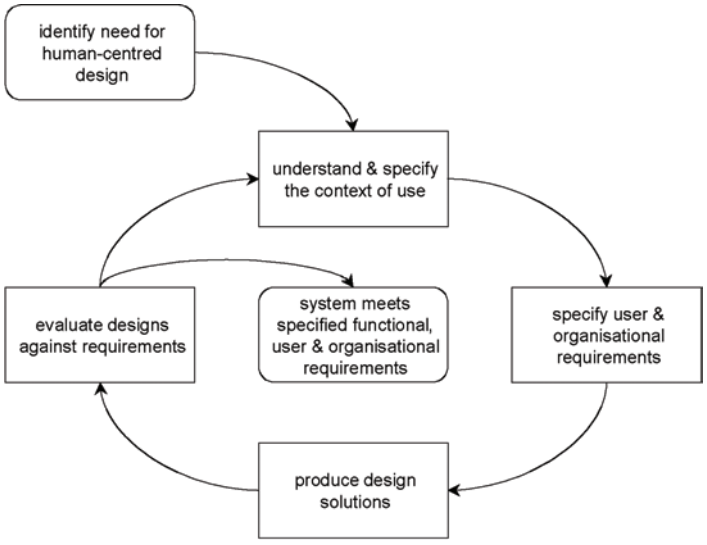
One of the main quality criteria for adapting an organisation to user-centred systems design is its ability to involve the users in the process. Even though this has been widely known for a long time, it still does not happen to the extent required for managing a sufficiently high enough level of usability in the systems developed. Involving users early generally has positive effects, but the role of the users must be carefully considered and more cost-efficient approaches for gathering user needs and requirements are needed (Kujala, 2003).

Managing user involvement is not easy, but still it is an important task. It is important that users as well as their managers are aware of the role that middle and top management play in supporting user involvement. Some guidance on management responsibilities and required actions as well as guidance on the representation process and the selection of users is presented in Damodaran (1996).

Related Research on Usability in Public Authorities

The context of managing this in a public authority forces particular consideration. Many public authorities have in-house development organizations, which in theory would facilitate developer-user communication (Grudin, 1996). But there are few studies focusing on the intro-

Figure 2. The ISO 13407 framework for "Human-centred design process for interactive systems"



duction of usability and user-centred design into the development context of a public authority. Experiences from the Italian public administration show that most acquisition of computer products are made in terms of ad hoc development, which they claim could constitute a good condition for usability purposes with a constant contiguity between designers and users, but that this did not lead to user-centred projects and usable products (Catarci, Matarazzo & Raiss, 2002).

On the other hand, the Norwegian experience is that user involvement is regarded as important by e-Government project leaders, but that user involvement often is conducted according to the participation practice of industrial democracy rather than the processes and methods advocated within the traditions of HCI (Fölstad, Jørgensen & Krogstie, 2004).

However, we would argue that the issues surrounding user participation is connected to political, organisational and attitude-related issues in the public authority. The methods provided by the HCI field only provides the methods for the participation, but that the effect of participation more has to do with other issues. This is in line with (Bossen, 2006) who argues that although participation is valuable "it must also include critical conceptualizations of participation, power, methodology and knowledge". In their study they conclude that users that were involved in the design process did not have the power to decide.

Usability Professionals

One of the most common ways that a public authority tries to introduce usability into their organization is by hiring a usability professional. In one of our previous studies (Boivie, Gulliksen & Göransson, 2003) we interviewed usability designers from public authorities and from contract development organizations to understand the usability designer role. It turned out that the usability designers were mostly working on their own (Lonesome cowboys) and that strategic issues consumed a tremendous amount of time. Several other public authorities have also employed usability experts, and they tend to make the same experiences. One risk when employing usability professionals in such an organization is that they risk becoming a replacement for user involvement. The expectation is that they should inform the designers and then comment on the solutions provided rather than actually contributing to the development of the system (Iivari, 2006).

Industrial Attitudes Towards Usability

Attitudes towards usability in industry are slowly changing. We see a slow progress from reactive usability engineering approaches focusing on evaluation as a means for improving already existing designs to a more mature user-centred design approach focusing on usability throughout the software development lifecycle. For example, a survey on usability in the software industry in Norway investigating a) to what extent software companies generally acknowledge the importance of usability and prioritize it in their industrial projects and b) to what extent software development methods and usability was perceived as integrated, concluded that although there is a positive bias towards usability, the importance of usability testing was perceived to be much less than that of usability requirements and that companies perceive usability and software development methods to be integrated (Bygstad, Ghinea & Brevik, 2008).

The Scandinavian approach to software development has different roots than the more test-oriented approaches stemming from the development in the U.S. According to the Scandinavian tradition involving users is the traditional way of performing development and thereby deeply rooted in the Scandinavian culture. These approaches go under the name cooperative usability practices (Borgholm & Halskov Madsen, 1999).

Designing Future Work

Introducing a new or modified IT-system into a workplace always leads to a number of consequences (Greenbaum & Kyng, 1991). Intended or not, work organisation and work practices are affected. We can sometimes see positive effects after the introduction of new technology, but there are also numerous examples of new technology producing negative effects. In many cases the new IT systems cause disturbances, inefficiency, frustration and stress (Åborg 2002). Thus, to achieve positive effects from the new IT-systems, it is necessary to simultaneously develop the work organisation and the work practices. This means that it is not enough to introduce IT-systems that support the organisation's current work practice - the focus must be on future practices. It is also important to use the full potential of the new technology to improve the organisation, work practices and work environment. If not, the introduction of the new systems will only "pave the cow paths". Technology should not only be seen as a tool to rationalize the present organisation, but also as a facilitator of positive changes on a broader scale. It has been shown that it is only when the organisation, practices and competencies are developed in parallel to the technology that beneficial changes will be achieved [Brynjolfsson 2000]. If technology is introduced without considering the new emerging organisation and the way work will be carried out, the future work will merely be what remains when the technological changes have been implemented.

In summary, we have found that three different perspectives must be considered:

- Design for future work requires a model of the future work.
- New technology should be seen as a facilitator for beneficial changes.
- Including work environment issues will promote sustainability in the future organisation.

Summarising the Theoretical Background

The project described in this paper has been based on extensive knowledge and previous experiences from research describing the relationships between the organisation of work, aspects of the design of the IT systems (usability, etc.), effects on work efficiency, individual effects and issues relating to work environment, stress, unhealthy work and mental work load. As described in this theoretical background we know much about these relationships, on how we balance demand, control and support in the work situation and the effects on the individuals in terms of mental workload, stress and un-health. The conclusion is that if we focus on developing work and IT-support in such a way that it contributes to a high level of usability and a balance between demand, control and support it will positively contribute to a good work environment, stress and health. You cannot build in a good environment afterwards; it needs to be in focus from the outset of the project. How an individual worker experience a work environment can never be seen in isolation, it needs to be viewed in relation to the work, the organisation, the tools, etc. No work environment problems are perceived as more severe than if the worker feels that he/she cannot do a good job or that he/she does not perform as good as hey would be able to provided the support was better. If there are hindrances in the work situations, such as an insufficient IT support system, this will have direct consequences on the work environment and eventually negatively affecting the user's health.

METHOD

One of the major reasons for the selection of methodology is the way in which the project was set. We became involved with the organization with the specific goal of helping them increase the usability focus in the development work and

to help them create a better work environment by focusing on improving their computer support and the methods they use to develop IT.

The Development Council for the Government Sector (www.utvecklingsradet.se/3630) provided funding to the public authority for hiring researchers. They were explicit about not funding research as such, but gathering of research data throughout the project was still part of the agreement.

The setting of the project was not uncomplicated, and the organization often saw the researchers as consultants providing specialist knowledge in a new and innovative field. At times this could cause tension, as we did not want to compete with traditional consultants, performing activities that could have been done by them. Therefore, the activities we engaged in were selected together with the organisation, and we focused on the aspects that would contribute to new knowledge and understanding for scientific community. We did not specifically engage in performing traditional HCI or usability activities, but rather help them using their competence to do so. In the interviews several pointed out that their expectations were that we would be more of consultants and act less as researchers in their activities. However, there was an understanding that we needed to collect data and an openness towards publishing about our findings in the scientific community.

When cooperating in this way and having a clear agenda to develop the organisation based on basic knowledge and values, the research approach that fits best is *action research*, as we as researchers are a part of the process we study. The following sections will describe how the action research approach has influenced the activities that have been undertaken and then subsequently how the entire project was evaluated.

Overarching Method Description

The overarching research approach in this project, spanning four years, has been action research. What is perhaps most distinguishing with action research is that it has two goals as described by McKay and Marshall (McKay & Marshall, 2001), i.e. one research interest and one problem solving interest for the organization in which the research is performed. This unique feature of having two goals makes the action research framework suitable for research in organizations. The researcher with her knowledge and perspective, together with the practitioner with her knowledge and perspective, can change the course of events at hand. This participative view of research is further explained in the following quote:

Action research is a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities. (Reason & Bradbury, 2001)

Hence, the research in this project has been planned and conducted together with participants from the organization, with a project group as the main point of collaboration. The project at large has been following a project plan, and the project group has been meeting regularly in order to evaluate the situation and plan actions. Consequently the action research project has been an iterative process (Avison et al., 1999) where the course of events in the organization has been informing the researchers and the project group when planning further work. However, the researchers have not only had the role of project members in the project, but rather several roles, as described by Rasmussen (Rasmussen, 2004). For example, one researcher had the role as a mentor for key participants in the project during one year, other researchers were educators, facilitators, etc. The data collection from the project has been rich, ranging from

researchers' diaries, field notes, participative observations, and interviews to surveys and documents used in the organization. The research data has been discussed continuously within the group of researchers, and analyzed during the project in the scientific writing process leading to several research publications (e.g. Cajander et al, 2006)

Moreover, we adhere to the quality criteria and principles established by Klein and Myers (Klein and Myers, 1999). These criteria include:

1. The Fundamental Principle of the Hermeneutic Circle
2. The Principle of Contextualization
3. The Principle of Interaction between the Researchers and the Subjects
4. The Principle of Abstraction and Generalization
5. The Principle of Dialogical Reasoning
6. The Principle of Multiple Interpretations
7. The Principle of Suspicion

We also adhere to the criteria established specifically for action research by Reason and Bradbury (Reason & Bradbury, 2001). These action research quality criteria are further explained by Rasmussen (2004):

- **A relational praxis.** The research should strive to improve the social capabilities of the participants, enhance their skills in communication, problem solving and collaborate.
- **A reflexive-practical outcome.** The research should strive to make the participants act and think in new ways. Participants in an action research project should preferably improve their abilities in reflecting on their own work.
- **A plurality of knowledge.** In action research, there should be an acceptance of different kinds of knowledge. The knowledge gained in an action research project should be anchored in the knowledge of the participants, in their own language and experiences.
- **An engagement in significant work.** There should be a clear attention to the choice of subjects that the researchers and co-inquirers attend to; these choices should also be clearly stated.
- **An emergent inquiry towards enduring consequences.** The aim of action research is to produce long-term results that exist after the researchers have left the situation.

Our research leads to contextual in-depth knowledge, and the results are not easily generalized. The researchers, the context, the organization and the conditions, under which the research takes place, colour the results. However, we see that this kind of research consist of a large number of cases that are both similar and unique. Consequently, we believe that the reader will find this knowledge applicable in other settings trough a careful transfer of the results.

Evaluation Method Description

The data used in this paper is derived from an evaluation performed at the end of the project, as well as through our experiences from working with the project. Moreover data has been retrieved using the usability index created within this and other projects of ours, funded by the same organization. The evaluation were prompted from the organization, but conducted by researchers from our group. The evaluation was based on 36 semi-structured interviews, as well as some numerical data from the organization, such as sick leaves and co-worker index (see next section). The interviewees were selected by their roles in the project, to cover all three years, as well as those not involved in the project to see how far the results from the project has reached. One additional interviewee was selected during the interview process; since several interviewees had mentioned him as an important factor in the future work with usability

issues. In general two researchers were present at the interviews, except three interviews that were performed by phone. All interviews were audio recorded and notes were taken, which both were used in the analysis of the material performed by the authors. The interviews were conducted between the 29th of November 2007 and the 6th of February 2008.

Statistics on Sick Leaves

Given that the major goal of the project was to improve health conditions and reduce the number of sick leaves, statistics on these things have been acquired from the organization.

Method for Analysis of Results

The data analysis has been made in different steps. First the research group compiled the data and found themes and understandings of the project work, and a project report was produced. In the writing process of this project report the material from the project was gone through, as well as the interviews. The analysis was partly made together with the whole research group in workshops and post-it sessions, and partly by the individual researchers. The different researchers focused on writing about their part of the project, but all parts of the report was read and commented on by all researchers. As a second step this report was presented to the organisation, and commented on by the organisation in a workshop. This project report and the input from the organisation constitute the basis of this research report.

CASE DETAILS

About CSN

This research study was conducted in cooperation with the Swedish public authority that handles financial aids for students, here called CSN. With offices in 13 cities in Sweden, the organization employs more than 1100 employees of whom 350 are situated at headquarters. Daily work at the authority is computer intensive, and the case handlers spend almost all day in front of computers. Case handler refers to a civil servant working at a public authority with case handling. Computer support that is used in the authority is mainly developed in-house, and a majority of these IT projects start because of changing legislations that influence the prevalent work practices. Consequently, time is a major factor controlling most IT development since the deadline of the implementation of a new legislation is fixed. IT projects have participants from different parts of the organization, as in a matrix organization, where each department has their role and responsibility. Officially, all projects are run according to methods provided by the business development department, and the IT architecture department. These include methods for acquisition, project management and systems development. In short, these methods provide a common framework, with descriptions of milestones, decision points as well as templates and role descriptions. Systems development is based on the waterfall model, and has few activities focused on the system usability.

About the Development Council for the Public Sector and "Satsa Friskt"

Sweden has a long tradition of cooperation by the social partners in the labour market to improve the work environment and create productive and efficient workplaces. The Development Council for the Government Sector (Utvecklingsrådet för den statliga sektorn) is a resource for local development activities in the Swedish government administration. Government agencies may obtain financial assistance for their own development projects, or benefit from development activities conducted by the Council on a national level. These activities encompass the whole government sector, with a

total of around 240,000 employees – roughly 6 % of the Swedish labour market.

The purpose of the Council is to facilitate for local development efforts in the form of financial support, arrange working networks between government institutions, provide guidelines, books, arrange seminars and conferences, etc. All activities are based on the cooperation between the social partners, locally and at the central level. Representatives of employer and employee organisations form steering committees and work together in central and local projects. The Council provides funds for project management, documentation and evaluation; the local institutions usually provide resources of their own to participate in the development projects. Projects conducted jointly by employers and trade union representatives at the workplace can receive financial assistance. Local development activities may comprise development of the organization of work, skills development, participation and cooperation, leadership, work environment, diversity, ethical and gender issues, efficiency and quality of activities or pay formation. Cooperation across government agencies is enforced. The financial basis of the Council comes from funds but also from contributions each year from all government agencies.

The Council also conducts several central development programmes. The objective is to develop methods and provide information to support work of development at workplaces in the government sector. These programmes often involve both practitioners and researchers. The nature and direction of these activities vary over time. They may focus on forms of cooperation and openness, increasing equality of opportunity and improving work environment and work organisation to reduce absence through illness and stress. The government agencies acquire the results of this work and actively participate in various projects.

The Council has made an initiative to support public authorities' work to improve their work environments and decrease the frequency of sick leaves. That is the reason why they started the development program "Satsa Friskt" (www.satsafriskt.nu). The program funds and provides expert help to various projects within different public authorities. The program spans a number of different areas; organisation, management, participation, rehabilitation, threats and violence, health, physical work environment and Humans and IT. Within "Humans and IT" a number of different projects have been conducted since 2004 at several public authorities.

The public authorities that participated were themselves responsible for the projects at their own organisations. Satsa Friskt organised experience exchange and seminars for the participating authorities as well as for others. Every project must have genuine management support and active union participation.

Pre-Studies of 6 Public Authorities

From Uppsala university we conducted qualitative pre-studies at 6 public authorities of which we conducted longer cooperation projects with 3; CSN, SMHI and the Migration Board. The overall purpose was to investigate the ability of future cooperation on usability, user-centred design and work environment considerations. A summary of these pre-studies has been published in (Cajander, Boivie & Gulliksen, 2008). On the detailed level the purpose varied between the different authorities but some common questions concerned business and systems development processes, long term goals for development of future IT support systems, competence development on usability and work environment issues in IT-supported work and opportunities to judge and measure usability problems in IT usage.

In the pre-study data was collected through semi-structured interviews with 127 informants, and from a case study of an ongoing project in one of the organizations. During analysis of data, we identified problems with attitudes and perspectives about users and their work, such as the strong

focus on automation, efficiency, and surveillance of work, which shaped the development of new technology and ultimately shapes work situations of users. Furthermore, we identified that the work of civil servants was frequently discussed in terms of simple steps and procedures that can be predefined and automated in accordance with clearly defined rules and regulations. As a consequence of the pre-studies we suggested among other things user-centred design, education and pilot projects to address the problems and to improve the understanding of the users' needs and work practices in development projects (Cajander, Boivie & Gulliksen, 2008).

Project Purpose

According to Satsa Friskt the goal of every project activity should be to achieve measurable positive effects in terms of improved work environment and decreased frequency of sick leaves by:

- increasing the employees participation in the design and development of the new system,
- improving the opportunities to influence the contents of work and design of the workplace,
- applying and evaluating methods,
- and, spreading relevant experiences to others.

CSN's goal with the project was through external support to create increased knowledge, improved methods and processes, and in the long run a good, sustainable, efficient and healthy work. The external research resources that were involved would support this process and focus on how knowledge and experiences can be transferred and made useful to others in the public authorities development processes.

The AvI (The internal name of the project at CSN; AvI – Användbar IT) project was also meant to broadly work for participation and communication within the field. Therefore an education and information plan was established and a number of workshops and information activities were launched.

The AvI project has had extensive union involvement. System usability and the co-worker's work tasks using the computer support system are issues of great concern from the unions. Usability was already form beforehand identified as an area of improvement. The co-worker organisations had over the last couple of years collected opinions from the co-workers concerning their IT work situation and they knew quite well their member's opinions and about their problems. Having the union organisations actively cooperating with the employers was considered important for the users' requirements to be dealt with in the best possible way.

The project involved 4 main activities and the results from these are reported below. These were: Business development leading to a good work environment, iterative usability analysis and IT usability index, systems development processes and long term goals leading to an attractive work environment.

Initially the responsibility for the project rested with the HR department, but it was unique in that it crossed many borders. Project participants came from all parts of CSN. 2005 and 2006 were knowledge building and performance and 2007 meant follow up and knowledge transfer. (Table 2)

RESULTS

Given the size of the project both in number of years, number of researchers and other staff involved and number of sub activities conducted, we can not provide a full coverage of all results from all sub activities. We have therefore made a selection of the results based on what we consider are the major activities or activities that have had an interesting impact on the development of usability and work environment within the organization.

Table 2. A table summarizing the results in terms of organizational support, process support and individual support

Level of influence of the results	Specific methods, issues or results obtained
Organizational support	• Work Environment, Health and Stress • Organizational Aspects and Communication • Business Development • Usability Policy – Strategic support for usability
Process support	• Long Term Goals – The Vision Seminar Process • Usability index – A method to assess the level of usability • Work Environment Consequence Analysis – a method to predict work environment effects of new computer systems • Usability Expertiese and Usability Experts • Revised Development Processes – pre-study, aquisition, business, system development • Iterations – and the problems of making it happen
Individual support	• Education and Information Activities • Usability Training Course for Systems Developers • Usability Coaching – Individual coaching from a usability perspective • Management Support and Sustainability of the Results • Attitudes and Basic Values – and their effects on overall development

Many of the sub activities have been, or will be discussed in separate publications. In this paper our purpose was to give an overview and discuss possible interrelationships on an overall level and in what way they have contributed to the overall goal of the project both from a research point of view and from the desired effects from the organization. We decided to structure the results according to the following three categories;

- Strategic aspects – that is aspects relating to what organizations needs to do to succeed
- Process aspects – relating to how these goals are to be fulfilled and which methodologies to use, and
- individual aspects – relating to who performs the operations and what effects these individual characteristics have.

Many of the results we have obtained fit under more than one of these headings, but below we structure the findings according to which category they mainly belong to.

Work Environment, Health and Stress

All major activities in the AvI project aimed towards improving the work environment and the worker's wellbeing and health, the major effect goals of the project. Focus was on business and organisational development, IT systems development, usability issues and evaluation, establishment of future visions and competence development, etc. We were fully aware that it would be difficult, within the timeframe of the project, to show any measurable effects on the workers' health and wellbeing, for example in terms of the number of sick leaves. There are so many other things in a work situation that may influence the number of sick leaves that you may never be able to prove a causal relationship in this matter.

The evaluation of the work environment was done in three different ways.

First of all the interviews brought up these issues, which provided us with some feedback. The indirect way of working in the project was brought up as one of the factors clearly improving the

work environment, e.g. focus on the work and IT support with the purpose of improving efficiency, work environment and health. The knowledge on these issues seems to be widespread within the organisation. Many of the respondents were aware about the relationship between these issues and consequently the importance of considering usability and work environment issues in system development and deployment has increased significantly as an effect of the project.

We now have checklists for how to work, how things should be viewed and when, for it to be as good as possible in the end.

Second, we applied the usability index (see below), which has a number of questions relating to work environment, stress and health. The aim of this instrument is to use it repeatedly over time to be able to monitor the work environment and identify problems over time. The measurements done so far are presented elsewhere.

Third, we try to look at the development of some health related key figures; even if these directly cannot be proven to connect with the activities performed they are nevertheless interesting. The figures we have access to are annual measurements of sick leaves and from the development of the Co-worker index (see Tables 3 and 4).

Statistics from CSN show that out of the total number of staff time in 2007, 10,6 % disappeared for vacation, 7,2 % on parental leave, 3,6 % in sick leave and 3,9 % in other leave. The average age in the organisation is 43 years, which is significantly low in comparison to other public authorities.

These figures are relatively low and also show a decreasing trend, both totally and within each of the age spans. It is not possible to further discuss the causal relationship between the activities conducted within the AvI project and these figures.

The goal for CSN has been to maintain and increase the engagement and involvement of the co-workers. To follow up on the co-worker's view on CSN as an employer, the organisation frequently run co-worker index surveys. The survey conducted during 2007 maintains CSN's high position when it comes to co-worker engagement; the co-worker index was 42 of 60 in 2005 and 43 of 60 in 2007. The following quote describes CSN's assessment of the effects of the AvI project:

In the long run CSN considers that the effects of the usability work will be that the IT systems of the authority are improved, both from the perspectives of the task to be solved and from the perspective of the co-worker's use situation. The needs for changes late in the project or above all after the implementation of the systems in the work will inevitably decrease, which means that CSN are able to introduce IT systems that are more stable and better adapted to the users – something that in the end means lower costs. CSN will in the future co-worker surveys measure the development of the usability of the systems. The tools and processes used may also be applied when developing services for external clients and contribute to better services for the general public.

Table 3. A table showing statistics on the number of staff at the public authority

Statistics of staff	**2005**	**2006**	**2007**
Number of employees	1.024	1.023	986

Table 4. A table showing statistics on the number of sick leaves

Sick leave (% of available resource)	**2005**	**2006**	**2007**
- female	5,1	5,1	4,3
- male	2,7	2,6	2,3
Total sick leave	**4,3**	**4,2**	**3,6**
Sick leave per age group			
- age group 29 years or younger	2,8	2,6	2,0
- age group 30–49 years	4,2	4,3	3,4
- age group 50 years and older	5,3	4,9	4,8

Organisational Aspects and Cooperation

Does it matter which part of the organisation that runs an organisational change project and does this affect the results? Unlike most projects at CSN, the AvI project started as an initiative from the Human Resource department with the HR manager as the procurer. During the interviews many of the respondents emphasised that they thought it to be strange that a project of this size was under the control of the HR department and not from the Development department that was in charge of most projects of this size. Some even went as far as stating that it was problematic for the project to manage the changes required since the HR department do not always have the same status within the organisation as a development department has. Opinions was expressed that given the HR belonging of the project it was not integrated with the other change projects within the organisation, thus having low impact. This was also our impression as we could follow the difficulties for the project manager to get a genuine dedication from other departments for the project, as they were to staff the project. Even if opinions were raised initially about the lack of distribution of responsibilities and deficits in the control of the project, things improved throughout the project.

Despite all the criticism for managing the project from the HR department many also said that it might have been necessary, since the project might not have happened if it had not been for the initiative from the HR department. Given that the project initially was seen as a work environment project it was natural to place it at the HR department and without the initiative and engagement from the HR department, the project would never have happened. Likewise many think that it takes quite a bit of flexibility and openness to change for a project like this to happen. The Development department consider it more natural to control and manage the project from their side since it is about business development.

We would have seen it as any project. In the end it is about how you professionally conduct the project. […] This is a business development project and we run numerous such projects.

It is impossible to say what the project would have been like if it had been run from the Development department, but everybody agrees that it is crucial to involve the Development department actively early on in the project and that that should be a critical factor if implementing similar projects in other public authorities in the future.

CSN can be characterized by differentiation and diversity, as different subgroups has different traditions, languages, and abbreviations. There were some clashes and conflicts during the project and we experienced some resistance towards interdepartmental cooperation. One commented that it is more about how things are expressed, than what is the essence of the message and that:

A majority of the work has been about 'planting' ideas with others in a way that will make them think that it is their own ideas.

In addition it became clear that it is difficult to bring new ideas of working into on-going projects as the time and budget for the specific project is already set, and the usability activities are seen as changes of plans.

Many claim that the climate for cooperation within the organization has significantly improved due to the project. The improvement consists of an increasing understanding for how different parts of the organisation work. In addition there has been an increasing tendency to involve other parts of the organisation in projects. For example, the Development department has substantially started to involve case handlers in their work, have systems developers do field studies or let case handlers do exchange work at the main office.

Active union participation was one of the conditions from the Development Council for the Public Sector who provides funding for the

project. The unions participated actively in the projects all the way from the early initiatives to following and taking part in the project work.

The evaluation shows that the union cooperation worked well. The union representatives contributed actively and substantially in all parts of the project and the relationship between the unions and the employers have also improved and they have mutually learned more about each other. The union representatives gained insight in the role they can play when working with requirements specification and which role they could play when it comes to acquiring new IT support systems. The project helped clarifying work environment issues in computer supported work. The unions intend to follow up what happens after the project is finished concerning computer supported work in relation to work environment damages, improvement of work conditions and work efficiency.

Business Development

The purpose with this activity has been to make the business development within CSN result in efficient business and a good work environment through the introduction of user centred systems design. This work has meant process analysis, process development, and modification of pre-study-, procurement- and project management models. Among other things this work has meant taking part in the development of methods for requirements elicitation, system procurement as well as participation in the introduction of improvement management teams. Mainly these things have happened in on-going pilot projects where we participated. However, this activity was hard to initiate, and it was not until the end of the project where any impacts could be noted. Even so, many stressed in the interviews that these activities were among the strategically most important and that they have resulted in the most important changes. The Development department was in charge of these activities.

The most important effect is on the Development Department and the new ways of acquiring requirements. […] The consequence is a clearer focus on deliveries and by defining the importance of having a user perspective in analysis and pre-study phases.

But, on the other hand changes were already initiated at the Development department in terms of re-organization of pre-study and procurement models. Some of the interviewees from the Development department claim that the changes of these models would have been made despite the project. Moreover, some of the interviewees describe that the Development department has always worked with user involvement, but that the AvI project meant a more structured way of working with these issues. After the AvI project, usability became a natural part of the development. The new ways of working means involving end users in a reference group and field studies to inform all pre-studies.

During the AvI project an improvement team was organized and associated to the Development department. This team consists of experienced case handlers representing all offices in the country. Their responsibility is to prepare the suggested improvements from the end users of the computer systems. The improvement suggestions are submitted through a web page on the intranet. During the evaluation interviews we understood that the process of gathering and dealing with improvement suggestions was something that significantly had improved due to these improvement teams. Previously many case handlers experienced that they did not know whether their improvement suggestion was read, considered or resulted in changes. The management of the submitted improvement suggestions became more transparent and the feedback to the users was significantly improved. Moreover, all changes are handled and discussed within the improvement teams, and some improvements result in further elaboration by working groups. However, after the first mail

feedback to the case handler there is no further information given as to what happens to the improvement.

Long Term Goals: The Vision Seminar Process

What should characterize CSN's work environment and work processes in the year 2010? The purpose with this activity was to develop a vision of the future work within CSN, visualising long term goals.

A vision seminar process was conducted during 2005. A working group developed the case handler's vision of the future work in terms of important aspects on the work and scenarios for this work. The staff was informed about the contents of this work in information meetings at the local offices. The long-term goals were then taken care of by those in charge of the development activities within CSN.

The vision seminar process (VSP) has been developed over several years in connection with different case studies (Hardenborg, 2007). The process is built up as a series of seminar meetings. During these meetings, a work group of user representatives meets together with usability experts who act as process leaders. The process must be allowed to extend over a longer period, as time is required to gain new perspectives on one's daily work practices and to be able to reflect upon these practices. Moreover, it takes time for all participants to be comfortable enough to be constructive and able to shape their future organisation and work practices. Preliminary ideas must be allowed to mature and be successively revised.

Each seminar during the process should last from a half day to a full day, at an interval of two to three weeks. The number of seminars is chosen based on objectives and needs, all well as on available resources. However, we find that four seminars seem to be a minimum, and often a longer series of meetings is needed.

During the seminar series, a proposal of the future work process is developed successively, through a variety of structured discussions. Initially, discussions deal with analysis of the current situation as well as broader visions about the future work. These discussions are then narrowed down and made more concrete. As with the concept Future Workshop (Jungk and Müllert, 1987), envisioning helps the participants to think "outside the box" and inspires new ideas that, with some modification, often can be put into practice.

A vision seminar process should be pre-planned from beginning to end. However due to the nature of the seminar process, there must be room to some extent for improvisation, changes in scope and revision.

The VSP is a mutual process where participants and process leaders are jointly learning and reflecting (Schön 1995). During the seminars participants are triggered to reflect upon their work practice. They explain, provide details and discuss with the process leaders as well as with each other. The practitioners participating in the VSP need to step back from their normal, everyday work and discuss it from an outside perspective. Moreover, we encourage involvement of their colleagues (those not attending the vision seminars) and discuss with them the topics that have been dealt with during the seminars as well as in the given assignments. Hence, we require that the participants in the seminar reflect about what they are actually doing in relation to what has been discussed during the seminars, while at the same time carrying out their usual work. Participants are then encouraged to bring their reflections and ideas back to the next meeting, thus making a valuable contribution to coming seminars.

Process leaders can also benefit from a reflective process between the seminars. They have responsibility for documenting the discussions. The act of documenting is in itself a reflective process that helps the process leaders to evaluate their efforts in previous seminars while generating new ideas about how to plan the next seminar in

detail. When the documentation is done, it is sent out to the work group for a review before the next seminar. This also encourages further reflection.

The documentation procedure has several benefits. When they write their own documentation and then read the documentation of the other group, both the work group and process leaders reflect on what has been done during the latest seminar. Our experiences are that if a seminar starts by reviewing this documentation, seminar work can thereafter continue efficiently - almost from the point where it ended at the previous seminar. Furthermore, this routine saves time by encouraging the work group to engage in a thought process about the meetings, during the interval between the seminars.

When proposing a new way of working, it is essential to have an understanding of how work is currently being carried out and to preserve the good qualities of the current work process. Since the important situated qualities of work are hard to find solely in a seminar context, it is therefore beneficial to the VSP to use additional methods such as interviews, field studies, visits to other workplaces and participatory observations carried out by the process leaders. The results produced by such activities serve as input for further discussions in the seminars. In this way, the VSP strives to find and map out both the organizational view of work as well as the activity view.

The work that is carried out and the knowledge that is accumulated during a vision seminar process must be documented in order to be shared with others and retained when the process is completed. We find the importance of documentation is twofold. First, the very act of writing the documents facilitates reflection. Secondly, the documents themselves serve as a concrete result of the seminar process, describing what has been agreed upon during the process. The documents should be seen throughout the process as living records and the following four types have proved to be suitable for the VSP:

- Documenting general prerequisites for the organization's future development. Descriptions of higher-level plans for the organization constitute a base for proposed future solutions. Such organizational plans are usually available at different management levels. In Sachs' (1995) terms, this becomes an organizational view of work in a future perspective.
- Documenting important aspects of future work. A description of the proposed future work in terms of characterizing aspects. The described aspects must comply with the prerequisites described in previous report.
- Documenting scenarios describing future work, based on the aspects of future work. They are practical descriptions of daily work situations illustrating the proposed future work. Scenarios are preferably made up as written stories, but it can be advantageous to complement the written text with pictures, shorter movies or dramatization.

A vision seminar process is most often the beginning of a process of change and something that aims at producing prerequisites for future information systems and organisational development. Depending on the purpose of the VSP, results can have their main focus on the prerequisites for forthcoming organizational development or on the design of new IT systems.

The work to establish the long-term goals was performed in a rather ambitious manner with a clear and sound plan. The purpose was to develop visions of the future case handling work, including such requirements on the IT system that efficiently could support the future work. There were no tight limitations in the scope of this activity; the purpose was to look at all types of case handling work within the organization. The project was conducted in 2005. It was planned for 3 phases. Two process managers, researchers, participated in every meeting in all parts for the projects.

At CSN the VSP was planned to be performed in three consecutive steps. In step 1 a small group of persons from a more strategic management position specified prerequisites and limitations for the coming vision process. In step 2 a group of 5 case handlers from the organisation performed the seminar process, as a series of 5 full day workshops. During the process the group described threats, desired scenarios, the existing computer systems, requirements for future work processes and computer systems. The group also produced a set of scenarios that illustrated how the work could look like in 4 to 5 years from then. The third step was never effectuated since the management decided that the time was not suitable for this. During the planned third step the described requirements and scenarios for future work and systems should have been distributed to all different departments for discussions, analysis and critique. Instead of the planned third step the management decided to hand over the documentation from the seminar process directly to all units and individuals responsible for development of organisation, competencies and IT systems.

The specifications and the scenarios of the proposed future work at CSN contained several rather innovative ideas. Examples of this are organisational changes, changes in work processes and competencies where more general activities and skills were proposed and new information systems with a more complete presentation of information of each individual customer was in focus.

During the evaluation many stressed the importance of the specified visions and scenarios. One important aspect concerned the fact that when new information systems are being developed this takes a long time, often 2-3 years. When the new systems are implemented, the situation is different from now, and it is important that the future work is used for specification of the new system.

You rarely think about that the systems CSN develops today will not be used within the next three years.

The fact that the third step was never performed has been lively discussed. Some are disappointed while others realize that the organisation was not ready for such an ambition process.

The long-term goals were so broad so the usability aspects were totally forgotten.

We have learned that it is important to precisely specify the purpose of the VSP before it is initiated. The ambition here was high, and this resulted in rather broad specifications and scenarios concerning the future work and systems. The organisation was not ready to receive such far-reaching visions. A strict focus on the need for more restricted organisational changes and improved information systems had perhaps been more beneficial.

The long-term goals could have provided more of a structure on the rest of the main activities.

In different development processes at CNS, the result of the vision seminar process has been used in a fruitful way. We have also seen that the experiences that it is possible to base development on visions and scenarios like the ones produced by the VSP has inspired the development department at CSN to adopt the methodology.

Usability Index: The AvI Index Tool

The purpose with this activity was to create a tool to be able to quantify usability and usability problems in existing IT support systems. We developed a survey based analysis method, called the AvI Index, and conducted evaluations with the method on several occasions. This has resulted in a sustainable approach to assess the system usability that has provided increased knowledge on how to perform usability evaluations, how to interpret the results and manage changes.

The AvI index is based on a questionnaire that has been construed in two different versions; one long (46 questions) and one short version (16 questions). The main aim of this tool is to get a quick and rather synoptic picture of the usability of an already deployed system, through the opinions of

users themselves, or to get a general picture of the usability level in an organization.

The main idea behind this questionnaire is that usability is dependent on user participation during system construction (Development subscale), on supporting work tasks (Use subscale), on acquiring knowledge and skills (Competence subscale), on contributing to work effectiveness (Utility subscale), on promoting healthy work environment (Stress and Health subscale), and on facilitating cooperation and coordination (Relations subscale). Avi Index is supposed to assess all these six variables, which are different aspects of the underlying main factor, that is, usability.

Three different versions of the questionnaire have been tested on system users. Depending on the results, the questionnaire has been successively changed and developed after the first and the second tests. The last two tests were applied on the same work task: handling of e-mail correspondence issues. The tools used for this task had been developed between the last two test periods of the questionnaire. It was influenced by expert evaluations, conducted independently of the AvI Index questionnaire and of the participation of the users.

The results of the last test were positive. Internal homogeneity in each subscale was high. Cronbach's α varied between 0,83 and 0,99. The six subscales were also highly correlated. Correlations varied between 0,37 and 0,92. Homogeneity was higher in the final version compared to previous test versions pointing to the fact that the questionnaire has successively been adapted to be a reliable assessment tool of usability.

Since the IT tools used were developed between the last two tests it was expected that the usability score would be higher in the final test. Indeed the results showed a higher overall usability score, 3,0 in a scale from 0 to 5, compared to 2,6 in the previous test that were conducted before the changes in the system took place. The same tendency can be found for each subscale too, except for Development subscale were the focus was on user participation. This result has been stable on a significantly low level, 1,3, both after the second and the final test. But this was expected since there was extremely low user participation in all change and development processes. The validity of the questionnaire is supported by these results, which clearly showed that the instrument could assess differences in usability as an effect of system changes and development.

AvI Index, the long version, can be used as an instrument to assess usability during system development processes, and to support all stakeholders, users, buyers and engineers. Particularly engineers need reliable instruments to use for obtaining knowledge from users on how to build a usable system. In the continuous processes of developing and adapting a system, this instrument can be applied by evaluating changes.

The short version of the instrument can be used for frequent and recurrent assessments of how users define the general level of usability of a system or of all the systems in an organization. Such recurrent assessments are good to stimulate and keep the usability awareness high but they can also contribute to the implementation of certain measures that heighten usability, they can result in a better work environment, and they can stimulate IT system utility.

Work Environment Consequence Analysis

As a small sub-activity within the project we developed a tool for doing work environment consequence analysis. The purpose was to structure and systematize the search for work environment aspects of an IT support system under planning or under development. The purpose of the Usability Index (described in the previous paragraph), was to evaluate an IT support system currently under use. The purpose of the work environment consequence analysis was to predict the consequences of the planned IT support system on work environment, stress and health. Theoretically the method was

based on the demand/control/support-model developed by Karasek & Theorell (see introduction). Within this project only a preliminary version of the tool was developed – continued development will be conducted in cooperation with other organizations.

One of the conclusions from the interviews was that the tool contributes to a more structured and systematic process for dealing with usability and work environment issues, in the projects where it has been applied (e.g. the MAX project). The tool is based on a set of issues, or questions relating to demand, control and support. There is of course a risk that such questions will be perceived as unclear, but the tests conducted during this project have contributed to refining the questions and making the tool easier to apply in practice.

The people we interviewed were convinced that the work environment consequence analysis tool would be used in the organisation in relationship to the development of new IT support in the future. However, for this to happen it is important that the organisation continues with the use and adaptation of the tool and gives support to the users of the tool.

Usability Policy

How can you make a usability perspective develop and spread in an organization?

One of the purposes with the AvI project was to increase the usability of the IT systems and improving the computerised work environment within CSN. Early on in the project the idea came up to establish a policy for usability within the organization in a similar manner as having a policy on equality and other important areas. For a policy to become useful within the organization it must be kept short and to the point, it must be easy to understand and well communicated to everybody within the organization. An easy way to do it would be to base the policy on overarching principles and rules that the organization must adhere to.

CSN's usability policy was based on our previously established key principles for User-centred systems design (Gulliksen et al., 2003). For such principles to be fully accepted in the organization, they must be adapted and tailored to the context of the organization. Therefore, in cooperation between the usability professionals within CSN and the researchers in the project a document called "The usability policy of CSN" started to develop. The document went through an extensive review in the organization, also involving union representatives. Many commented that the process was too long, but others claimed that the long development times actually contributed to a much better process of negotiation and support from within the organization that could not have been achieved in a shorter period of time.

In the evaluation interview both positive and negative comments were raised upon CSN's usability policy. Many mention the usability policy as the door opener giving usability issues a legitimacy showing the importance to everyone involved in all forms of development. Others explain that CSN already have a great number of policies and therefore it is difficult to see its effect at all.

Quite clearly, the usability policy is often mentioned when explaining usability work or when needing to motivate why these issues are important. Particularly in relation to the overall management of the organization it has been important to use the policy to show that these issues are of key concern. It has frequently been used for education purposes and it is perceived as short, to the point and accessible. The policy has both product principles and process principles (c.f. Table 5).

The purpose with this is to amplify that usability is not just about "windows and buttons" but describing how to go about developing new systems, something that is communicate in the process principles.

One of the most difficult principles to relate to has been the process principle on iterative development. The views on the importance of

Table 5. An overview of the usability policy

Usability policy
Process principles
• Active user participation continuously throughout the process.
• Iterative development throughout the process.
• Analyze work environment consequences when developing the business.
• Design for all.
Product principles
• Adapt the dialogue to human capabilities
• Adapt the user interface to the needs and prerequisites of the target audience

iterative development to be able to arrive at usable systems vary. Many argue that the majority of the thoughts behind the usability policy are equally valid without adopting an iterative way of working. Also the view has been expressed that you may risk loosing control on the development work to be able to tell weather or not you deliver sufficient quality within the estimated time. Others actually claim that they do develop iteratively but without being so explicit about it to the acquirer or procurer, because that information is of little use to them. In the future, to be able to do iterative development may be useful in that it gives you the ability to adapt to a changing project involving modified requirements. Iterative development is evidently one of the key success factors behind the decision (and also fully in line with ISO 13407 Human-centred design processes for interactive systems).

For usability work to live on and prosper within CSN, the usability policy constantly needs to be revised, further developed and adapted to the particular circumstances in the organization. As some aspects become fully implemented there might be room to emphasise other aspects through the policy.

As an appendix to the policy a document called "Usable usability" has been developed. The purpose has been to provide concrete guidance in the use of specific methods. Many has mentioned this document as a valuable source of inspiration for the use of specific methods, but at the same time, for others, this document may be difficult to find or to make concrete use of in the day-to-day work.

In the evaluation interviews the organizational belonging of the Usability policy has been brought up. It has not been fully clear weather or not the policy was specific for only parts of the organization or if it was to be regarded as general guidance for the entire organization. Some people thought that the natural organizational belonging would be with the development department, that is, in charge of most documents of similar kinds. By moving the organizational responsibility it would be emphasised that usability is not only something to consider in the development of the technical system.

Usability Expertise and Usability Experts

Many have mentioned the usability experts as immensely important for the sustainability of the changes that the AvI project has meant. However, many see the role as vaguely defined, and very late in the process a decision was made that the usability experts would not be a "free" resource within the development work in the organization, as they had been all through the project previously. Also people expressed concerns that the usability experts were left to writing documents instead of actively contributing to the systems development work. Many mention that the usability experts need power and an authority to lead usability issues within the organization. Even at the main office many were not aware of the role at all, or aware that it was a full time role in the organization.

The particular expertise and knowledge that the usability experts have are considered important in the organisation, but it is knowledge that everybody should have that is involved in development. Therefore it is important that the usability experts regularly run educations within the organisation and works in a way that the knowledge spreads.

The interviews also showed the importance of the personality of the usability experts and that they are able to do a good job. The Development department expressed a wish that the usability experts should take more own initiatives in pre-studies, procurement and in projects. Since the role is not clearly defined the usability experts need to be prepared to negotiate their role in every project they take part in.

Revising the Systems Development Process

The purpose with this activity has been to develop general guidance and concrete suggestions as to how CSN may improve their systems development model to be able to deal with usability and work environment aspects in a better way in systems development. This has been seen as an important step to create sustainability in the changes suggested. A particular focus has been the iterative nature of the model with continuous prototyping activities. The intention is that all CSN's projects shall apply the systems development model in the development.

When interviewing people few mention that they have seen any changes in the systems development processes at all. Particularly case handlers in the local offices have little or no knowledge of the systems development models. Others know that changes have happened and trust that the changes made are improvements, even though they do not know any details of the changes. Some people have expressed concerns weather or not the revisions made are sufficient to fulfil the goals of the AvI project. Others emphasise that the changes made really have changed the way the organisation talks about changes as such, something that the following quote may illustrate:

... it feels like it is here that we have reached the furthest, in the development of the usability policy and the methods documents.

One problem that is mentioned in the interviews is the difficulty of having one mutual development model for all sorts of development within the organisation. For example, the support needed from a developer within Java/web differs a lot from the needs of those working in Datawarehouse or those working in CoolGen. The consequence might be that a developer from the web side does not think that the system development model provides the support that they need and therefore considers it less relevant.

One of the more fundamental changes introduced in the revision of the systems development model is the efforts done to ease the possibility of doing field studies for the developers in the development projects. Particularly the increased opportunities for participation from the case handlers have been emphasised as an important change, and as such the field studies have been named to contribute a lot (see more below in the education of developers), even if the feedback to case handlers on which results the field studies has provided are requested. One disturbing thing that was mentioned was when the field studies were documented on film, which did not happen at all case studies.

One of the interviewees mentioned the difficulties supporting the design work about issues relating to usability. It is relatively simple to prescribe methods for field studies or evaluation/testing, but a lot more difficult to support the design. Usability comes in much more naturally as a step when working with the development of new routines for how to work. Including better support in the systems development model for prototyping has been requested; the people concerned do not now consider the systems development model to support prototype-driven development.

The need to revise the routines for testing was also brought up in the interviews. There has been an extensive discussion on how to involve case handlers earlier in the development and not only as it often is today as testers. Somebody suggested that CSN should have professional testers instead.

However, one should not mix up testing with the evaluation that is such an important part of the iterative development process.

Finally, the testing routines as such often prevent iterative development, as it tends to show a lack of fulfilment of the stages when each step has not been concluded in accordance with the waterfall model.

Iteration

Iterative development is one of the corner stones of a user-centred development process and is often mentioned as a necessity for being able to develop usable systems. Iterative development means a cyclic process of analysis, design and evaluation continuing throughout the development process. It means a subsequent refinement of the requirements to a much higher extent than in traditional development, and that the requirements are changeable all the way through to the end. Iterative development is also adopted by CSN as one of the major principles in CSN's usability policy.

Performing iterative development is by many people within CSN seen as something controversial. Many people mention the anticipated risks involved when performing iterative development in terms of being able to complete the project on time, within the estimated budget frame and with all the required functionality.

In our evaluation interviews it became clear that CSN was not yet ready to take on iterative development and that they thought that the researchers had pushed iterative development too much. CSN was prepared to introduce a more user-centred development process, but not prescribe iterative development since they considered this to involve too high risks. In addition, the mere fact that still much development in traditional environments (such as Cool Gen) presumes a more waterfall oriented development process and that there is no room for a more iterative way of working in such projects.

Education and Information Activities

The purpose with the education and information activities was to support and contribute to the general goals of AvI and to contribute to the performance of the goals of every main activity. A great insight into and knowledge about everything that is going on within AvI has been sought for.

The AvI project has continuously informed its co-workers and managers about the project progress with information adapted to the audience. The activities have contributed to the increased knowledge about usability and the work environment area in the entire organisation. A more initiated and positive image of the project has spread throughout the organisation. The organisation also planned for exchange work between the local offices and the systems developers at the main office.

Informing all employees about the project is important for the result to become successful and for the sustainability of the knowledge in the long run. Since the AvI project relied on active participation from many users from all parts of the organisation, it was important that the staff was informed about all activities, planned ones as well as previous results. If the staff is well informed they feel a lot more secure in the projects and they believe that they can have a much higher influence. One of the purposes with the AvI project was increasing the awareness of usability and work environment related issues, and improving these things also means changing the attitudes in the organization.

From the concluding interviews we can tell that the information activities were good to start with, but that they did not live up to the expectations later on in the project. Given the high stream of information, information about the AvI project rarely managed to get through the regular workflow. To get information the readers needed to actively go and search for the information on the intranet. But if they did that, they usually found what they were looking for. A better informa-

tion structure and systematizing the information would enhance searching and understanding the information.

Work team meetings have been a good channel to inform and discuss the effects of the AvI project. These activities worked well to spread the information but worked less well for discussing or collecting and systematizing the feedback. Language and concepts may be perceived as unnecessarily abstract or complex, but subsequently the organization learned from this experience and has designed the information in a different way. Also a specific program for new employees has been initiated to inform about AvI.

Finally organisational obstacles have been mentioned as one efficient filter for the information. Managers may have been informed about the project but failed to forward that information further down into the organisation. The feedback given on the information also shows that it tended to use abbreviations and computer-related terminology that was difficult for the readers to relate to.

Usability Training Course for System Developers

As a part of the AVI-project, the researchers taught a usability training course for all software developers at CSN. It was a three-day course, with one day of basic knowledge on general usability, quality attributes and an introduction to field studies. The introduction contained detailed examples and practical tips and tricks on how to conduct field studies. The second day was the participant's practices their knowledge and conducted a field study, documenting it and filling in a feedback survey. On the third day the results obtained in the feedback survey were discussed, and basic introduction to design workshops and evaluation methods were taught. The course focused on the practical application of methods, with many opportunities for interaction as well as several practical group assignments. The course was given five times for about 20 participants each time between October 2006 and February 2008. All in all 100 developers completed the education.

The theoretical background contained an overview of the usability concept, a basic introduction to stress and work environment problems, the Swedish Work Environment Law and other regulations controlling the work environment. The role of the IT system in the organisation and hence also the responsibility of the developers as well as social responsibility in delivering this quality was discussed. The following are some of the major topics that were discussed in the course:

- **Planning.** For the analysis of user groups and needs you need to determine; who to meet for the interview, where to meet, how long time it will take and where to report the time for the field study, in order for it not to disturb the core business too much. Here, it is important to guarantee anonymity and facilitate the opportunity for users to speak freely about their work.
- **Interview guide.** Specifying the interview template is a part of the preparation for the field study. Open-ended questions support the interview process better than detailed and leading questions should be avoided.
- **Documentation.** Pros and cons on documentation were discussed. Taking handwritten notes during the interview and directly afterwards summarize and document the findings was preferred. Moreover, a separation of objective facts from subjective discussions helped to clarify the situation. Recording the interviews was not considered worth the hassle. User profiles, personas, scenarios were brought up as examples of documentation formats.
- **Requirements.** Requirements are not something you go out and find among the users. Users have wishes, needs, goals and tasks that they want to achieve. Requirements, on the other hand, are something that we put on a technical system.

Normally users should not have requirements on the technical system, but the users' goals might lead to requirements when considering them in relation to business objectives and other important restrictions.

- **Atmosphere.** Creating a friendly atmosphere by showing an interest in the user's work situation and showing humility and respect was considered important. This involves an introduction of oneself, justification of the purpose of the study for the users as well as potential consequences.
- **Context.** The importance of looking beyond the computer application and seeing the entire use situation; organization, special tools, such as calculators and Post-IT notes, work environment related issues and informal aspects was emphasized.
- **Observations.** Shadowing the user as they are doing their work, perhaps using think-aloud techniques. Acquiring a genuine feeling of case handling, includes more than the cases the system developers already had some knowledge of as an understanding of what precedes the cases and what is bound to happen afterwards also is a part of the work situation. Moreover, a natural situation is preferred, e.g. if the users usually deal with cases and are constantly interrupted by the telephone, that should be included in the observation as well.
- **Feedback.** Giving the users the opportunity to comment on the field study report and stay in touch for future issues that might arise. Observations that could help the users in their current work should be mentioned.
- **Open mind.** Do not look to verify your prejudice about the users or to confirm a hypothesis. There are no stupid users, only unforeseen usage. Two users do not behave in the same way. Make sure to understand every step of the process.
- **Solving problems.** Aim at identifying potential solutions to problems found. Track good aspects of usage and include them in the next system development iteration.

Field studies give you an understanding of the current work situation, but not necessarily an understanding of the potential of the new technology to be developed or the needs of the business processes to change. These field studies served the purpose of capturing the work practices of today which is possible to use as a basis for future development.

In addition to the survey used to evaluate the education, it has been followed up by interviews and discussions conducted during the course. The participants almost unanimously experienced the course very useful and inspiring. It has contributed to a more holistic overview of the users' work situation and has given much information about how to improve the systems that are currently used. For many developers this was the first time they got some insights into the users work situation and many considered that the course had been an important eye opener to be able to incorporate usability activities in future development work.

One of the consequences of the education was that CSN from now on emphasises the importance of field studies in pre study and procurement to the extent that the development models actually prescribe these activities. But, on the downside many saw the method as something gathering information to be summarised in a field study report, rather than as an important step for developers to increase the knowledge of the use situation. The field study as such provides much more information than is possible to capture in a written report and therefore the report as such play a less important role and the fact that the person conducting the field study follows through the project is a lot more important. Such an aspect must be possible to capture in a systems development process.

Probably the most clearly evidence of the effect of the systems development education is the increased aptitude to plan and conduct field studies. It is not only the developers that see the benefits of doing field studies; project managers, method managers and those responsible for developing standards and style guides within the organisation benefitted a lot.

Unfortunately the parts of the education that focused on design and evaluation has not as clearly left any traces in the development work. One reason for this is that there was not time enough to do practical exercises to the extent required. Another reason was the strong urge for better methods for gathering knowledge from the use situation.

Usability Coaching

The purpose of the usability coaching activities has been to support persons at CSN that has different areas of expertise in order for them to act in a more efficient way when it comes to issues relating to usability in a broad sense. Issues relating to knowledge, particular problems, performance of activities, etc. has been covered.

Usability coaching has happened in all major parts of the project. Researchers from Uppsala university has given advice and support to all persons in charge of the major areas and other key players within the project in regular scheduled appointments. The coaching has provided extra support and a mentorship and has been greatly appreciated by parties involved. It has been particularly important during the final half year of the project when the major focus was on creating a understanding of how the organisation would work with usability after the project had ended.

The coaching talks started early in 2007 with members of the project group after an initiative from the project manager. An additional goal was to increase the contacts and facilitate the knowledge exchange between the researchers and the staff at CSN, and to provide concrete advice concerning their specific areas of responsibility. One of the researchers from Uppsala university acted as coach and participation was voluntary. Some of the participants declined to be coached after an initial meeting. In the concluding interviews we were informed that some of the participants felt unsure about the purpose of the coaching talks and the reason why they had been initiated. None of the interviewed participants were directly negative towards the coaching talks. The usability experts at CSN were those appreciating the coaching talks the most. Many of the interviewees emphasised that the coaching talks would have been a lot more useful if they had started earlier. Even if some of the people that were interviewed did not see that the coaching talks had meant any changes in how they themselves conducted their activities, but when we go through the diary notes of the coach we can see changes in the attitudes and in how the persons being coached are talking about usability after the coaching talks.

A conclusion may be that the coaching talks are important but that they should start earlier to be able to manage a better functioning user-centred development work.

Management Support and Sustainability of the Results

Management support is often mentioned as one of the major success factors of a project of this kind, or for any project as a matter of fact. From the interviews we clearly saw that management support was one of the crucial success factors for the project and for the sustainability of the changes that actually took place at CSN. Many also emphasised the importance that management now continues their support and clearly shows that usability also is an important factor for the future. Many mentioned that the general manager of the public authority had been supportive, despite the fact that she was not the general manager when the project was launched. However, many also mentioned that there were other members of the management group that were not as supportive.

For the sustainability of the results it is important that the general manager and the middle management agrees on the importance of usability activities and provide the necessary support and financial resources it requires.

Many emphasised the importance of establishing new views, new values, new competences, new ways of working, new methods, and that these are made sustainable in the long run in the organisation. It is important that the results do not disappear as soon as the project is over. This was also a clear goal from the outset in the project.

One concrete action to approach this goal is that the general manager has given the overall auditors the assignment to evaluate how the organisation manages to continue its work with usability and work environment issues in 2009. It was also mentioned that it is important to clarify everybody's area of responsibility when it comes to issues like this. It was suggested that usability aspects should be integrated in all guiding documents and educations in a way that makes it impossible to circumvent these in the future.

From previous experiences we know that it is important to maintain a discussion of these issues in the organisation in the future to make the changes sustainable.

Attitudes and Basic Values

Half way through the project we did an interview study with 19 managers at CSN with the purpose of investigating basic attitudes, perspectives and values in the organisation when it comes to usability and work environment issues. The results of this study have been published in (Cajander, Gulliksen & Boivie, 2006).

The results indicate that usability is interpreted differently depending on the role and area of responsibility of the manager. Several of the managers then expressed an unclear image of usability. Many of the managers see themselves as personally responsible for parts of the usability concept, but they do not realize that they have a more holistic responsibility and that the responsibility is more informal. These managers also expressed that users involved in the IT projects do not have any formal responsibility or authority in the projects. They have become IT workers who do advanced tasks such as function testing. The study also revealed organizational obstacles for usability work where the lack of involvement of the local offices is one of the problems. The results of the study were presented on several occasions, both for the managers involved and at a management meeting.

In the interview study conducted after the AvI project we specifically asked about the effects of this study of management attitudes. This study shows that the results are mixed; some were provoked by what they thought was misunderstandings in the study (even though they were direct reports of opinions raised), others said that the study lifted important issues that needed to be debated and dealt with within the organisation.

The survey showed the importance of an ongoing discussion on what usability is and a good work environment means and the importance of clarifying the responsibility to make this happen. The survey as such seems to have contributed to an increased focus on clarifying the responsibility for usability in the subsequent development work. We can clearly see that several of the persons that were interviewed significantly have changed their perspectives from when this study was done until the end of the project, but then again it is difficult to see what contribution the study as such had to that change.

Pilot Projects

We have been more or less involved in a number of pilot projects and the purpose of this part of the paper is to share some of our experiences from these projects. Many of the pilot projects were initiated without the extra resources required. The fact that a project was a pilot for the application of new methods was not always rooted in

the organization. For example, the e-mail project was not well connected to the procurement and was therefore working a bit in parallel with these things. The MAX project was successful, but doubts were raised to what extent it actually could be considered to be a typical pilot project. In the intranet project the activities were much appreciated, but there was unclarities about to what extent it was a pre-study or not. However, it was clear that the user's opinions played an important role in the development.

Following are some short reflections about each of the pilot projects.

The Student Aid Project

Before we were introduced to the project it had already conducted some usability-related activities. The procurement contained some usability-related requirements, but the business processes were quite rigid and did not allow for much flexibility in the design. The organizations' own usability specialists had made some field studies, but apart from these, no field studies had been conducted. Work environment aspects had not been considered – these were considered to be on a more comprehensive level. Organisational representatives participated early in analysis and design, which was positive, even though these were not practically involved with case handling on a day-to-day basis. Early on they had made use of prototypes, but very much on the "buttons level" but with limited ability to influence the business processes. The opinions about to what extent it was possible to conduct the development in an iterative way. The biggest problem in the project was the changing deadlines, which caused problems in the staffing of the project.

The E-Mail Project

This project turned out to be an excellent example of what happens when the design of work tasks and the design of the user interface collide. In this project the focus on the user interface limited the support for the case handler's work tasks in a good way. The usability work was considered important but unfortunately it started far too late and went on in parallel to the project as such and without connecting with the development of the use cases. Field studies, prototype design and evaluation had to happen in a short time and based on limited information about work tasks. This lead to a lack of confidence in these activities and it thereby had less influence on the forthcoming construction work. Also the project emphasised the importance of automatizing case handling and through this letting the users deal with the cases the system were not able to deal with. Designing to make the automation as positive as possible is a difficult task. In addition we could see from the work environment consequence analysis that the system would have a great impact on the users' work environment, which was a risk for the project. In conclusion it is important to provide a good instruction to the projects in order for them to realize what it means to be a pilot project. Usability and work environment issues must be clarified in the procurement, system development and project management models. The usability work must be started much earlier and be integrated with the development work. Field studies with real users and user participation in other parts of the project is important. A work environment consequence analysis may provide important additional information. Finally, the participation of skilled usability professionals in the project may have great impact on the quality, provided that their role in relationship to the development leader and project group is important.

The HEM Project

An interesting pilot project was the project to develop a new system for home equipment loans as this got an approval to rebel against the prevalent systems development model and apply iterative design. Success factors in the project were an

experienced project manager, skilled developers of both system and business. The procurer had previous experiences of user-centred development. The HEM project worked iteratively with paper mock-ups that were subsequently refined and tested with real users. However, one potential obstacle in the project was using a development terminology that partly distanced the project from the user representatives. In addition the project contained quite a few consultants, which unfortunately did not contribute to the knowledge building in the organization. In conclusion the HEM project showed how to successfully work in a user-centred and iterative way. But at the same time it meant risks, such as not allowing for the user involvement that the project would have required.

The MAX Project

The pre-study and procurement part of the MAX project, that had the ambition to define a new system to maximize automation through point multiplication. The goal was to be a pilot project in the introduction of user-centred activities, even if the project initially would not expect to include much interaction. Field studies, a user workshop and a work environment consequence analysis were performed as well as providing feedback to the operational advisory board. The field studies confirmed inconsequence in the business processes and the ways of working in practice. In addition, the terminology and language used for communication with the case handlers was not appropriate. This confirmed that usability is about a lot more things than the user interface. The pilot project ran pretty smoothly, with the exception that the participants could have been better informed about the expectations on them, with the consequence that the different stakeholders could take the time required.

The Intranet Project

As researchers we conducted a usability evaluation of their intranet and a creative design workshop with study visits to similar organizations. The usability evaluation was conducted by the organisation's own usability expert in cooperation with one of the researchers. It was done as an interview study followed by a design workshop. Based on this a conceptual design visualising the future appearance was developed. Based on that a simple interactive prototype was developed and tested with the user representatives that had taken part in the design workshop. The menu structure was also redesigned using a card sorting method. A reference group from the communication department and web developers was put together. From the interviews we could conclude that the participants in the usability evaluation was happy with the work. The evaluation produced clear results that subsequently could be used in the forthcoming development. But, due to financial restrictions and due to a forthcoming change of the technical platform it is unclear to what extent these activities will have any impact in practice. The group responsible for developing the intranet had previous experiences cooperating with users, but mainly through surveys to gather information. But the methods applied was considered useful and the results may, even if it does not lead to a new intranet lead to changes in the handbooks that are produced within the frame of a different project. One of the user representatives commented upon the prototype that was developed:

It looked a lot like what they had been discussing before, they really listened to us.

Developers at CSN have been inspired to use prototypes in their own development work as a result of the collaboration.

DISCUSSION

From a research point of view the interesting conclusions to draw from the project is what makes sense when one during a long period of time cooperates through action research with the goal of changing the organization including processes, knowledge and skills and attitudes to improve usability of IT systems, and user's work environment. Clearly some things work better than others, and in this section we discuss our insights and understandings of success factors and pitfalls. The success factors have been grouped in general aspects where the overarching success factors are described, followed by the individual aspects and organisational aspects. Finally some pitfalls experienced in the project are described.

Critical Success Factors: General Aspects

Sustainability has been a project focus, and throughout the project changes are seen as part of an on-going process. The process never stops, and it is not possible to say that the change is complete and that you are through with the development of these issues. This perspective on usability work as a ongoing process also inspired CSN, and after the project usability is one of the key issues that will be brought up in an audit in 2009. Hence, CSN shows the willingness and aptitude to continue its development of usability-related issues.

The long-term ambition of the project was one of the critical success factors, as many changes that relates to usability is not easy to accomplish in a short period of time. The AvI project has been stretching over a period of more than 4 years and thereby allowing for issues of strategic importance and long-term changes.

The problem-oriented setting was another success factor, as the focus of the project has not been to provide answers to specific research questions. Instead the problems that CSN experienced has been the starting point of our research, and often their interpretation of the problem has inspired us to do research in new and unexplored areas such as for example system developers and field studies. The activities we have engaged in were both important for CSN and for the research group. This approach has provided some real-life experiences of how usability and work-environment issues can be taken into consideration in such organisations.

Most of the research has been conducted directly in the client organisation in cooperation with staff from CSN. Therefore the context has played an important role beyond what could have been achieved in a research lab.

In the vision seminar process many different parts of the organization was given the opportunity to participate, which made the visionary work open and democratic. Even if the organisation did not decide to move ahead with these visions, they have clearly had an impact on the forthcoming development through by its method of participation and involvement.

Critical Success Factors: Individual Aspects

The participation and presence of the research group individuals was a key success factor in this project. Uppsala University participated with 8 different researchers, and the researchers provided different flavours of HCI expertise which made the environment lively, analytic and creative. Some of the researchers took more of a coaching role, some worked with education, some discussed ethical issues and systems development, and others more worked in concrete development projects.

One of the most important changes mentioned in the interviews is that usability is something that you talk about at CSN. Moreover, knowledge about IT-related stress and work environment issues has developed tremendously. One example is the use of the model proposed by Karasek & Theorell (for further information, see the section on work environment and health), explaining stress in terms of demand, control and support. This model has

made a clear impact and is often referred to by people from the organisation.

One individual success factor was the increased developer awareness. Developers and other stakeholders in IT development projects completely changed their opinions about involving users more in the development work. They found it very useful to observe and interview users in their work environment. Previously a prevalent opinion and attitude among developers that users "do not understand how to use the IT systems" was replaced by an increased respect for the users and the value of getting first hand experience of their situation. When developers saw why users do not appreciate systems that do not support their work, it became easier for them to understand the rationale behind requirements and propose solutions to fulfil these requirements. This change is something we believe will have a long-term effect in the organisation.

During this project we experienced that mentoring is a surprisingly powerful tool when trying to introduce usability. These findings are confirmed in other studies where the benefits of mentoring are extensively explored. Studies have shown that individuals who are mentored *"often advance more rapidly in organizations, earn higher salaries, are less likely to leave the organization, and express more favourable work attitudes"* (Allen and Eby, 2006). Our findings indicate that the mentoring program made mentees more aware of their responsibility for usability, and in what ways usability related activities are a part of their professional role.

Critical Success Factors: Organisational Aspects

A critical success factor in this type of change work is a clear, explicit and active support from top and middle management. Management support can include many things, and differs depending on management role, style and position. As there are many managers at CSN, their support has been expressed in a variety of ways from strategic discussions, prioritizing usability, funding of usability related activities, to discussions about system development models. From the top level this management support has always been clear and active, and many managers have supported the project. The project has been given high priority and sufficient amount of resources and attention required for it to become successful.

One of the organisational success factors was that CSN had rather a high maturity as a starting point of the project. In previous attempts to work with an organisation to introduce usability it has been organisations with little or no previous experience of the field (referens). For example CSN had used some user centred methods, and they had usability designers in some of their development projects before the action research project.

Strategic support through documents such as policy documents, strategic documents, methods descriptions etc has been one success factor in the project. One of the interesting findings from the project was that the policy document played a very important role in the organisation. It is referred to and used in many contexts, and functions as a reminder of the usability focus. The usability policy was described as short, clear and to the point; hence it has been widely communicated within the organization. Many have described it as the leverage for usability-related activities and good for communicating and understanding what usability is about. However, perhaps this large impact was due to the actual process of writing the policy were many different parts of the organisation were involved and engaged rather than the policy document as such. Another strategic support that had great impact was the organisation's development processes. These documents prescribe what activities to undertake and in what way, by which roles. Therefore the way in which these documents support and promote usability-related activities are important. During this project several of the development models have been rewritten and further developed and

new models have been introduced. This has also been important as a support for usability activities, even if the models and processes as such could have gone a lot further in their support.

CSN's participation in the project has been characterized by openness, curiosity and willingness to experiment with new methods and approaches. A project of this size and length requires an aptitude to change and revise plans and directions throughout, and the organisation has really lived up to such demands.

One critical organisational success factor in the project was the power relations. The project group had authority to do quite a lot, but it was not always clearly specified and explicated from the overall management. Hence the balance between responsibility and authority has been quite good, and the project has had the authority to act and react in different situations. However, naturally there were a few conflicts, but the overall picture is that power relations did not disturb the project. It was easy to involve, communicate with and make decisions with all parts of the organisation.

Another critical success factor from the organisational aspect was the controversial management study that we presented (Cajander, Gulliksen & Boivie, 2006). As mentioned in the results section we conducted an interview study with managers halfway through the project about their responsibilities and basic values when it came to safeguarding usability. The result of this study surfaced an important discussion about basic values and responsibilities when it came to usability and work environment issues and that started a process of discussions that worked towards further developing the organisation's attitude and culture.

Pitfalls

During the project the research group needed to change project manager or front figure several times, and this was clearly a drawback. These changes were caused by one researcher returning to the IT industry, changes in workload, maternity leave, and reorganisation of the project work. Even though this was necessary due to the staffing situation, it was not beneficial for the project.

One of the pitfalls in this project was the geographical distance between the research group and the head office at CSN. The geographical distance did have a negative effect on our presence on site, due to practical reasons. If one cannot be on site when spontaneous discussions or meetings happen, it is difficult to handle irregular and unexpected events. Also the amount of time spent travelling also had a negative effect on the project, since this time could have been better spent doing other things.

Another pitfall in the project was the role of an action researcher. In many situations uncertainties have occurred in what roles the researchers play in various projects, and we had to spend much time on discussing and adapting our role to each project activity. Once again this most likely relates back to the action research framework and the fact that many saw us as consultants rather than researchers. On the other hand if we had been consultants we would never have had the opportunities to achieve what the project actually managed to achieve. A clear description of the role the researcher takes in such a project would clearly have helped, but then on the other hand meant a lot less flexibility.

During the project we had difficulties when trying to implement with the vision seminars method (as described in Hardenborg, 2007), and they were never an integrated activity in the organisation. As previously mentioned the vision seminar process was disrupted, but clearly such a work is important to manage the development towards a well-established and organisationally grounded vision. The vision seminars would have benefitted by a follow up process, but to have the desired effect this should most likely have been performed at another time and well connected to the organisation's own long term business development process. However, several interviewees mentioned how the ideas from the vision seminars had inspired important strategic documents as

well as the new procurement model created by the development department.

One of the pitfalls of the project was the inability to motivate the development department to actively engage in the work. Many of the informants in the interviews have mentioned the effects that the development department has had when it comes to actually having usability work happen on a more regular manner. Initially in the project this department had a passive role, but as the work progressed, the effects of their initiatives became a lot clearer. From the development department voices were heard that they already worked in a user-centred fashion and that the AvI project therefore could not contribute that much. But in the other end many have mentioned that if the development department would have engaged earlier in the project the effects on the end result could have been a lot bigger. The project did not succeed in convincing the development department of the benefits of usability, and there were conflicts and discussions to resolve this problem throughout the entire project. The development department did not want to engage in activities related to the project, and argued that they had the competence needed to include usability activities in their work. The division of systems development from business development at the development department has influenced the work with usability, and the relationship between these two organizational units was complicated.

One pitfall discovered in this project was the implementation of an iterative systems development process as a compliment to the waterfall oriented process that they had used. Despite rigorous attempts at explaining and arguing for the application of iterative development the organisation reacted the opposite way and argued that iterative development is risky and difficult to apply in the prevalent development models. Many agreed that the waterfall model approach to systems development seldom works in reality, but they still argued that this was due to circumstances. Many saw changes and new perspectives on the system as problems, and not as prerequisites when constructing systems. Others argued that it was not any problems applying an iterative approach, but that the project management tools and testing environments did not allow this way of working.

One of the pitfalls experienced in the project was related to information and information management. From the interviews we learn that several of the users in the local offices felt that they were not sufficiently informed about the project. At the same time we as researchers have been active in informing about the projects in a number of different situations. Information management was a problem in the project despite the fact that there was an expert in charge of information management, and the fact that the project worked according to a specified communication plan that included mailing lists, a web site and presentations of results to the local offices. To succeed better in the future we must find other ways of informing about projects such as this and to make everybody in a large organisation involved.

Several of the requested project activities often did not happen at the pace that would have been wished for, and speed and dynamics were two problems in the project. For example the usability policy and the referral process when writing it could have been a lot quicker. But on the other hand this prolonged process has meant that many people have had a chance to become involved and voice their opinion which might have been one of the success factor of the policy document.

The competence area usability at CSN involves everybody that either has an explicit usability responsibility in their role descriptions to those that in one way or another have an influence on usability. Recently the usability professionals has gone from being a free resource that the project do not need to pay for to being resources that needs to be planned and budgeted for in the process. Unfortunately the demands for usability activities still is much smaller than the need and therefore

the usability expertise needs to sell their services to a higher extent than what actually should be desirable. One of the reasons for this is that the usability expertise is not involved in the routines sufficiently yet, even if the expectation is that they should be expected to work at about 10% of the development budget. Another reason is that the project budget for the forthcoming year was already set when it was decided that the usability professionals should be planned and budgeted for.

One major pitfall in the project was the lack of well functioning pilot project. Due to several problems it has been difficult to find an appropriate pilot project, and the pilot projects that started have been aborted. This has lead to many extensive activities that have been planned that needed to be aborted or delayed several times. Instead, several small projects have asked for assistance with usability matters, which has been a drawback from an impact point of view. On the other hand this has meant that the knowledge has spread much more to several different parts of the organisation.

One difficulty in this project was the strong focus on the head office, where the research group has spent most of their time. This has had the negative consequence that some of the local offices feel that they have not been involved sufficiently.

One pitfall in the project was the lack of methodical continuous evaluations. During the interview study, some interviewees expressed the lack of a thorough mid evaluation. Perhaps this should have made it possible to distinguish and deal with some of the identified problems, while there still was time to impact the project.

One pitfall is related to the sense making of usability as common sense in the organisation. During the project a common view on usability as common sense grew strong, and many in the organisation argue that they had the knowledge needed to do usability work and to include usability in their work description.

FUTURE WORK

The discourse on CSN claimed that "usability is very important", but the concept means very different things to different people. For some people the expression merely is an expression to be politically correct, not that you are assumed to work with any usability issues. For others it meant a new way forward and a change of focus.

Moreover, further research is needed to explore how the mentées made sense of the mentoring and their experience of the impact on their actions. Here, recent theory building in research about mentoring offers useful guidance considering what mentées learn in a mentoring relationship, and offers a taxonomy of learning outcome (Wanberg, Welsh & Hezlett, 2003). These categories include affective learning, which consist of changes in attitudes and motivation. Another alternative way of exploring learning outcomes from mentoring would be to use Bloom's Taxonomy.

CONCLUSION

To sum up one can conclude that in our study some well-grounded methods from a research point of view failed to provide the necessary benefits for being adopted in this particular organization. For example the notion of iterative development did not warrant it merits. In some cases the need to adapt and tailor the methods to fit the particular needs of the organisation became so big that the effect became a totally different one from what we had expected. One example of this is the usability policy that turned out to be something completely different to what was initially introduced, but in which the process of coming to an agreement on a usability policy probably was more important than the policy itself. But particularly the changes in attitudes and values, that partly comes with increasing knowledge and awareness is perhaps the most interesting change. Finally, we would like to stress that it is impossible to see the effects

of several activities, since they will not have an effect after several years. Therefore a follow up study in 2009-2010 would be advisable.

Our main conclusions are that it takes extensive management support, improved development methods, both for business and IT development and extensive development of skills and roles to be able to address these issues in a professional and sustainable manner. In addition integrating user-centred systems design in the development work requires a long-term commitment and several activities needs to be performed over a long period of time, or as one of the interviewees interprets it:

Usability is somewhat like democracy - it must be won every day.

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Chapter 6
Usability in the Context of E-Learning:
A Framework Augmenting 'Traditional' Usability Constructs with Instructional Design and Motivation to Learn

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ABSTRACT

The issue of e-learning quality remains prominent on end users' (the learners') agenda. It is no surprise that many non-motivated adult learners abandon prematurely their e-learning experiences. This is attributed in a great extent to the poor design and usability of e-learning applications. This paper proposes a usability framework that addresses the user as a learner and extends the current e-learning usability practice by focusing on the affective dimension of learning, a frequently neglected issue in e-learning developments. Motivation to learn, a dominant affective factor related with learning effectiveness, has been similarly neglected. Usability and instructional design constructs as well as Keller's ARCS Model are being employed within the framework proposed in this work upon which new usability evaluation methods can be based. This framework integrates web usability and instructional design parameters and proposes motivation to learn as a new type of usability dimension in designing and evaluating e-learning applications.

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INTRODUCTION

E-Learning technology and applications provide exciting possibilities for supporting adult learners, professionals, employees in organizational settings seeking new training and learning innovations. However, dropout rates are high and this is a very serious concern for e-learning practitioners (Levy, 2007; Diaz, 2002). Between 30-75% of learners fail to complete e-learning courses (Ganzel, 2001). Thus far, techno-centric approaches (Lohr, 2000) still dominate the design of e-learning applications, systems and courses, i.e. the focus is being placed more on technology issues and not on quality of learning, (focus on the *"e"* part and not on *"learning*"). In addition there are a lot of concerns regarding the use of e-learning technologies in higher educational institutions. Selwyn (2007) argues that most of the students and teachers make only limited use of these technologies and applications during their teaching and learning and further analyzes the respective concerns across several levels: economic concerns of government, the commercial concerns of IT vendors, the managerial concerns of university administrations and the strategic concerns of students.

Another main reason behind high dropout rates is the poor design of e-learning applications. Poor usability compounds this attrition problem by causing frustration or by creating unnecessary barriers to completing e-learning courses (Notess, 2001). Lack of control, navigational disorientation, content, instructional assessment, interactivity and feedback are the most commonly reported nuisances in several studies (ASTD, 2001; Bonk, 2002; Massy, 2002). Amongst other factors, learners' motivation is one important determinant for the dropouts in e-learning (Levy, 2007). It seems that there is a lack of frameworks that integrate usability and instructional parameters so as to address the users of e-learning as real learners. Most of the current usability design and evaluation methods neglect the intricacies and specificities of e-learning and do not address the user as a learner. Traditional usability practice proposes generic usability parameters and measurement constructs having in mind the user as a typical software user. Learner-centered approaches are needed to inform the usability practice in the e-learning context. Hence, pedagogical aspects need to be embedded in e-learning usability design and evaluation methods. In this paper a learner-centered perspective is adopted taking into account new dimensions in human computer interaction with emphasis on users' affect; thus, a new usability framework for e-learning applications is proposed integrating usability and instructional design parameters under the light of one of the most prominent affective learning dimension which is motivation to learn.

NEW DEVELOPMENTS IN HUMAN COMPUTER INTERACTION: THE ROLE OF AFFECT

New developments in Human-Computer Interaction are characterized by the increased focus on design approaches driven by the increasing heterogeneity of the user population, the decreasing tolerance of user frustration, the diversification of their needs and tasks, their idiosyncratic characteristics and reactions and their changing needs (Hudlicka, 2003). The user is in the center of the process and his/her needs drive the nature of the interface and the function allocation of tasks between the user and the machine. In addition, regarding the web and its applications, the need for more usable systems is becoming a necessity since an increasingly large proportion of the population with less computer expertise is using the web (Nielsen, 2000). These concerns are also valid for the widespread use and adoption of e-learning (in this work the focus is on web-based learning).

As Hudlicka (2003) points out, a major component of these emerging requirements and of effective HCI in general is the ability of these

emerging systems to address user affect. It is critical that systems designers assess the range of possible affective states that users may experience while interacting with the system. This summarizes the main broad aim of the affective HCI. Some important research questions that researchers should be addressing in the affective HCI field include the following (Hudlicka, 2003):

- The importance of affect, that refers to identification of HCI contexts where affect is critical and must be addressed particularly, when affective considerations interfere with performance.
- The selection of emotions, i.e. which emotions should be considered in which context and for which types of users.
- The measurement of effectiveness that focuses on how can "typical" usability criteria be augmented to include affective considerations.

In this research it is supported that all the above research dimensions are critical for e-learning design; attention is being drawn on how such considerations can augment existing usability criteria. The proposed usability evaluation framework has a clear orientation towards development of a new set of usability parameters that will integrate existing ones with instructional design and affective considerations. The following section highlights the importance of affective learning where motivation to learn has a prominent place.

Affective Learning and Motivation: A Neglected Area in E-Learning Usability

As shown in the previous section the concept of learner-centeredness is a major concern for usability design and evaluation of e-learning. "*Knowing the user*" is crucial. Treating the user as a learner means focusing on learner's characteristics, learning styles, cognitive and emotional state. There has been considerable research into cognitive aspects of learning but this is not the case with affective dimension and emotions. Ensuring the latter can lead to an important connection that is needed to make e-learners more active and engaged in an e-learning course; that is the affective dimension of learning. Often, the affective dimension is a neglected or underutilized dimension in e-learning developments. It has been argued that affect is the fuel that learners bring to the learning environment connecting them to the "*why*" of learning. Affect goes beyond simple enjoyment, and it plays a part in the development of persistence and deep interest in a subject (Goleman, 1995). Affective differences exert powerful influences on learners' ability to engage with learning and to progress. Although these findings have been confirmed by modern cognitive science, they are neglected in most of the models and implementations of computer-based and web-based learning. If human emotions and affect are essential for human thinking and learning processes, e-learning environments and courses have to intensively consider them if they are to be successful. Interface design as well needs to consider human emotion and affects and especially motivation (Stoney and Wild, 1998).

Research that explores the crucial role of affective dimension of learning in e-learning developments is still in its infancy. Some of the affective learning factors that have been investigated are bewilderment and confusion (Schaller et al., 2002), fear and alienation (Wegerif, 1998), learners' distress (Hara and Kling, 2000). A more recent study that adopts a holistic perspective investigating the role of emotions in e-learning developments is that of O'Regan's (2003). His study explores an array of emotional states that enlighten the e-learning experience: frustration, fear, anxiety and apprehension, shame/embarrassment, enthusiasm/excitement and pride. Research evidence clearly verifies the centrality and importance of affective and emotional dimensions in the process of learn-

ing while interacting with an e-learning course or environment. One of the most –probably the most- profound affective states intimately linked with learning and instructional design is motivation (Martens et al., 2004). Motivation is a prerequisite for the learner to approach learning offers and also refers to maintaining e-learners to interact with the tasks in the contexts of exploratory learning (Konradt and Sulz, 2001). As already mentioned dropout rates and learners' frustration that leads to low levels of motivation, is a major concern for the e-learning researchers and practitioners. Hence the focus of this study is on motivation.

Motivation to Learn

Motivation can be *intrinsic* or *extrinsic*. Extrinsic motivation has external causes, such as social approval / disapproval, rewards or avoiding negative consequences. Research has shown that it is the learner's willingness to learn that matters (Kinzie, 1990; Schunk, 1991; Ormrod, 1995; Stoney and Wild, 1998). Intrinsic motivation can be characterized as the drive arising within the self to carry out an activity whose reward is derived from the enjoyment of the activity itself (Csikszentmihalyi, 1975).

Learner-centered approaches put emphasis on the learner as an active participant at the center of the learning process with special interests and needs, intrinsic motivation, personal constructions of meaning and the need for self-regulation. Learning environments should foster intrinsically learning motivation (Spitzer, 1996). Especially the new web-based learning technologies call for new instructional methods, most of which are based on constructivism. Thus learners should become responsible for regulating their own learning processes (Martens et al., 2004). Research has shown that intrinsically motivated learners tend to be more explorative, self-regulated and demonstrate behavior that aims at deep learning and reflection. Therefore the focal construct in this research is *intrinsic motivation to learn*; the term motivation in this paper corresponds to intrinsic motivation. Several researchers have analyzed intrinsic motivation. Malone and Lepper (1987) classify the features evoking intrinsic motivation into four categories: challenge, curiosity, control and fantasy. In addition Hutchins et al., (1985), used the concept of engagement in order to explain the affective and motivational effects of an interaction style on the user. Hutchins et al's concept of engagement is similar to the constructs of control and fantasy in the theory of intrinsic motivation (Davis and Wiedenbeck, 2001). Other researchers have recently begun to apply the concept of intrinsic motivation to adult learners of standard software packages; Stoney and Wild (1998) emphasize the importance of intrinsic motivation in designing the instructional interface and associate it with four basic elements of interface design. Venkatesh (1999) used an intrinsically motivating game-based approach to learning, and found that game-based training was associated with higher perceptions of ease of use and higher behavioral intention to use the software in comparison to lecture-based training. All these findings and research efforts reflect the importance of affective learning and especially motivation to learn in the design of e-learning applications. Authors support that such –crucial for learning- constructs must be evident in every design and evaluation effort of e-learning. Following this argument and adopting a learner-centered approach, a new usability framework for e-learning employing motivation to learn, usability and instructional design constructs, is proposed. Prior to the description of the framework and its practical applications, a discussion on usability evaluation in the e-learning context (defining the context of use following by relevant research work) provides the necessary conceptual basis upon which the proposed framework has been developed.

USABILITY EVALUATION IN THE E-LEARNING CONTEXT

The Need for Usability in E-Learning

The two most widely reported challenges for the design of educational technologies are (Bates, 1995): a) the lack of pedagogical support within the educational systems and b) the difficulties experienced by learners in using such systems. Such reasons seem to be also valid for the case of e-learning applications and courses. In the same vein under the auspices of ACM's SIG-CHI (2001) it has been reported that: a) very little quality control and usability testing has been going into the designing of courses and the design of e-learning technologies, typically due to time constraints and low perceived importance of usability, b) there is a need to focus on how to develop useful and usable tools and environments since so far focus has been more on the technology and not on the pedagogy, and c) there is very little thought at the decision-making level to usability issues.

Recent studies verify the aforementioned problems in e-learning context (Ihamaki and Vipola, 2004; Jones et al., 2003; Kent, 2003). Ease of use and pedagogy should be aligned in order to develop usable e-learning courses. A "usable" course is one that "*teaches in the ways that the learners need in order to get the value that they are looking for when they enroll in an e-learning course*" (Feldstein, 2002). Thus, it is extremely important to assess the learners' needs and preferences and further, to examine the *context* in which they live, work and learn. Consequently e-learning design, research and practice have to capitalize on past experiences and findings in several fields: particularly human factors in computing systems, instructional design and systems design. As Squires (1999) encourages HCI practitioners to take into account the latest developments of learning theories: *"workers in HCI and educational computing areas rarely speak to each other or take note of each others' work: the educational computing literature is littered with naive and simplistic interpretations of interface design issues, and many writers in the HCI literature appear to be unaware of the significant developments that have been made in theories of learning*".

Another major concern is how to evaluate the degree to which a course is usable. In order to have a clear insight upon the critical issue of evaluation a concise description of the e-learning context of use is required. In HCI *users*, *tasks* and *environmental* parameters constitute the *context of use* (ISO, 1997). The following sections initiate a discussion that analyzes the general concept of context of use in the e-learning landscape.

Defining the Context of Use

The User is a Learner

A key observation here is that it is crucial to identify the double persona of the *user – learner*. Smulders (2002) asserts that most of the problems in e-learning design that relate to poor usability stem from the fact that most of the e-learning designers do not recognize the distinction between the roles of user and learner in the e-learning environment. Many e-learning courses are designed for learners without any thought to users while at the same time other e-learning courses do just the opposite. Smulders (2002) further asserts that the difference between users and learners can be boiled down to the issue of *form* (user interface) versus *content* (learning material). The user part of persona is concerned mostly with the form and the learner part is mostly interested in the content. This is not to say that content is not important in other contexts such as e-commerce sites, e-shops etc. Rather, this distinction aims at highlighting the special value that content brings to e-learning applications. Content is more important in e-learning. The content of an e-commerce site is not that 'questioned'. Product descriptions, prices etc., is information mostly taken at face value. The Bauhaus principle (form follows function) is

more apparent in e-learning design. More details for content and learning resources design are presented in section 5.

The Task is to Learn

The main *task* for a learner while interacting with an e-learning course or application is to learn. Learning cannot be approached as a conventional task, as though it were just another kind of job, with a number of problems to be solved and various outputs to be produced (Mayes and Fowler, 1999). In this context it is critical to examine learners' expectations and goals as they interact with e-learning courses. Lohr and Eikleberry (2001) identify learner issues that reveal their main goals and expectations along four dimensions: a) learners' comfort, b) learners' orientation and direction, c) learning process and d) feedback. A careful examination of learners' questions and expectations reveal some usability goals that should be met, such as navigation and control (e.g. "How do I get out of this?" or "Can I start up where I left off?" or "How do I get unstuck?"), learnability (e.g. "Do I know what is clickable?"), media use (e.g. "Can it show me?" or "Can I hear this?"), content (e.g. "Is this professional, does it seem credible?"). Additionally, other learners' expectations point out instructional design issues such as specific cognitive processes like metacognition ("Did I choose/use successful strategies?" or "Do I know when I'll be finished?" or "How much do I need to learn?" or "Have I achieved my learning goal?" etc.), collaborative learning ("Are there other people/resources I can learn from?" or "How do I get in touch with other people/resources?") etc.

E-Learning Environmental Parameters

Environmental parameters can be examined along three dimensions: technical, physical and social/organizational (Maguire, 2001). The technical environment is the software and hardware, which is used in conjunction with the system. Such characteristics can affect the usability of a system (Maguire, 2001). In the case of e-learning, the technical environment has to do with the dominant medium, the web. The web is a cross-platform design environment. In this case a huge variety of hardware platforms and multiple servers are the norm, therefore it is almost impossible to specify which equipment will be used by the user (Vassilopoulou, 2001). In the framework proposed in this paper, the main assumption for e-learning applications is that they are web-based and can be accessible through a common web browser. Another focus of the proposed framework is the design and evaluation of e-learning in corporate settings. That brings the discussion to the physical and organizational environment, which can also have a profound effect on the usability of a system (Maguire, 2001, Preece et al, 2007). For instance bad lighting or loud noise in the workplace may actually prevent the users from achieving their actual learning goals through the interaction with an e-learning course. At an organizational level, issues such as the way materials are viewed and disseminated, whether documents are individual or shared (Mechlenbacher, 2000) and less tangible constructs such as the attitudes of the organization and of the employees towards the introduction of an IT system such as an e-learning technology and application and the way work and training is monitored, can affect whether the system is accepted and used to carry out training or work processes (Maguire, 2001). At a lower level the structure of the organization, the way people work and learn (individually and in groups), the availability of assistance and the frequency of interruptions, are also likely to affect the usability of an e-learning application.

Relevant Work

According to the above it is clear that defining the context of use for e-learning designs is not a trivial task. Nevertheless review of studies and

attempts made by other researchers to define usability and conduct usability evaluation within several e-learning contexts can provide useful insights. Usability frameworks in the context of e-learning are very limited. Earlier studies focused on generic usability heuristics such as Nielsen's (1993) without any further customization to e-learning specificities. For example, Dringus (1995b) proposes that usability heuristics suggested by Shneiderman (1987) and Nielsen (1993) can be applied to evaluate online course interfaces; Parlangeli et al (1999) used Nielsen's heuristics in their study. However it is supported that "*evaluating e-learning may move usability practitioners outside their comfort zone*" (Notess, 2001). In order for usability evaluation techniques to be more effective, they need to familiarize themselves with the evaluation frameworks and methods from instructional design (Lohr, 2000), learning theories (Schunk, 2000), learning styles etc. The emerging question is: Do the established sets of heuristics apply effectively in the e-learning context? It has been argued that web heuristics should be used with caution since many assumptions about the users of e-commerce and other web applications do not apply to the users of e-learning. Towards this direction Squires and Preece (1999) realized that simple application of web heuristics could not be effective because they fail to address the specific challenges of learner-centered interface design as well as the issue of integration of usability and learning. Thus, these authors propose an adaptation of Nielsen's (1993) heuristics, taking into account socio-constructivism tenets (Phillips, 1995; Soloway et al, 1994). Other studies also promote the idea of instructional design and usability integration. Reeves et al (2002) proposed an elaborated tool for heuristic usability evaluation for e-learning, which is based on a combination of instructional design and usability heuristics. Similarly, Lohr and Eikleberry (2001) proposed a 3-step approach to learner-centered usability testing, which is built upon the integration of instructional design and usability principles and takes into account learners' perceptions during the process of evaluation. However no empirical evidence regarding its effectiveness has been provided thus far. In those few cases where efforts to develop design heuristics specifically for e-learning have been made, these are still practice-driven and proprietary pieces of work with limited impact in the e-learning community as a whole. There is a need for systematic approaches and frameworks that combine pedagogical guidelines with the web design heuristics.

Recently, there have been some research efforts on building e-learning usability frameworks. Lanzilotti et al. (2006) proposed "eLSE", an evaluation methodology, which derives from a usability evaluation methodology, called SUE (Systematic Usability Evaluation), originally developed for evaluating hypermedia systems. It is about an effort that addresses the appropriateness of design with respect to the peculiar nature and purposes of the e-learning systems. The main idea of eLSE is that the most reliable evaluation results can be achieved by systematically combining inspection with user-based evaluation. Triacca et al. (2004) presented a systematic and practical approach called "MiLE" for evaluating the usability of an e-learning application, taking into account the user requirements, their goals and scenarios of use. MiLE is based on inspection and combines scenario-based evaluation (when inspectors verify the feasibility of given tasks on the application) with heuristic-driven evaluation (which verify the compliance of the website with a set of usability principles). Both frameworks have been developed with a cognitive orientation. Despite the increasing importance of affective parameters, there has been little exploration of the extent, nature and significance of affect in e-learning design and evaluation.

Next section presents the proposed framework, which adopts an integrative view of web usability

and instructional design under an affective orientation that focuses on learners' motivation to learn.

TOWARDS A COMPREHENSIVE USABILITY FRAMEWORK FOR E-LEARNING

Usability practice for e-learning needs to be based on a multidisciplinary approach. 'Traditional', generic usability design elements are not sufficient. Software for learning might be usable but not educational or vice versa (Quinn, 1996), hence the pedagogical quality of the e-learning design becomes a key concern. This imposes that the proposed framework is based on usability parameters and key tenets of learning theories and instructional design; instructional design incorporates such tenets into the design process supporting pedagogical quality. What differentiates the proposed usability evaluation framework from others in the literature is the systematic orientation towards affective learning and more specifically to motivation. Methodologically the proposed usability framework was based on a conceptual framework for e-learning design quality (Zaharias, 2005) and an extensive review of the literature that synthesizes usability and instructional design. Concerning the conceptual framework, three main axes are considered as the most significant (Zaharias, 2005):

- Implementation of learner-centered design paradigms
- Implementation of effective pedagogy for the design of e-learning
- Guidelines and frameworks for quality assurance and evaluation

This conceptual framework for e-learning design quality was the basis for a desk research that focused on motivational design, instructional design and usability.

Instrumenting Motivation to Learn: Keller's Model of Motivational Design

One of the most influential and widely applied models of instructional design is the "ARCS" (*Attention, Relevance, Confidence* and *Satisfaction)* Model of Motivational Design proposed by Keller (1983). Keller's model is a systematic model for designing motivating instruction. It is based on a number of motivational theories and concepts. The basic theory behind Keller's model is expectancy-value theory (Vroom, 1964; Porter and Lawler, 1968). This theory supports that "effort" is a major measurable motivational outcome. For effort to occur a) the person must value the task and b) the person must believe he or she can succeed at the task. The interpretation of this theory into the instructional/learning situation is that learning tasks need to be presented so as they can be engaging and meaningful for the learners and at the same time facilitate and promote positive expectations for the achievement of learning objectives. The ARCS Model identifies four essential strategy components for motivating instruction (Keller, 1983):

- Attention strategies for arousing and sustaining curiosity and interest.
- Relevance strategies that link to learners' needs, interests, and motives.
- Confidence strategies that help students develop a positive expectation for successful achievement.
- Satisfaction strategies that provide extrinsic and intrinsic reinforcement for effort.

According to the above the proposed usability framework employs *motivation to learn* construct, which is composed of four sub-constructs: attention, relevance, confidence, satisfaction. It also contains web usability and instructional design parameters in a way that it is possible to highly influence *motivation to learn.* The selection process

Table 1. Usability parameters that may influence motivation to learn

Usability parameters	Studies from which usability parameters have been elicited
Learnability	Rentroia et al. (2006); Feldstein (2002); Lingaard (1994); Quinn et al. (1993); Guillemette (1995); Al-Hunaiyyan et al. (2001)
Accessibility	Granic and Cukusic (2007); Shiratuddin and Hassan (2001); IBM (2000); Lynch and Horton (1999); Weston et al. (1999)
Consistency	Reeves et al. (2002); Powell (2000); Shiratuddin and Hassan (2001); Lynch and Horton (1999); Chua (2002)
Navigation	Bolman et al. (2007); Rentroia et al. (2006); Martens et al. (2004) Reeves et al, (2002); Powell (2000); Lynch and Horton (1999); Nielsen (2000); IBM (2000); Weston et al. (1999); Evans and Edwards (1999); Stanton et al. (1992); Stoney and Wild (1998); Reushle et al. (1999); Ford and Chen (2000); Shiratuddin and Hassan (2001)
Visual Design	Lanzilotti et al. (2006); Shiratuddin et al. (2003); Powell (2000); Nielsen (2000); Horton (2000); Shirley (1999); Morkes and Nielsen (1998); Stoney and Wild (1998)
Interactivity	Lanzilotti et al. (2006); Rentroia et al. (2006); Hiltz and Turoff (2002); Weston et al. (1999); Reushle et al. (1999); Reeves et al, (2002); Laurillard (1995); Stoney and Wild (1998); Powell (2000)
Content and Resources	Lanzilotti et al. (2006); Silius et al. (2003); Reushle et al. (1999); Weston et al. (1999); Jonassen (1998); Smulders (2002); Reeves et al. (2002); Nielsen (2000); IBM (2000); Keeker (1997); Horton (2000)
Instructional Feedback	Kayler, M., & Weller, K. (2007); Rentroia et al. (2006) Driscoll (2002); Spitzer (1996); Laurillard (1995); Merrill et al. (1992); Johnson and Aragon (2002); Horton (2000)
Instructional Assessment	Kayler, M., & Weller, K. (2007).; Govindasamy (2002); Dick and Carey (1996); Smith & Ragan (1999); Weston et al. (1999); Twomey (1996); Brown et al. (1989)
Learner Guidance and Support	Lanzilotti et al. (2006); Clark and Mayer (2003); Alexander et al. (1998); Horton (2000); Driscoll (2002); Jones and Farquhar (1997)Govindasamy (2002); Clark (2002); Wade (1994); Herrington et al. (2000)
Media Use	Zhang et al. (2006); Clark and Mayer (2003); Herrington et al. (2000); Weston et al. (1999); Nielsen (2000); Keeker (1997); IBM (2000); Shiratuddin et al. (2003); Driscoll (2002); Wild and Quinn (1998); Horton (2000)
Learning Strategies Design	Cercone (2008); Kiili (2007); Henderson (2007); Martens et al. (2004) Clark and Mayer (2003); Brown et al., (1989); Tam (2000); Squires and Preece (1999); Jonassen (1994); Roschelle and Teasley (1995); Dillenbourg (1999); Jonassen (1998); Horton (2000)

was based on a wide range of studies reviewed by the author (as exhibited in Table 1).

Instrumenting Usability in E-Learning Context: Integration of Web Usability and Instructional Design

The review and synthesis of previous studies examining usability in learning software, instructional design guidelines and motivation to learn associated with interface design, lead to identification of twelve usability parameters. Five of them represented web usability parameters while seven were derived from instructional design literature. The following describes the usability parameters of the framework:

1) Learnability

Learnability refers to *"the ease with which new or occasional users may accomplish certain tasks"* (Lindgaard, 1994). Learnability problems may result in increased training, staffing, and user support or corrective maintenance costs (Guillemette, 1995; Lindgarrd, 1994). Users must be able to understand navigation options and to use them to locate wanted information. In addition to ease of understanding, web systems should be *easy to remember*. The users should have no problems

in remembering how to use and navigate in the system after periods of non-use. Concerning e-learning design "*usability is not the major issue; learnability is*", according to Norman (quoted in Feldstein, 2002). Ideally, e-learning systems and courses would have no learning curve: learners would be able to use them for the very first time and achieve instant mastery (Rentroia et al., 2006). This is probably not the case with real users in their working environments. Learnability is commonly measured by the number of trails, that a new user needs to complete a task without being trained (Lingaard, 1994).

2) Accessibility

One of the defining principles of the Web is that it should provide all people, regardless of physical or technological readiness, with access to information (Lynch and Horton, 1999). Accessibility is considered to be very important for web-based applications. Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C) have focused their efforts to the design of accessible web pages and applications for disabled users. For example the provision of text option over images, diagrams etc. will provide visually impaired users to utilize screen reader software to extract the content of the e-learning course. IBM (2000) guidelines suggest that designers should focus on accessibility in the context of different technologies used by users to access the web. Cross platform design, speed of access, and proper use of text are examples of this. Especially response time may create a situation where learning will be compromised because of long periods of inactivity and time constraints.

3) Consistency

Consistency is considered as one of the basic web usability factors (Shiratuddin and Hassan, 2001; Lynch and Horton, 1999). Web design should be built on a consistent pattern of modular units that all share the same basic layout grids, graphic themes, editorial conventions, and hierarchies of organization. Design consistency is important to speed up user's learning. It is related to the use of different words, situations, or actions (Reeves et al., 2002), as well as the use of fonts, text, and element/features placement (Chua, 2002). A consistent approach to layout and navigation allows users to adapt quickly to the design and to confidently predict the location of information and navigation controls across the web pages (Powell, 2000; Lynch and Horton, 1999). The goal for an interactive design such e-learning design is to be consistent and predictable (Lynch and Horton, 1999); users should feel comfortable exploring an e-learning course and confident that they can find what they need.

4) Navigation

Navigation has been considered as an important consideration when designing e-learning; Weston et al. (1999) define navigation as "how the student moves through the instruction and how the instruction is designed to facilitate understanding of *organization* and *structure of content*". Little attention is given to the content of the instruction and how the navigation can be designed so that the organization of the content is evident to the learner. It is important to think about how the capability of hypertext links can be used to support content. Navigation is the cornerstone of several research studies (Bolman et al., 2007; Rentroia et al., 2006; Martens et al., 2004); a body of research explores the effects of individual differences on learners' navigation patterns and resultant learning outcomes (Ford and Chen, 2000). Another strand of research relates navigation with learner control (Stoney and Wild, 1998; Reushle et al., 1999). Reeves et al. (2002), relates navigation with the assistance/direction provided to the learners, the elimination of the need for referring to help manual or documentation, as well as the use of a course map or table of contents that allows the

learner to see what has been seen and not seen. Shiratuddin and Hassan (2001) support that navigation is the key for making the experience enjoyable and efficient.

5) Visual Design

Aesthetic or visual design is one of the main characteristics in web design. Visual (or screen) design can be divided into 4 sections: space provision, choice of colour, readability, and scannability (Granic and Cukusic, 2007; Shirley, 1999; Morkes and Nielsen, 1998). Choice of color emphasizes the need to use proper color in web page design not only to attract users but to also improve learnability and ease of use (Powell, 2000). This is also considered valid for e-learning courses and learning environments; graphics and the colors used in an e-learning course should make it easier for the learner to understand the content. Shiratuddin et al. (2003) associate visual design with content, which "*should be structured and designed in such a way that users will find information easily and effectively*". Readability and scannability are also closely associated with the design of content: Readability concerns with the issue of providing a readable content within web pages. This is a quite complex task for the designer because reading from a computer screen is different from reading from a paper. Designers should also consider the issue of scannability, where contents are chunked into smaller parts so that the users could skim rather than read (Nielsen, 2000; Morkes and Nielsen, 1998). In addition the right combination of text and graphics will encourage users to stay in a course or to further explore it (Lanzilotti et al., 2006; Stoney and Wild, 1998).

6) Interactivity/engagement

Interactivity is one fundamental way of how learners can be engaged during their learning experience. Interactivity, interaction, and engagement are terms that have been used interchangeably in the literature. Interactivity is difficult to define and even more difficult to implement in terms of instructional design. Weston et al. (1999), put special emphasis on interactivity, as they consider it to be the most powerful feature of the Web to date, and as such "*it deserves special attention when designing online instruction*". Interactivity is also one out of fifteen heuristics for e-learning as Reeves et al. (2002) propose and associate it with content-related interactions and tasks that support meaningful learning, problem solving etc. Reushle et al. (1999) directly link interactivity with learner control and active participation on behalf of the learner. They also quote Romiszowski's words in that interactivity should not only be measured by the frequency of interactions but by the quality of thinking it demands from the learner. Hiltz and Turoff (2002) distinguish interactivity as a) interactivity between learners and instructors, b) interactivity between learners themselves as they engage in discussions and collaborative learning activities and c) interactivity between learners and the software. Interactivity has been associated with *practice* (Weston et al., 1999) and *feedback* opportunities (Powell, 2000; Weston et al., 1999) as well as *reflection* and *problem solving* (Laurillard, 1995), collaborative activities and dialogue (Lanzilotti et al., 2006; Hiltz and Turoff, 2002; Powell, 2000) and active participation (Rentroia et al., 2006; Hiltz and Turoff, 2002; Stoney and Wild, 1998; Reushle et al., 1999).

7) Content & Resources

Content refers to "the subject or ideas contained in something written, said, or represented" (Cambridge University Press, 2001). Content has been a major consideration of instructional designers. The basis of a sound e-learning course should be quality of content or information. By using criteria such as credibility, accuracy, objectivity, coverage and currency, the content information quality should become evident to learners as well as instructors or evaluators (Lanzilotti et al., 2006;

Weston et al.,1999; Silius et al., 2003). Content must be relevant (value of content), must come from a reliable source, must reflect the state of the art and represent the current trends in the domain each time. Design of learning resources is also of great importance. Jonassen (1998) recommends that the designer "*should determine what kinds of information the learner will need in order to understand the problem*". Furthermore Horton (2000) propose that the online learning environment should provide some "core" information resources selected by the designer and/or the subject matter expert while learners should use the search capabilities of the Web to find, evaluate, and justify their own resources. In addition Reeves et al. (2002), use *resources* as a distinct heuristic for effective e-learning design. They support that range of resources must be appropriate to the learning context, must include web links, etc. Relevant information resources should be linked to the environment. These may include text documents, graphics, multimedia resources (sound, video, animations etc.) that are appropriate for helping learners comprehend the problem and its principles (Jonassen, 1998). Smulders (2002) supports that learning is about making connections and it further relates that with the use of resources. As he mentions "…*instructional design involves selecting suitable resources and activities that will engage learners and encourage them to make the connections necessary for learning to occur*".

8) Instructional Feedback

Feedback is a vital part of the learning process during which misconceptions are corrected. Meaningful feedback improves performance (Rentroia et al., 2006; Driscoll, 2002). Effective web-based training programs can provide rich and meaningful feedback to develop learners' ability to self-diagnose their learning problems and correct errors without prompts. Inadequate feedback is one of the main reasons for learners' frustration while they interact with e-learning courses (Driscoll, 2002). Feedback can take two forms (Laurillard, 1996): intrinsic and extrinsic. Intrinsic feedback takes place when the consequences of performing a particular act are indicated as an outcome to the learner, while they are completing a task. Extrinsic feedback is not "situated" within the learner's immediate action and may take the form of right-wrong, attention-focusing or the correct answer (Merrill et al., 1992). Right-wrong feedback does not convey any basis for correcting a wrong answer, much like supplying the correct answer. Attention focusing feedback directs the learner's attention to key aspects of the designated task with the goal of inducing correction of their misconceptions. Either extrinsic or intrinsic feedback must be conveyed in a positive, encouraging and non-critical way in order to facilitate learners' motivation (Horton, 2000).

9) Instructional Assessment

Instructional Assessment is a major concern when designing any kind of instruction (Dick & Carey, 1996; Smith & Ragan, 1999; Govindasamy, 2002). Instructional assessment can provide information about the achievement of learning goals and its results can be used to diagnose learning difficulties and help in planning instruction. The most important thing about instructional assessment is a direct match between stated learning outcomes and what is evaluated (Weston et al., 1999). Govindasamy (2002) asserts that assessment reinforces the learning approach a learner adopts. If learners are often tested on higher order thinking skills, they are likely to adopt the desirable deep holistic approach to e-Learning, while if they are tested on lower-order thinking skills, they would probably be encouraged to practice the atomistic approach to learning (Twomey, 1996). With opportunities for assessment, which have relevance and purpose, it is possible for learners to "own" the set of assessment tasks. Importance of task ownership has been emphasized (Brown

et al., 1989), where learning is linked closely to the environments where the learning will be used.

10) Media Use

Media use has a prominent position in web design and instructional design literature. Nielsen (2000) outlines the importance of proper integration of multimedia elements into web pages. In addition multimedia can reduce the effort required to convey a message (Driscoll, 2002). All media elements especially animations should be used effectively and attractively (Keeker, 1997). IBM (2000) provides specific design guidelines so that media elements can be used to enhance usability: a) provide user control, b) inform users of the content and size of media objects, c) use animations to attract attention, and d) use animations to enhance explanation. Despite the fact that multimedia elements such as video and animation could enhance presentation, they should be used properly so as not to affect usability (Zhang et al., 2006; Nielsen, 2000; IBM, 2000). Additionally, unnecessary media should be avoided to prevent long downloading time. When it comes to e-learning the emphasis should be put on effectiveness of multimedia and its impact on learning and motivation (Heller and Martin, 1999). E-learning designers should take extra care when introducing multimedia elements as improper use of them may distract learners and affect usability (Shiratuddin et al., 2003). Choice of media should be driven by the performance and content stated in the learning objectives (Driscoll, 2002). In a learner-centered approach to designing e-learning applications the primary focus should be on the learner and their existing knowledge and experience; media should be designed in order to address the learners' pre-determined learning styles and individual approaches to learning whenever possible (Wild and Quinn, 1998). In any case designer's goal is to increase engagement and focus attention (Driscoll, 2002; Clark and Mayer, 2003).

11) Learner Guidance & Support

Providing learners with guidance and support is a serious matter in any learning context. E-learning requires learners to adapt to new learning methods (Clark and Mayer, 2003); learners have to master to use browsers, navigate through non-linear programs, interact with peers, instructors, experts using unfamiliar tools such as chat-rooms, discussion boards and other computer mediated communication (CMC) technologies (Driscoll, 2002). The need for further support for learners using the Web and CMC is also evident in other studies (Alexander et al., 1998). As part of the design process, consideration is given to elements which will help learners to locate the resources they require for study, to navigate through the course materials, to manage the tools provided within and also a range of support facilities such as glossaries, guided-tours etc. (Horton, 2000). Govindasamy (2002) argues that learner support is one area of e-learning that is markedly different from the traditional classroom delivery method; introduction of performance support features have to be foreseen in advance in e-learning design. In addition learners cannot be given complex and authentic tasks with no support or coaching to guide their learning (Lanzilotti et al. 2006; Jonassen, 1998). Wade (1994) pointed out that learner's autonomy and responsibility if it is to succeed, requires "*a strong framework of support and guidance for the student from the outset*". In conclusion, Govindasamy (2002) directly relates learners' support with motivation or positive reinforcement of the learners.

12) Learning Strategies Design

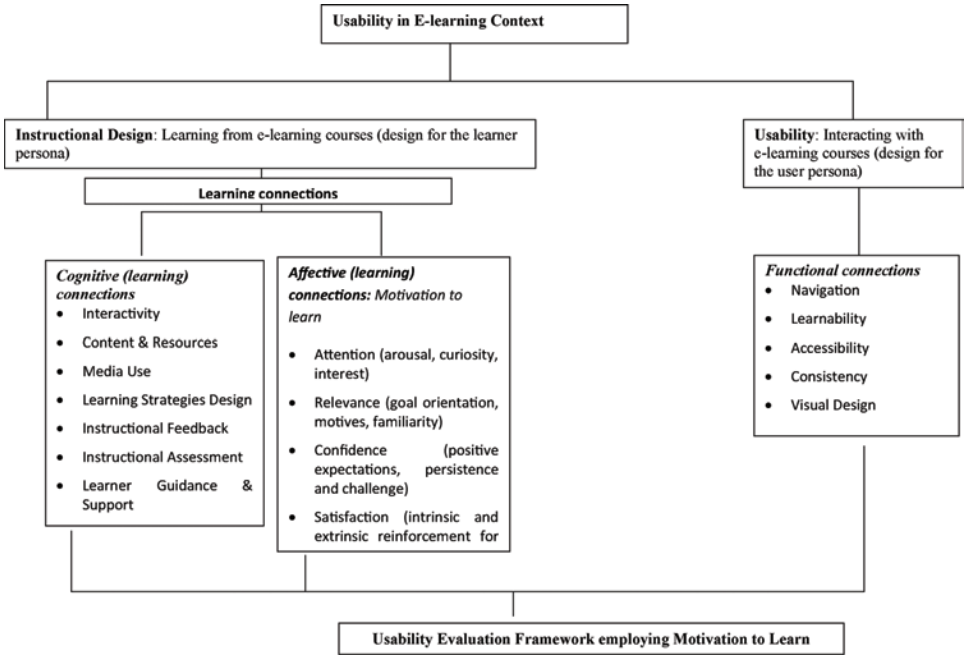
It is imperative for an e-learning designer to take into account how certain learning strategies can be conveyed or facilitated through interface design. Learning strategies refer to how key tenets of learning theories and pedagogies can be practically implemented (Cercone, 2008; Kiili, 2007).

Recently the main emphasis has been given to socio-constructivist view of learning (Brown et al., 1989; Jonassen, 1994; Tam, 2000; Squires and Preece, 1999). Squires and Preece (1999) use contextual authenticity as a key determinant for educational software design. Brown et al., (1989) emphasize the importance of task ownership in "situated cognition", where learning is linked closely to the environments where the learning will be used. A belief in contextualized learning also emphasizes collaborative learning in which peer group discussion and work is prominent in helping learners to learn (Jonassen, 1994; Tam, 2000). Clark and Mayer (2003) emphasize that collaborative learning and its integration with self-study makes e-learning unique. Conversation and collaborative tools (such as online discussion groups, bulletin boards etc.) enable communities of learners to negotiate and co-construct meaning for problem solving and knowledge construction (Jonassen 1998). Use of collaborative learning activities, as well as periodic online discussions, conferences and chat sessions have been considered as main elements for the enhancement of learners' motivation (Horton, 2000).

Following the discussion presented in section 2 and 3, this framework focuses on the user of e-learning systems, the learner, in a holistic way by: a) integrating cognitive and affective aspects and b) addressing the specificities of the double persona of the *user – learner*. This double persona implies functional and cognitive connections. According to this view *using* an e-learning course requires functional connections while *learning* requires cognitive and affective connections (Figure 1).

The usability parameters (derived from web usability and instructional design) as included in the proposed framework reflect the required connections: *Navigation, learnability, accessibility, consistency* and *visual design* represent the appropriate functional connections of an e-learning course. These functional connections with emphasis on the *form* facilitate the *user persona* while interacting with an e-learning application.

Figure 1. A usability framework augmenting 'traditional' usability constructs with instructional design and motivation to learn



In addition *Content and Resources, Interactivity/ engagement, Media Use, Learning Strategies Design, Instructional Feedback, Instructional Assessment* and *Learner Guidance & Support* represent the appropriate learning cognitive connections. The latter help the *learner persona* to achieve his/her learning goals while using an e-learning application. The proposed framework goes a step beyond and extends the current practice by integrating the required cognitive connections with affective learning connections such as, in this case, learners' intrinsic motivation to learn. The latter can be proposed as a new usability dimension, which is more appropriate when assessing the usability of e-learning designs (Zaharias, 2006). The following section presents empirical uses and potential practical applications of the proposed framework.

PRACTICAL APPLICATIONS OF THE FRAMEWORK

The framework proposed in this article can be a multi-functional tool in the hands of e-learning designers and usability practitioners. A further elaboration of the framework leads to the formulation of practical usability measurement criteria. Such criteria can be used either in formative or summative usability evaluation efforts. As Heller and Martin assert, this framework and the respective criteria can be "*the floor not a ceiling for a series of guidelines that can be used to generate evaluation questions*" about an e-learning application. More specifically, the authors propose the following e-learning usability criteria as they have been adjusted to the usability parameters of the framework (see Table 2).

In the following practical applications of the framework are provided:

1) E-learning designers can use the framework's parameters at the early stages of the e-learning design lifecycle. The parameters included in the framework can serve as a basis for producing design principles that will guide the designers to design and develop e-learning applications with "motivational" quality. Zaharias and Poulymenakou (2007) have used this framework to propose a set of design guidelines for asynchronous e-learning applications. Table 3 exhibits some of these guidelines.

A more comprehensive list of design guidelines according to the framework can be found in (Zaharias and Poulymenakou, 2007).

2) New usability evaluation methods for e-learning applications can be developed according to the proposed evaluation framework: for example a usability engineer can build a checklist-based or a questionnaire-based usability evaluation method where new items can be developed in order to measure the usability of e-learning according to the key tenets of the framework. Zaharias (2006) has developed a questionnaire-based usability evaluation method for e-learning following this framework. A psychometric-type of questionnaire was developed to measure users' perception of e-learning usability and motivation to learn. The design parameters included in the proposed usability framework were the main constructs included in the questionnaire. These constructs were measured with items adapted from prior research. The usability questionnaire was developed according to the methodology suggested by Kirakowski and Corbett (1990) and was empirically tested in two pilot trials. Findings revealed satisfactory levels of the questionnaire's main psychometric properties, i.e. reliability and validity. Further information regarding the development of the method is provided in Zaharias (2006) and Zaharias and Poulymenakou (2009).

Table 2. Usability parameters and measurement criteria

Usability parameters of the framework	Measurement criteria
Learnability	• The e-learning application layout is sufficiently apparent so that learning can develop without extensive consultation of online help. • Learners can start the application (locate it, install plug-ins, register, access starting page) using only online assistance • It is clear what learners should do if they get stuck or have questions • Learners can predict the general result of clicking on each button or link
Accessibility	• The pages and other components of the application download quickly • The e-learning application is easy to install, uninstall and launch • The e-learning application is free from technical problems (hyperlink errors, programming errors etc.)
Consistency	• Terminology of the functions is used consistently throughout the e-learning application • The fonts, colors and sizes are consistent throughout the e-learning application • The application maintains an appropriate level of consistency in its design from one part to another.
Navigation	• Learners can choose (easily) what parts of the e-learning application to access, the order and pace of studying • Learners have control of their learning activities (studying, exercising, collaborating with other peers etc.). • Learners always know where they are in the application. • The e-learning application allows the learner to leave whenever desired, but easily return to the closest logical point in the course. • The application layout is sufficiently apparent so that learning can develop without extensive consultation of online help. • It is clear what learners should do if they get stuck or have questions
Visual Design	• The most important information on the screen is placed in areas most likely to attract the learner's attention • Text and graphics are legible (readable). • Fonts (style, color, saturation) are easy to read in both on-screen and in printed versions • The online help or documentation is written clearly
Interactivity/engagement	• The courses use games, simulations, role-playing activities, and case studies to gain the attention, and maintain motivation of learners. • The courses provide meaningful interactions (for example embedded quizzes, tests etc) when there are long sections of text • The courses provide access to a range of resources (web links, case studies, simulations, problems, examples) appropriate to the learning context and for use in the real world • The courses engage learners in tasks that are closely aligned with the learning goals and objectives. • Media are used appropriately so as to assist in highlighting and learning critical concepts rather than merely entertaining or possibly distracting learners.
Content & Resources	• Content is organized in an appropriate sequence and in small modules for flexible learning. • The material in the course is accurate and current. • The course covers the subject in sufficient breadth and depth to meet the learning objectives • Resources are provided in a manner that replicates as closely as possible their availability and use in the real world • Text blocks are written in minimalist style: compact, yet useful • The courses provide access to a range of resources (web links, case studies, simulations, problems, examples) appropriate to the learning context • Vocabulary and terminology used are appropriate for the learners. • Abstract concepts (principles, formulas, rules, etc.) are illustrated with concrete, specific examples. • All units/modules in the courses include an overview and a summary. • Learning objectives of each module are quite (obvious) clear to the learners.

continues on following page

Table 2. continued

Usability parameters of the framework	Measurement criteria
Instructional Feedback	• The courses motivate learners to request feedback from instructors, experts and peers, through e-mail or other online communications • Feedback given (by exercises or simulations etc.) at any specific time is tailored to the content being studied, problem being solved, or task being completed by the learner.
Instructional Assessment	• The courses provide opportunities for self-assessments that advance learners' achievements. • Wherever appropriate, higher-order assessments (for example case studies, business simulations, discussion topics etc.) are provided rather than lower-order assessments (for example simple quizzes and tests) • Post-tests and other assessments adequately measure accomplishment of the learning objectives.
Multimedia Use	• Graphics and multimedia assist in highlighting and learning critical concepts rather than merely entertaining or possibly distracting learners. • Graphics (illustrations, photographs, graphs, diagrams, etc) are used appropriately, for example, to communicate visual and spatial concept. • Media (text, images, animations, etc.) included have a strong connection to the objectives and design of the courses.
Learner Guidance & Support	• The online help or documentation is written clearly • The online help is screen- or context-specific • The courses offer tools (taking notes, job-aids, recourses, glossary etc.) that support learning. • The course provide support for learner activities to allow working within existing competence while encountering meaningful chunks of knowledge
Learning Strategies Design	• The courses provide opportunities and support for learning through interaction with others (discussion or other collaborative activities). • It is clear to learners what is to be accomplished and what will be gained from its use. • The courses include activities that are both individual-based and group-based. • The courses provide learners opportunities for reflection
Motivation to learn	• The e-learning application incorporates novel characteristics • The e-learning application stimulates further inquiry • The e-learning application is enjoyable and interesting • The e-learning application provides instruction/training that matches with learners' experience • The e-learning application meets learners' needs • The e-learning application provides learner chances to make decisions • The e-learning application provides learner with frequent and varied learning activities that increase learning success. • Learning requirements, criteria for learning success are clear within the e-learning application • The e-learning application provides learners opportunities to use new skills in authentic situations • The e-learning application assists learners to have positive feelings about their accomplishments

CONCLUSION AND FURTHER RESEARCH

Designing usable e-learning courses and applications is important but not enough. The design of e-learning must address users as learners. As emphasized in this paper, there is a need for usability frameworks and respective methods that may focus on e-learning specificities and address users as learners. An extended view of usability in e-learning context is more than necessary. Such a task is not trivial; Designing for the double persona of the learner-user imposes extra difficulties to e-learning designers and usability practitioners. In this work authors proposed that conventional and more generic web usability parameters that have been defined and used in e-commerce and other relevant applications, could be augmented with new ones derived from instructional design. In addition most of the current relevant efforts are

Table 3. An excerpt of design guidelines for asynchronous e-learning

Design guideline # 1: Design interactive content
• Illustrate abstract concepts (principles, formulas, rules, etc.) with concrete, specific examples • Use games, simulations, role-playing activities, and case studies to gain the attention, and maintain motivation of learner • Provide meaningful interactions (for example embedded quizzes, tests etc) when there are long sections of text • Provide access to a range of resources (web links, case studies, simulations, problems, examples) appropriate to the learning context and for use in the real world • Develop media so as to assist in highlighting and learning critical concepts rather than merely entertaining or possibly distracting learners.
Design guideline # 2: Provide constructive and instructional feedback
• Provide where appropriate, higher-order assessments (for example case studies, business simulations, discussion topics etc.) rather than lower-order assessments (simple quizzes and tests) • Provide feedback which is tailored to the content being studied, problem being solved, or task being completed by the learner

not based on a holistic approach, which requires the effective integration of cognitive and affective learning parameters. The review of relevant work revealed a lack of focus on integrative approaches (i.e. the combination of web usability and instructional design) that augment the more "traditional" usability interpretations and a lack of focus on affective parameters that influence learning effectiveness. Motivation to learn, the most prominent affective learning factor, is the main pillar of the framework as developed in this work. The authors support that identifying usability parameters that affect intrinsic motivation to learn is a crucial and attainable goal when designing and evaluating e-learning. The main objective of this work is to provide a comprehensive way to describe e-learning usability. This framework provides e-learning designers and usability engineers a scientifically sound basis in order to further develop methods and techniques for ensuring and evaluating quality of their designs under an extended usability perspective with an affective orientation.

Future research is focused on further empirical validation of the framework. Such an objective implies a series of practical applications of the framework mainly through the development of new usability evaluation methods or enhancement of existing ones. Authors currently undertake further empirical testing of the questionnaire-based technique that has already been developed by Zaharias (2006). Additionally further refinement of usability criteria presented in this paper is already under way. Empirical use of design guidelines may lead to the development of a heuristic evaluation protocol according to the usability parameters of the framework.

At a macro level, this paper also stresses the need that future research must address the establishment of communication channels for a closer and fruitful collaboration between research communities from HCI, Educational Psychology and Instructional Design in order to better understand the learner and enhance the quality of e-learning experience. Authors' ultimate goal is that this framework enables members from these communities to have a common vocabulary and a sound basis for further analyzing and describing this complex phenomenon such as e-learning usability.

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Chapter 7
Humans and Emerging RFID Systems:
Evaluating Data Protection Law on the User Scenario Basis

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ABSTRACT

Radio Frequency Identification (RFID) technology offers a lot of promises. To redeem them, RFID applications have to respect privacy and they need to be supported by the legal system. The article evaluates how the current EU directives on data protection support emerging applications that are based on RFID tags. The evaluation is based on user scenarios that illustrate human needs in relation to technologies and applications. The article continues earlier analyses and uses more realistic and state-of-the-art applications and scenarios. We conclude by pointing out further research needs in the field of RFID and data protection.

INTRODUCTION

Radio Frequency Identification (RFID) is an important technology to enable the Internet of Things, ubiquitous computing (ubicomp), ambient intelligence (AmI), and other promising future platforms. In short, the main components of RFID technology are a tag and a reader. The tag has an electronic circuit storing data and an antenna to communicate using radio waves. The reader also has an antenna, and electronics to translate the incoming data to be processed by a computer. A reader may thus send a radio signal requesting tags

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to identify themselves, and tags reply by sending the information that is stored in them.

The simplest and the most inexpensive RFID tags are called passive tags. They do not have any internal power supply. Enough power for the tag to power up and transmit a response is induced in the antenna by the incoming radio frequency signal. Passive tags are typically quite small, in the size range of a stamp. Therefore, a passive tag is relatively easy and cheap to place in almost any object.

Active tags, in contrast, include internal power supplies. They are able to communicate further, and store and process more information. Although active tags are more versatile than passive tags, they can be much more expensive, larger, and more difficult to place.

While RFID tags become smaller and cheaper, reader technology is also developing. It is already possible to equip, for example, mobile phones with RFID readers. Thus not only tags, but also readers are spreading widely and enabling an unforeseeable amount of new services.

RFID technology is said to advantage not only businesses but also individuals and public organizations in many ways. It enables useful new services and applications. The benefits of RFID tags are apparent, but their exploitation has been retarded by notable obstacles. So far, there have been three main problems that have hindered the diffusion of RFID technology: First, the technology has not been mature enough. Second, there has been a lack of standards. Third, there have been severe concerns on the risks that RFID poses to the end-users privacy. In this article, we concentrate on the third problem. Especially, with the help of RFID tags, it is possible to collect and process personal information on human-beings.

Many researchers have studied RFID privacy issues in recent years. The following brief list includes some of the important studies related to this topic.

Ohkubo, Suzuki, and Kinoshita (2003, 2005), Lahlou, Langheinrich, and Röcker (2005),Garfinkel, Juels, and Pappu (2005), Juels (2005) and Garfinkel (2006) have discussed various RFID related threats and potential solutions to them.

Langheinrich, Coroama, Bohn, and Mattern (2005) have presented some of the consequences of ubiquitous computing implied by several scenarios.

Spiekermann and Ziekow (2006) have analyzed consumer fears associated with the introduction of RFID technology.

Goel (2007) has outlined critical barriers in implementing RFID technologies, specifically for authentication and privacy, and provided a set of initial responses.

Langheinrich (2007) has gathered a good overview of earlier studies in this field.

From the legal viewpoint, Kardasiadou and Talidou (2006) have discussed the implications with emphasis to data protection.

Kosta and Dumortier (2008) have excellently analyzed European data protection legislation and its ambiguity in relation to RFID.

Also, some official reports have been published on RFID privacy issues. For example, in Europe, the advisory body called Article 29 Working Party has published a working document, which aims to provide guidance to RFID deployers, manufacturers, and standardization bodies. (Art 29 WP 105, 2005) In the USA, Federal Trade Commission (FTC) has published a staff report on RFID Applications and Implications for Consumers (2005).

The above mentioned working paper by Article 29 Working Party was criticized that the examples of RFID applications do not represent reality. Societal benefits and a realistic appreciation of technical possibilities should be looked at when judging RFID applications. (Art 29 WP 111, 2005) Similar problems can be found in all the studies in this field. This is not surprising, since it is very difficult to predict, what the actual applications will be. The examples are always somewhat limited. This article is not trying to exhaustively patch up the lack of realistic RFID applications. Yet, we aim at improving the picture on privacy

challenges by studying several RFID, ubicomp, and AmI applications that have been developed in research projects. We are also evaluating the current European data protection law to find out how well it will suit the future needs.

In the following, we first describe a few scenarios and forthcoming applications of RFID technology to illustrate potential privacy problems. In the next chapter, we depict sample technological solutions to those problems, and show that each of them has shortcomings. Thus, technology alone is not enough, but needs support from legal tools. In the following chapter, we introduce the European data protection law and evaluate its applicability to the RFID scenarios described earlier. In the last chapter, we conclude that even though the European system provides users with a reasonable protection, it will be necessary to continuously follow the development to ensure that the law will not harm useful businesses and that the law remains adequate to emerging technologies.

RFID APPLICATIONS

Scenario methods can be used to evaluate possible future applications and services. (Pitkänen, 2006a) In the following, we go through several RFID applications and scenarios to see, what sort of privacy threats are likely to occur in the future.

MIMOSA

Microsystems platform for MObile Services and Applications (MIMOSA) was a European research project supported within the IST priority of the Sixth Framework Programme. It developed a set of scenarios to show how RFID technology could look and feel in different everyday situations. The scenarios were evaluated for credibility, acceptability and technical feasibility. Therefore they represent realistic and societally beneficial applications while also showing ambitious and guiding future possibilities. (Niemelä et al, 2005)

Below, the two health care scenarios are presented in more detail, since they include interesting data protection issues. The other MIMOSA scenarios are quoted more superficially.

Health Care Scenarios

Travelling and taking care of diabetes. (Niemelä et al, 2005) Ines is retired and travels a lot despite of her diabetes. For diabetic persons, it is vitally important to frequently monitor their blood sugar (glucose) level. At home, Ines uses a quick blood test to monitor her blood sugar level and injects insulin regularly. However, when travelling, she feels that diabetic-special smart plasters are handier because of irregular life during travel. The smart plaster can be worn for 24 hours at a time and it monitors glucose level of the blood as well as automatically adjusts the insulin dosage according to the user. Although quite expensive, the plaster is easy to use and wear.

The smart plaster analyses the glucose level of the blood sampled by a set of micro needles. This information is sent via Bluetooth to a mobile phone. The mobile phone warns if the blood sugar level starts to be seriously offset. In addition, the information is sent to a server, which stores the data for later analysis. Based on the long-term information of the glucose level variation, the diabetic together with the supporting team can evaluate whether the treatment has been effective.

In a four-week travel to China, Ines notices that her insulin will be running out in a few days. Ines goes to the local pharmacy, in which all medicine labels are written in China only. Ines uses her mobile phone to recognise equivalent insulin. The hand-held device indicates appropriate insulin with a light signal, and it also checks compatibility of the medicine to other medicines Ines is using as well as allergies.

If all the relevant information is not available in the database, or if the connection to the database fails, the mobile phone suggests contacting Ines' family doctor or the local call centre for advice.

The family doctor has access to Ines' medical history as agreed with Ines earlier, so the doctor is able to follow Ines' medical conditions on-line whenever needed.

From privacy viewpoint, the processing of medical information – like described in the scenario – represents most sensitive a case. One should be extremely sure that unauthorized access to that personal information is made impossible.

Another important privacy issue highlighted in this scenario is internationality: while travelling abroad, even in other continents, the individual should be as confident with regards to the processing of personal information as in the home country.

Looking after Louis the toddler. (Niemelä et al, 2005) Rosalita and Jorge have a 20-month old son Louis suffering from several allergies and an often repeating flu. The parents has put small, light-weight wearable sensors on Louis' skin that continuously measure his skin temperature and sweating. In Louis' clothes, there are sensors that measure his heart-beat and breathing patterns. All sensor information is wirelessly send to both Rosalita's and Jorge's mobile phones. If Louis is crying and bad-tempered with no obvious reason, the parents check Louis' condition in the mobile phone. If the sensor data values exceed certain threshold values, the mobile phone will alert it's owner.

In addition, Rosalita and Jorge have installed a movement and activity monitoring system in their home and backyard. The system includes activity sensors in walls, floors, and furniture, as well as in the garden. The system monitors vivid Louis' activities when he's awake and in sleep, whether he is inside the house or in the backyard. If Louis is trying to access dangerous places, for instance, to walk away from the backyard, the system alerts the parent at home by calling an alarm sound in the mobile phone.

The sensor and activity data are continuously collected to the hand-held device's memory and regularly send to a database on a server. When Louis is taken to the family doctor either for his regular examination or because of alerting symptoms, the doctor is able to check his health condition history from a year's time.

Considering the legal aspects of this scenario, the sensitive personal information on one's healthy is again at the central. The outsiders should never get an access to that information. But in this case, it is also interesting, who is an outsider and who is allowed to view the information. A small child needs the parents to take care of healthy issues, while adults do not necessarily want to share their own medical information even within the family. Therefore, it is necessary to define the group that may access the information case by case.

Other MIMOSA Scenarios

MIMOSA published some of the applications under the label of "Everyday Scenarios". 'Everyday' refers implicitly to normal usage for ordinary people in the European Union, i.e. the scenarios do not presume any special circumstances. Yet, the scenarios do not explicate cultural aspects and thus it is possible that they do not represent everyday situations in other cultures. The everyday scenarios of MIMOSA illustrate the use of mobile centric ambient intelligence in common situations, which often take place in public environments. The scenarios especially describe the use of tags and physical selection of tags for interaction by touching them or pointing at them from a distance with the mobile phone. (Niemelä et al, 2005)

The sport and fitness scenarios demonstrate the use of sensor measurements to understand better performance in exercising and to maintain motivation. Several performance-related measures can be collected of a person over a long time, helping to follow the progress and providing instant feedback in the user's personal mobile phone. (Niemelä et al, 2005)

The housing scenarios illustrate MIMOSA applications in housing as well as home and fam-

ily contexts. The scenarios focus on the benefits received from remote monitoring and controlling housing applications with a mobile phone, and how this can be used to support independent living of elderly people and ease the burden of their care-takers. (Niemelä et al, 2005)

These scenarios represent several privacy-related issues. In many cases, the technology is used in public spaces where others can easily access the data that is stored in RFID tags or transferred to a reader. The housing scenarios, on the other hand, represent situations in which most private information is to be managed.

MobiLife

MobiLIfe was an Integrated Project (IST-511607) in European Union's 6th Framework Programme. It was to bring advances in mobile applications and services within the reach of users in their everyday life by innovating and deploying new applications and services based on the evolving capabilities of 3G systems and beyond. Enabling technologies include RFID, Bluetooth, sensors, and so on.

The project created and evaluated a set of scenarios. They illustrate the key user requirements of modern family life that can be supported by mobile services and applications and identify the requirements to the underlying technologies that will enable the provision of these services. Selected scenarios were further developed to mock-ups and probes.

Also, the project developed a mobile service framework that identifies the essential functional blocks for the implementation of the new mobile services and applications. (Räisänen et al, 2006) Especially *personalisation*, *adaptation*, and *context awareness* building blocks of the framework introduce significant privacy concerns, which *privacy and trust* building block tries to solve. However, technical solutions cannot alone solve the privacy issues. Therefore it is essential to assess the framework also from the legal viewpoint. It seems that MobiLife applications like any similar mobile service systems will be facing significant challenges with privacy and data protection. Lots of personal data will be processed and transferred. For example, the system will not only collect information on the end-users to personalize services, but also – using e.g. RFID tags and Bluetooth devices – information on the context, environment, and circumstances in which the end-users are, including information on the other people in proximity. (Pitkänen, 2006b)

The system as a whole can be distributed to a large extent. There are important legal cross-border issues related to a distributed system like those that implement MobiLife architecture. If a system is distributed in several countries, all the applicable laws should be obeyed. For example, transferring personal information even within the system but between organizations and/or countries may violate data protection law. Similar problems arise if MobiLife system is connected to other systems. So, both internal and external data processing should be legal. Also, data protection directives are implemented in slightly different ways and they are not applicable outside the EU. Thus there are differences e.g. which information is to be provided for data subjects, i.e. for those whose personal data is processed. (Pitkänen, 2006b)

TECHNOLOGICAL SOLUTIONS TO PRIVACY PROBLEMS

RFID developers are aware of the potential privacy problems that RFID applications may bring up. The engineers have also found several clever technical solutions to the problems. Some of them are briefly introduced below. As discussed above in relation to the scenarios, RFID technology will be likely to process information that must not be accessed by unauthorized third parties. Also, the end-users should be able to control how the information is processed and who may access it.

Kill Tag

A typical application for RFID technology is to use them to identify goods within a logistics chain and in the store. Many researchers have pointed out that these RFID tags that replace barcodes in packaging pose a threat to privacy since the tags can be used to trace a customer. (e.g. Garfinkel et al, 2005) The simplest way to solve these privacy problems is to kill (i.e. disable), or remove tags at the point-of-sale. If the tag is no longer able to communicate, it will not pose any privacy threats either. However, a tag can be valuable also after sale. It is presumed that there will be lots of useful services that are based on the "Internet of things." If all objects around us were equipped with RFID tags, it would enable services that benefit individuals as well as businesses. Today, it is hard to imagine all the innovations that it might facilitate. Although the kill tag approach is inexpensive and relatively secure way to enhance privacy, it reduces these possibilities. Also, the MIMOSA scenarios above present RFID applications in which killing the tag is not an option. (Garfinkel et al, 2005; Goel, 2007; Ohkubo et al, 2003; Ohkubo et al, 2005)

RFID Blocker

A blocker tag prevents RFID tags from being read. RFID readers cannot read more than one tag at a time, because the reader is unable to decipher radio waves reflected back by two tags simultaneously. So vendors have developed anti-collision protocols to enable the reader to communicate with one tag at a time in rapid sequence. The blocker tag essentially confuses the reader by always responding, thereby preventing any tags from being read. (RSA, 2003; Garfinkel et al, 2005)

The blocker tag has some notable limitations. Although it does not disable RFID tags permanently, it blocks temporarily all the RFID applications, also those that the person would like to use. Thus RFID blocker significantly limits the possibilities that the technology offers. For example, the applications in the above scenarios would be much less useful, if the blocker tag were used in their surroundings.

Also, Garfinkel et al (2005) note that a sophisticated adversary might well be able to develop a reader that sometimes defeat blocker tags and thus blocker tags provide nothing like foolproof protection.

Privacy Bit

An alternative is to set aside a logical bit on the RFID tag. This bit is initially off when items are in the shop. The bit is flipped to the on position to deactivate a tag at the point of sale. If RFID readers in shops refrain from scanning private tags, i.e., those tags whose privacy bit is turned on, then a good measure of consumer privacy will already be in place. Tags belonging to consumers in this case will be invisible to shops. At the same time, tags on items on shelves and storage rooms, i.e., those that have not yet been purchased, will be perfectly visible. The privacy bit will not impact normal industrial use of RFID. (Juels, 2005)

Home appliances, on the other hand, should contain RFID readers capable of scanning private tags. RFID readers that scan tags for item returns in shops might likewise have this capability, if consumers want it. With proper RFID reader configuration, the privacy bit is an interesting compromise between privacy and utility. To ensure this balance, there is a need to enforce proper reader configuration and to defend against rogue readers used intentionally to infringe privacy. Thus Privacy Bit is an excellent example of solutions that require both technological and legal components. (Juels, 2005)

Access Control (MIMOSA)

MIMOSA project developed a platform that includes the following key building blocks: personal mobile terminal device, wireless sensors

exploiting the RFID technology, highly integrated readers/writers for RFID tags and sensors, low-power short-range radios, novel sensors for context sensitivity, and intuitive, user-friendly interfaces.

These building blocks are the enabling technology for mobile centric ambient intelligence. The user is able to communicate with the surrounding environment by wirelessly reading local tags and sensors embedded to everyday objects with her personal mobile phone. In addition, the phone enables wireless connection to the internet. As the communication can be tied to a specific place, object, and time, this approach enables context related information and services.

Overall MIMOSA architecture specification is an example of a highly sophisticated service architecture that uses extensively RFID technology. The architecture includes an access control component that resides on the application server side. The access control component is consulted in case of an incoming acquisition request in order to determine appropriate access rights for the particular application with respect to the particular data requested. (Lappeteläinen et al, 2005)

A mechanism like this can provide an adequate privacy protection scheme for many kinds of emerging ambient intelligence services. However, a sophisticated access control requires remarkable processing and data storage resources. Therefore all the tiny ubiquitous computing devices cannot be equipped with such technology for the foreseeable future. Especially, this kind of solution is usually too expensive for mass-use. Consequently, such solutions will be important in certain types of services, but there will remain applications that cannot benefit them. (Garfinkel et al, 2005; Ohkubo et al, 2003)

LEGAL FRAMEWORK: DATA PROTECTION DIRECTIVES

It is important to notice that all the technological solutions introduced so far to enhance privacy protection in RFID applications are far from perfect. Actually, it is very questionable whether any technological solution alone could completely protect privacy while simultaneously enable all the desired applications. Some of the privacy protection technologies (e.g. kill tag and all the expensive solutions) reduce the useful applications area significantly. The rest of them, to be efficient, require strong support from the legal or other non-technological systems (e.g. economic or social incentives). For example, Garfinkel's (2005 and 20062006) "RFID Bill of Rights" works only as long as everybody voluntarily follows the model, unless there is a law or another strong incentive that forces them. Likewise, the Privacy Bit presented above, does not work without proper legal support. Without good incentives or regulatory force, it is more tempting to ignore technical privacy protection solutions while developing the systems. Also, most solutions depend on people's trust in something (e.g. in technology that is said to protect privacy, in a company that claims to respect their customers' private data, and so on). The legal system that ensures reasonable protection could be the one that is trusted and thus fosters the technology and business. If the legal system included a built-in support for adequate technical solutions, it would reduce remarkably the cost to implement a working solution.

In the following, we briefly present the current legal framework and evaluate its ability to foster RFID applications.

The legal basis of data protection within the European Union is the EU Directives on data protection, especially the general Directive 95/46/EC on the protection of personal data, but also the more specific Directive 2002/58/EC on the protection of personal data in the electronic communications sector. (Kosta & Dumortier, 2008)

The Data Protection Directive applies to the processing of all personal data. Under the Directive, 'personal data' is very broadly defined and includes 'any information relating to an identified or identifiable natural person'. In assessing

whether the collection of personal data through a specific application of RFID is covered by the data protection Directive, we must determine (a) the extent to which the data processed relates to an individual and, (b) whether such data concerns an individual who is identifiable or identified. (Art 29 WP 105, 2005; Directive 95/46/EC; Kosta & Dumortier, 2008)

Therefore, although not all the data processed in an ambient intelligence system is governed by data protection law, there will be many scenarios where personal information is collected through RFID technology. Especially, if RFID technology entails individual tracking and obtaining access to personal data, data protection law is directly applicable, but also in cases where the information gathered through RFID technology is linked to personal data, or personal data is stored in RFID tags, it is likely that data protection law applies. (Art 29 WP 105, 2005; Kosta & Dumortier, 2008)

The processing of personal data is not illegal in general. On the contrary, the data protection law tries to enable useful processing of personal data. However, the processing needs to be carried out in accordance with the law. Especially, the Data Protection Directive (95/46/EC) requires that personal data must be

- processed fairly and lawfully;
- collected for specified, explicit and legitimate purposes and not further processed in a way incompatible with those purposes;
- adequate, relevant and not excessive in relation to the purposes;
- accurate and, where necessary, kept up to date.

Personal data may be processed only if the data subject has given an unambiguous consent or there is another lawful basis for processing. The controller must provide the data subject with certain information, including the purposes of the processing for which the data are intended.

It is also important that disclosing by transmission, disseminating or otherwise making available to others is processing of personal data and thus needs also consent or another lawful basis. Especially, transferring personal data outside the European Union is highly restricted.

There are some important restrictions to the applicability of data protection law. Usually, if a natural person in the course of a purely personal or household activity processes personal data, the data protection law is not applied. Furthermore, the data protection law applies only partially to journalistic and artistic context. Also, the law is not always applied to data processing that is related to e.g. national security, criminal investigation, or important national financial interests.

Completely automated individual decisions are restricted. The directive sets strict limitations to decisions, which produce legal effects concerning individuals and which are based solely on automated processing of data intended to evaluate the individuals' personal aspects, such as performance at work, creditworthiness, or reliability.

Certain sensitive information should not be processed at all without special lawful reasons. These special categories of data include racial or ethnic origin, political opinions, religious or philosophical beliefs, trade-union membership, data concerning health or sex life, and data relating to offences, criminal convictions or security measures.

EVALUATION

How are RFID tags and other AmI technologies going to affect data protection? Because devices that are able to exchange information on people are spreading, the quantity of privacy problems will arise. The scenarios above include a number of privacy issues. Although privacy problems are not that common today, it is predictable that they will be increasingly ordinary.

But will there be also something else? Will some qualitative changes also occur?

First, current legislation, although it claims to be technology neutral, is somewhat biased towards existing technical solutions, like personal computers, large displays, keyboards, and web pages. For example, according to the European Directive on privacy and electronic communications (2002/58/EC), services must provide continually the possibility, of using a simple means and free of charge, of temporarily refusing the processing of certain personal data for each connection to the network or for each transmission of a communication. It would be quite easy to fulfil such requirements with a PC based system, but very difficult with a tiny AmI device which has a minimal user interface.

Second, people's notion on privacy is changing. We are already getting used to the idea that while we are using for instance Internet services, someone can be able to observe our doings. While travelling abroad, we need to frequently present our passports and other documents, even though it makes it possible for authorities to follow our paths. In the past, that was not possible, but still most people are not concerned about the change. Either they accept the reduction of their privacy, because they think it is necessary or that they get something valuable instead, or they do not care. Anyway, it seems that most people will not object the gradual impairment of their privacy, and the younger people have views on privacy that are different from those of their parents (Acquisti & Grossklags, 2004; Allen, 2001; Lehtinen, 2007). The expectations of privacy are very much related to the surrounding culture and social norms and as they slowly change, people will also have a different notion on privacy.

For obvious reasons, especially medical scientists have been interested in ethical and legal questions on privacy in families. For example, if they study a disease that appears to be inherited in some families, they want to collect information not only on research subjects, but also on the whole pedigree. Based on his studies on medical pedigree research, Cook-Deegan (2001) has shown that studying a family does not reduce to studying a group of individuals one at a time. This opens the door to legal and moral concepts applied to collectives rather than individuals, which will be an increasingly important subject in scenarios such like those of MobiLife.

MIMOSA scenarios, especially the health care scenarios highlight the importance of data protection in relation to RFID technologies. Lots of sensitive information on data subjects' health is gathered by RFID tags, processed by mobile devices, as well as stored and further processed in a server. The scenarios clearly show how useful and valuable the technology can be for the end-user, but how urgent it is to protect the data. As mentioned above, the processing of sensitive data is strictly restricted by the Directive. MIMOSA Ines scenario is a good example to show the importance of this subject.

Louis the Toddler scenario on the other hand is less dubious since parents – as the legal guardians – have a right to get all the information on their children. Once again, however, it is necessary to make sure that outsiders are not able to access the sensitive health information.

Yet, recent studies have pointed out that especially teenagers consider privacy simply something that their parents and teachers do not know. (Lehtinen, 2007) Therefore, it is not always the optimal solution that parents make privacy decisions on behalf of their underage children. Actually, in many cases the biggest privacy risk is not that a malicious attacker or unwanted commercial marketing accesses our private information, but that our friends and relatives find out about us something that we do not want them to know. The new technology enables people to embarrass themselves in ways that they are not aware of. As this topic is becoming increasingly common, the question whether legal, technological, or other solutions are needed will soon require an answer.

The travelling scenarios like MIMOSA Ines scenario underline also the international aspects:

it is increasingly important to get an adequate level of protection also in the countries which are not members of the EU and in which the EU legislation is not directly applicable.

It was noted above that many privacy protection technologies need support from the legal system to be affective. Currently, the legal systems hardly provide that support. On the other hand, if the laws support certain technologies, it becomes challenging to make technology-neutral laws that are often considered desirable.

The sample scenarios and applications above suggest that it will require a lot work to develop systems that comply with the data protection directives, but also to streamline the directives in a way that they do not unnecessarily harm societally beneficial services.

CONCLUSION

The examples presented in this article show the importance of privacy and data protection in relation to RFID and other ambient intelligence technologies. Because the usage of RFID tags and AmI technologies increase rapidly, also the quantity of privacy problems will arise. The European legal system provides individuals with reasonable privacy and data protection, but it should be also ensured that the legal system will not unnecessarily hinder the development of useful services and the information society as it sometimes seem to be the case in the above examples. Especially, the directives should be made more technology neutral than they are today.

To identify research needs from RFID towards the "Internet of Things" with respect to privacy and data protection, we conclude that it is necessary to continue studies on user needs and privacy expectations and how well technologies and legal systems support them as well as what sort of new threats emerging technologies pose and how the legal system possibly hinders useful services.

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Chapter 8
‘Listening to the Voices of the Users’ in Product Based Software Development

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ABSTRACT

(IT) development, but it is often challenging, especially in the product based software development context. This article critically examines the practice of ‘listening to the voices of the users’; how it is accomplished in product based software development. First literature addressing users’ role in the product development context is reviewed. Afterwards, empirical analysis in three IT companies involved in product business but with different degrees of productization is carried out. In the analysis, the focus is on: 1) Where do the uses’ voices come from? 2) When are the users’ voices listened to? 3) What happens to the users’ voices; whether and how do they affect the development? 4) What are the challenges and particularities of each case? The analysis reveals similarities but also clear differences between the cases. Implications both for theory and practice discussed.

INTRODUCTION

This article critically examines the practice of ‘listening to the voices of the users’; how it is accomplished in information technology (IT) development, particularly in the product based software development context. Based on the degree of productization, software development strategies today could basically be characterized by a line with two ends and with variations in the middle. These two ends have been called by different names: custom or contract vs. product development (Grudin, 1991), customized vs. general products (Sommerville, 1995), custom

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vs. packaged software (Carmel & Becker, 1995), custom or made-to-order vs. packaged products[1] (Sawyer, 2000, 2001), custom-made vs. generic or consumer products (ISO, 1999), professional services vs. product business (Hoch, Roeding, Purket & Lindner, 2000), and product vs. services (Cusumano, 2004), to name but a few examples. In this article we will mainly focus on product based software development for a market of many possible customers as opposite to the traditional information systems (IS) type of custom development for one well known customer only. However, many software business organizations lie somewhere between these two extremes. Therefore, in this study we consider product based software development as development with the aim for a standard, generalized software even though the degree of productization may be different (high in mass-market packaged software and low in many enterprise solutions types of products).

As Grudin (1991) points out, we like to highlight product based software development from the point of view of its different relation to users compared to IS type of development – the uncertainty related to users, namely. Product based development is considered as a very challenging context from the viewpoint of listening to the users. In this context, products are developed potentially for large and heterogeneous user and customer populations in a situation in which both the users and the customers might be unidentifiable until the product is in the market, as well as very difficult to be in touch with during the development (Adam & Light, 2004; Grudin, 1991; Grudin, 1993; Grudin & Pruitt, 2002; Grønbak, Grudin, Bødker & Bannon, 1993; Iivari, 2006a; Keil & Carmel, 1995; Kujala, 2007; Symon, 1998). It is also typical that basic functionality is defined by marketing or even by engineering (Karlsson, Dahlstedt, Regnell, Natt och Dag & Persson, 2007). It has been criticized that users, if contacted at all, are contacted while defining issues related to human-computer interaction after the basic functionality has been defined (Beyer & Holtzblatt, 1998; Carmel & Sawyer, 1998; Grudin, 1991, 1993; Keil & Carmel, 1995).

However, it has been widely accepted that users should be taken into account in the IT development. In IS research, user participation has been central topic for decades, and currently legitimately labeled as an 'old, tired concept', which, however, needs revisiting (Markus & Mao, 2004). Especially the Scandinavian collective resources approach (Bjerknes & Bratteteig, 1995; Bansler, 1989; Kraft & Bansler, 1994; Kyng, 1998) has emphasized the importance of 'giving the users' (or more specifically the workers and their unions) a voice. The approach focused on workplace democracy and union involvement in the development of computer systems. The approach maintained that the workers need to be able to participate in the decision-making in their work place. Within the more recent participatory design (PD) or cooperative design tradition, however, political issues have decreased in importance. The focus has shifted from industrial democracy to participatory and cooperative design process, in which the developers and the users are to be appreciated as equal partners, both contributing their specific type of expertise (Asaro, 2000; Bjerknes & Bratteteig, 1995; Bansler & Kraft, 1994; Kraft & Bansler, 1994; Kyng, 1998; Spinuzzi, 2002). This contemporary tradition has recently been very influential in emphasizing active user participation in the design process (Greenbaum & Kyng, 1991; Schuler & Namioka, 1993). The field of Human Computer Interaction (HCI), and more specifically usability[2] research in HCI, on the other hand, has addressed particularly the product development context, and emphasized the importance of taking the users into account in approaches such as of UE (Usability Engineering) and UCD (User-Centered Design) (Bannon, 1991; Grudin, 1991; Gulliksen, Göransson, Boivie, Blomkvist, Persson & Cajander, 2003; Karat, 1997).

This article critically examines the practice of 'listening to the voices of the users'; how it is accomplished in the product based software

development context. Existing literature has already indicated that user involvement or user-centeredness might be used only as buzzwords or as weapons for achieving surprising or even paradoxical ends (Artman, 2002; Catarci, Matarazzo & Raiss, 2002; Hirschheim & Newman, 1991; Howcroft & Wilson, 2003; Iivari, 2006a, 2006b; Robey & Markus, 1984; Symon, 1998). However, there is a lack of empirical research examining what is involved in 'listening to the voices of the users' in the product development context.

The article is organized as follows. The next section reviews literature addressing the role of users in product based software development. The third section offers data about the research approach and methods utilized in the empirical case studies. The fourth section outlines the empirical findings. The fifth section discusses their implications. The final section summarizes the results and limitation of this article, and outlines paths for future work.

USERS IN PRODUCT BASED SOFTWARE DEVELOPMENT

As pointed out by Grudin (1991), depending on the development context the relationship with users and customers is different. In product based software development the uncertainty related to users and customers is a key characteristic that dominates the relationships. While 'listening to the voices of the users' in the product development context, the core issues relate to three main areas of software development: requirements determination, design and evaluation. During the early phases of development, the real users are considered as the best sources of knowledge related to the application domain. To know who the users are, and what they really need, and to understand their context of use in order to integrate this knowledge to functional and other requirements, are the special focus areas of the user-centered requirements process (ISO, 1999; Kujala, 2007). Second, design should be carried out together with the users, appreciating users' expertise regarding their work practice. Participatory design methods have been suggested for the product development context (e.g. Bødker & Buur, 2002; Grudin & Pruitt, 2002; Kyng, 1994). Third, evaluation (of scenarios, mock-ups, prototypes, etc.) conducted by real users is preferably done as early and as frequently as possible (Gould, 1988; ISO, 1999).

As mentioned, the HCI background has been very influential in the product based software development context. Traditional usability research focused on the user interfaces (see e.g. Helander, 1988). First, during the spread of personal computing, this has been quite a natural step with market of large number of individual users. Usability provided sufficient qualitative distinction to gain market success. Demanding specialized knowledge of its own (related to laboratory experiments, heuristic evaluations, expert reviews, etc.), in product companies this has typically been considered as a special area of usability experts (Siegel & Dray, 2003).

However, it has been criticized that this type of interface and evaluation -focused approach is still too 'technology-push' -type of polishing, and does not provide enough contact with the expected users during the uncertain early phases of development. Therefore, the principles of user-centered design started to highlight early and continual focus on users (Gould, 1988) during the early phases of development in order to move developers closer to the real users and to gain better understanding of their natural context of use (e.g. in Beyer & Holtzblatt, 1998). The interest turned to empirical inquiries in the user population with the aim to understand the users, their work practices and the context of use in depth, without the design team only asking the users about these issues, but instead the team observing them (e.g. in Beyer & Holtzblatt, 1998).

However, the concept of "the context of use" is in fact quite confusing from the product based

software development point of view (see e.g. Pollock, Williams & D'Adderio, 2007). The ideals behind the concept lead us to the customer-driven custom IS development. "Today, product development projects in particular have acquired the same motivation to involve users that in-house development projects had 10 years ago" (Grudin, 1991, p. 63). In custom IS development the users are typically known, yet in product based development during the early phases there is many times only preliminary ideas about who the potential users might be. In addition to the known confusion between user and customer (e.g. Poltrock & Grudin, 1994), there is the confusing relationship between one and many users or customers (Pollock et al., 2007). The concept of "context of use" refers to some specific users, yet with market of large user and customer population, product development needs to rely on the early assumptions made by the developers. Involving users in product development means involving some representative sample of the potential users (e.g., Butler, 1996; Vredenburg, 2003; Pollock et al., 2007). Especially under high market uncertainty, care must be taken when selecting the suitable representatives (Grudin & Pruitt, 2002; MacCormack 2001).

One could assume that the usability experts should be involved very early in the requirements determination, but, however, problematic is that in product organizations usability experts do not usually define the requirements, but it is within the field of other functions (Siegel & Dray, 2003; Karlsson et al., 2007), typically marketing. Marketing collects data on customers and users in different target markets (Nielsen, 1993, p. 85). Yet, marketing does not employ methods familiar to usability experts, their interest is not in the users and their work practices but instead in the one who is paying for the solution, and their results tend to be poorly communicated and difficult to utilize in the development (Beyer & Holtzblatt, 1998; Nielsen 1993).

In addition to the need of listening to the voices of the users during the requirements determination, there is the same need also during design and evaluation. However, it has already been noticed that PD methods tend not to be used in the product development context (Bødker & Buur, 2002; Grudin & Pruitt, 2002; Kyng, 1994). Evaluations involving the real or potential users, however, are popular in product development (Rosenbaum, Rohn, & Humburg, 2000; Vredenburg, Mao, Smith & Casey, 2002). In addition, direct contact with users during the usability evaluations provides feedback not only for the current product release, but "a newly released product can be viewed as a prototype of future products" (Nielsen, 1993, p. 110). Early feedback on the performance may also be considered as a strong link to the target market (MacCormack, Verganti & Iansiti, 2001; MacCormack, 2001). Furthermore, more "passive" sources like user complaints, modification requests, and calls to help lines may provide valuable feedback for future development (Nielsen, 1993), not to mention trade shows and training courses.

However, it needs to be acknowledged that the final product is the outcome of a "complex integration of many perspectives and considerations: business and market factors, technological possibilities and constraints, design constraints and trade-offs, and deep understanding of users and their interaction with the technology" (Siegel & Dray, 2003; Karlsson et al., 2007). Product based software development is always "done within a context of design trade-offs and limited resources. We are certainly justified in focusing some attention on user involvement, but we must do so while keeping in mind the difficult necessity of multidisciplinary communication" (Karat & Karat, 2003, p. 540). While traditionally user contacts are expected to deepen the developers' understanding concerning the real needs and requirements of the users, in product based software development user contacts are becoming input for the more multidis-

ciplinary release-planning process (e.g. Damian & Zowghi, 2003; Karlsson et al., 2007), where a continuous flow of requirements are gathered from many different sources and prioritized for the forthcoming product releases. Many times, in fact, this process is even separated from the more concrete part of development meaning that the main functionality of the new product is defined (by a different group of people) before even the development team is formed (Grudin, 1993). Requirements are to be seen as the outcome of a multi-disciplinary, cross-functional decision effort collaboratively reflecting customer experience (Hutchings & Knox, 1995; Karlsson et al., 2007).

However, despite the acknowledgement of the importance of the cross-functional collaboration, it has also been noticed that cooperation between different functions (usability, engineering, marketing, sales, customer support, documentation, etc.) is difficult (Beyer & Holtzblatt, 1998; Grønbak et al. 1993; Grudin, 1993; Hutchings & Knox, 1995; Karlsson et al., 2007; Mayhew, 1999; Poltrock & Grudin, 1994; Vredenburg, 1999). In product based software development, the usability experts have mainly been considered as people with a very limited area of expertise in development (Mayhew, 1999), and unfortunately, the position of usability experts in the company has proven as challenging (e.g., Gulliksen, Boivie & Göransson, 2006; Iivari, 2006a; Poltrock & Grudin, 1994). Gulliksen and co-authors (2003, 2006) have mentioned issues such as a professional and user-centered attitude as important principles of user-centered design, meaning that all the people involved should be committed to the importance of user-centered design. User-centered design denotes a cultural change providing an alternative development approach with activities, practices and methodologies appropriate for different phases of development (see e.g. Dray & Siegel, 1998; Mayhew, 1999; Tudor, 1998). User-centered design is linked to "product planning, quality, reduced risk, efficiency, and innovation" (Siegel & Dray, 2003). However, there are problems on the way. There are fundamental differences (e.g., in perspective, reward structures, and expertise; see Rosenzweig & Ziff, 2003) between the different organizational functions. As Siegel and Dray point out, there is a structural problem here, since it is very difficult to interfere with "business as usual" (Siegel & Dray, 2003). Adopting the user-centered approach may require substantial organizational change (Grudin, 1991; Iivari, 2006a).

RESEARCH DESIGN

Research Approach

In the empirical part of the research effort a case study method is utilized to examine "a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or few entities (people, groups, or organizations). The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used" (Benbasat et al., 1987, 370). Case studies are particularly suitable, if there is not much prior knowledge of the phenomenon under investigation, or there are controversies and conflicts in the current understandings (Eisenhardt, 1989). Related to listening to the voices of the users' in product development, as mentioned, there is a lack of empirical research.

More specifically, the case studies are interpretive case studies, in which the researchers attempt to understand and make sense of the world, not to explain in the sense of predicting. Focus is on meanings attached to the phenomenon under study. Aim is to produce 'thick descriptions', and to gain thorough understandings of particular cases. Theories are used only as sensitizing devices; they are not aimed at being falsified. (Denzin & Lincoln, 2000; Klein & Myers, 1999.)

Case Descriptions

Three companies provide us with three distinctive development contexts of product based software development. Data was gathered from different units inside the companies. Access to the companies was gained though a research project that was about improving the position of user-centered design in software development organizations. The development methods followed within these companies was not in our focus and what is even more interesting is that, although clearly well organized, no currently commonly known and appreciated development approaches (like RUP or agile methods) were formally followed or identifiable within the companies.[3]

The first development context (case A) was identified in a small-to-medium-sized IT development company with around 60 employees. The company provides information systems and software intensive products for national and international markets. The aim of the research project in this case was to improve the position of user-centered design in the company. Both action research-oriented researchers and qualitative, interpretive research -oriented researchers worked with the case. The results of the latter type of research are reported here. The aim of this part of research was to examine the context and the process of user-centered design as it naturally unfolds, documenting it as much as possible. We observed these issues for three years time. (For more information, see Iivari, 2006a.)

The second development context (case B) was identified within a medium-sized international software product company operating on business-to-business product markets. The aim of this case was to improve cross-functional collaboration. The main approach in this context was action research for three years time (Greenwood & Levin 2000, Baskerville & Wood-Harper 1996) where the researchers were working very closely with the practitioners while actually trying to solve their real problems with cross-functional collaboration. Both parties were committed to the intensive team effort including collaborative and iterative practices of "defining the objectives, constructing the research questions, learning research skills, pooling knowledge and efforts, conducting the research, interpreting the results, and applying what is learned to produce positive social change" (Greenwood & Levin, 2000). The researchers were building suggestions for improvement based on their theoretical understanding and expertise, while the practitioners were concentrating on the implementation practices. In fact, the case company was quite influential itself, directing the research questions and suggesting the most challenging problems to be studied. However, the research was not too company-led since every deliberate intervention was collaboratively planned and implemented. (For more information, see Molin-Juustila, 2006.)

The third development context (case C) was identified in a large, global corporation developing telecommunication products and systems for international markers. The company represents a traditional, large product development company. In this article, data gathered from two units is presented. The first unit is responsible for the concept definition phase of certain kind of product development projects. The second unit is responsible for user interface development of certain kinds of products. The aim of the research project in this case was, again, to improve the position of user-centered design in the company, the results of the qualitative, interpretive research -oriented part being presented here. Again, the aim of this part was to examine the context and the process of user-centered design as it naturally unfolds, documenting it as much as possible, during three years time. (For more information, see Iivari, 2006a.)

Information about the cases is summarized in Table 1.

Table 1. Information about the cases

	Case A - Moving from custom IS to product based business	Case B - Emerging new software product business	Case C - Traditional IT product business
Company	Small-to-medium sized IT company	Medium-sized IT company	Large IT company
Information technology	PC solutions, embedded software, smart cards	Web-based solutions	PC solutions and embedded mobile software
Customers	Domestic and international customer organizations	Domestic and international customer organizations	Domestic and international customer organizations and consumer-users
Research approach	Interpretive case study	Interpretive case study, action research	Interpretive case study

Data Gathering

The research material has been gathered over a period of three years, 2000-2002, in Finland. The material has been gathered while carrying out usability capability based process improvement efforts within each of the different case contexts. Beginning with usability capability assessments, according to the assessment protocol (ISO/IEC, 1998 and ISO, 2000) the improvement projects interviewed the personnel within each case context about their ways of working, and the assessment team examined whether user-centered design was carried out.

During the improvement efforts data was also gathered by multiple methods. The choices of different methods and techniques depended on the circumstances: which ways of collecting the data were considered possible and optimal in the different situations and contexts. Different types of documents were gathered and there were individual as well as group interviews, and more or less unstructured conversations around predefined specific issues. In addition, there were collaborative development and evaluation sessions involving also company representatives that focused on specified tools created and suggested as for improvement of the practice. Especially in the case B with action research approach, the data gathering was very much intertwined with the daily practices of the practitioners: people joining in and leaving collaborative sessions according to their hectic business as usual. Unplanned and informal meetings also took place every now and then. Although the main approach was intervention oriented, there were also few occasions with clearly more observation focus: e.g. trade fair and trade shows. The research material, altogether, include interview transcripts, minutes of the meetings, assessment reports, e-mail correspondence with the personnel and field notes the researchers kept after each joint event. From this huge amount of empirical material, some illustrative excerpts will be presented in the empirical part of the article.

In addition we had a specific interest on cultural issues in the study and cultural data was gathered from each case context. First we experimented with organizational culture surveys and gathered quantitative data from all cases. We produced survey results reports for the case units. Afterwards we interviewed the personnel and gathered feedback from the survey results. We interviewed both the usability experts and people whose work is directly related to the case's core mission. In the interviews we discussed the context for and the process of user-centered design. An interview results report was produced. Afterwards, we organized workshop sessions in which we discussed and evaluated the interview results. The results report was updated after the sessions. Finally, we organized additional workshop sessions in which results gained though the different techniques for data gathering were compared, and contrasted with the results of the other cases. In addition,

before the workshop sessions we went through all the memos, e-mails, field notes, and assessment reports produced. From this material we listed all user-centered design activities carried out in the cases, all problems reported related to the activities and all preferences expressed for future actions. We presented this material in order to allow the participants to comment also on that material. Therefore, the technique of member checking was utilized extensively in this research effort.

Data Analysis

Multiple qualitative analyses have been carried out related to the datasets gathered from the cases (see e.g. Iivari, 2006a; Molin-Juustila, 2006 for more information). The organizational culture surveys were mainly used for initiating the data gathering in the cases, due to which no quantitative analyses have been carried out. In the analysis carried out related to this article, we focused on the different aspects related to 'listening to the voices of the users' in product based software development, and collaboratively, inductively identified the following aspects as interesting: 1) Where do the users' voices come from (who are the users whose voices are listened to)? 2) When are the users' voices listened to? 3) What happens to the users' voices; whether and how do they affect the development? 4) What are the challenges and particularities of each case?

EMPIRICAL FINDINGS

Case A: Moving from Custom IS to Product Based Business

This development context is encountered in a small-to-medium-sized IT development company, which has six organizational units: hardware, marketing, customer support, systems, project delivery and product development. As one can see, the company has two different kinds of projects, product delivery and product development projects. Earlier, the company has provided tailored systems for their customers, trying to fulfill all the wishes of the individual customers, but there were very negative experiences of this kind of projects:

There were a lot things related to sales techniques, to make the customer a little bit happier. (...) They promised some little things, from their viewpoint, but many of them affected the [another system] so the things that the sales had promised as little things, were actually the biggest things. (...) New features were implemented and around one third was changed. (...) Everywhere around the [system] was fiddled around, so that there was not much original functionality left. (...) Requirements based on customers wishes, delivery projects let them through. I don't know based on what they did that. In the beginning, in my opinion, wishes and requests were let through very easily. It was promised that okay; we can do this and that. (Project manager)[4]

The maintenance phase of the phase one was left to me. But it continued a couple of years, even though it should have been a lot shorter job. (...) Continuously, small new features were added. The worst problems were investigated and customer's requests were examined: what kind of changes and wished they have and what do they want and what can be done. (...) We prioritized the biggest things and tried to fix them. When the customer was in a hurry and angry enough, then we gathered the existing parts and built a software version and made them happier for a short period of time. (...) So the phase one took almost all of my time and very little time was left for the phase two, in which I was a project manager. So, too little time was left for that. So, it kind of went sour the whole thing. (Project manager)

During the time of data gathering, the company was putting effort on the new product development

project, in which the company aimed at developing a more generic solution for the customers:

I criticized that at some point of time, when we have accomplished things to a certain point; we take them in front of the customer. (...) If there were very different implementation possibilities that could be sold to the customer, it is technically and economically a little bit burdensome. Now there is a centralized solution, there is a model for the customer; this is how it is like. Then it is more difficult to question that could the solution be totally different? (Executive)

At this point, it was acknowledged that also user-centered design could be used for keeping the customers away from the development.

ISO standard (1999, on user-centered design) aroused unexpected enthusiasm. Ed (a project manager) figures out appropriate slogans (dealing with usability) and t-shirts (with the slogans) for the company. He was delighted of the possibility to slash the demands of customers with the help of this authoritative standard. It is a good tool in the sales and marketing. (Field notes)

Eric (a manager) noticed that if the company can appeal to the standard (ISO 1999) and affirm the customer that the usability capability of the organization is on a high level, the company could prove that the customer is the one who is wrong. (...) "We design our products according to the principles of this standard, so we are the ones who are right". (Field notes)

Beforehand, the company had very little background in user-centered design, but during the time of data gathering, the company appointed one of their employees as a usability expert, who was also nominated as the project manager of their internal usability improvement project. This project group initiated field visits and usability evaluations. The users were contacted through the existing domestic customers of the company. The group also put quite much effort on the user interface design in their next generation product development project. All this work was carried out in a close cooperation with a university led research project dealing with user-centered design:

Customers do not know what is good for them. The company has to convince the customers that the company knows better. One way to do that is to appeal to the fact that the company participates in the university project dealing with usability issues. This might give authority to the company in relation to the customer. (Field Notes)

Eric (manager) told me the basic reasons why we would participate (in the research project). We need to be more convincing in the eyes of the customer. That way we could dictate some things, for example user interface issues. The project would offer facts which could enable us to do that. (Usability expert)

In their field visits and paper prototyping sessions together with their users, the users were naturally listened to. These sessions were carried out in two domestic user organizations. Therefore, one can say that these two user organizations were carefully listened to. Based on the sessions, improvements to their existing solutions were made. However, user-centered design still seemed to be used as much for silencing the users and the customers as for giving them a voice:

According to Ed (project manager) usability is a nice slogan in the marketing and helpful when too demanding customer must be tamed. Usability is still not everything. Ed says that they really do not need any more new wishes or opinions from the users. Too much user-centered design and user involvement with several differing users' voices does not sound very inspiring. (Field notes)

Furthermore, there were problems between the user-centered design team and the development team. The user-centered team produced specifications for the prospective product development to ensure that their work has some impact. However, the developers perceived these outputs unfinished and not very reliable, and user-centered design, altogether, as time consuming and inefficient:

Rick (manager) again suspects the suitability of user-centered design. Last time he raised doubts about whether the requirement specifications (produced by a usability team) are complete: have all exceptions and requirements been taken into account? Now he argues that paper prototyping seems to have too many loops and users; when can you stop? (Field Notes)

When compared to the costs one can raise a question that what has been received? (...) Eric (manager) says the company has moved backwards: in the beginning this (user centered design) was a big thing, but now the situation is that soon nothing is done. Eric asks Rick (manager): has usability become a curse word? (Field Notes)

According to Eric, Rick has decided that no user-centered design activities will be carried out in the new product development project. (...) Due to the bad reputation it currently has, the term usability will not be mentioned for a while. (Field Notes)

Therefore, in this company usability ended up to be a curse word among the developers, and the user-centered design activities were cancelled in the upcoming new product development project.

Case B: Emerging New Software Product Business

This development context is within a medium-sized IT company operating on business-to-business product markets. Our focus was on their new emerging software product idea, a generalized core product with some tailored components and services, and emerging business related to this product. The organizational functions of concern in this study were marketing, sales and consulting, support and services, custom development, and core product development with usability issues as one of its organizational sub function.

At the time of our fieldwork, the new product was considered to be in the very early phases of the product life cycle. Development of the core product was carried out through their newly defined continual and parallel 'streams' processes, namely market visioning, cross-functional requirements management, specification and design, implementation, and validation and testing. Each product release was a diagonal cross-section of these parallel streams, different streams possibly working with different releases of the core product. In addition, custom development was carried out as individual custom development projects initiated by the sales and consulting staff. The company was aiming at niche markets with groups of customers with similar needs as the basis for segmented product solutions. A special feature within this context was the continuing tension between early unique pilot custom solutions and the aim towards more generalized core product, segmented solutions being in the middle.

The company had already started to pay attention to usability issues at the beginning of the 1990s so during the time of data gathering it already had ten years of experiences of user-centered design with usability experts and visual designers as permanent staff.

I think it (user-centeredness) has been a selling argument and a thing that we have had, but not necessarily the competitors. We have been most progressive in this respect. (Team leader)

If we talk about our strengths as a company, we don't talk only about customer-centeredness, but we say we have this competence; we have behavioral scientists, research, and cooperation with

universities. (...) Because this is quite exceptional. (Executive)

Starting with usability tests they had broadened the scope first to specification reviews and finally towards ISO (1999) standard by implementing more established practices like feedback process and contextual design.

It has changed here. Earlier we tested a lot. First we tested, then we had this guideline phase and now we focus on specifications. It's where to focus. You do it all the time; you carry out usability tests, but quite seldom. And you produce the guidelines, but less than the specifications. Specifications are the main thing. (Team leader)

When we think about how the next generation product development project is managed, the specification starts when I and Susan (a usability expert) do the functional specification and the APIs are specified according to that. (...) How should I say it? It's not anything like vague assistance. The whole thing starts from the specification and those are in the project plan. (Manager)

Following contextual design (Beyer & Holtzblatt, 1998), especially contextual inquiry, the company had developed ideas for their new product. During the early phases of development of the new product it was typical to work very closely with so called pilot customers. These custom projects were used in order to build first prototypes of the new product and at the same time to carefully listen the pilot customers in order to learn more about the potential users and market for the new innovation. However, at the same time traditional market studies and sales efforts gave different type of input for development and it was becoming clear that the different viewpoints of these organizational functions, although each contributing, were sometimes in great conflict with each other.

The base practices of user-centered design were already managed in the company, and they were now trying to widen the perspective to the areas of business development of a whole new business area. They believed that user-centered approach would provide business benefits for the new product business if somehow taken into account during the early phases of new product development. However, this would also mean that user-centered approach should focus more on the cross-functional nature of defining a common target. User-centered approach was seen as a potential cure for the fuzzy early phases, if only being able to build better dialogue between the single customer cases and cross-functional requirements process.

Here the most important targets for improvement are not related to making the position of the usability experts better or their work easier, but they are related to the strategic level (...) Related to the decision making, for example when you are defining what to include in the next release. (Manager)

It was clear that there was a need for better communication, prioritization and coordination between different functions. Hence the company had started to pay attention to the cross-functional collaboration and had established a new process for requirements management with cross-functional requirements review team. The members of this team represented the most important organizational functions of the company: management, marketing, sales, consulting, and development. It was this team's responsibility to make decisions about the new requirements for the core product and to plan the roadmap for the forthcoming product releases. The emphasis was on: 'proactive product and business planning and strategy development influenced by a user-centered approach' (Project documentation)

From the users' point of view there are some interesting characteristics in this context. First of all, when the aim is to find the next 'killer appli-

cation' the expected customer base is large with lots of users to listen to. So the question is, who to listen to, i.e. where to find the users and how to select the right users who best represent the future market? In this company one potential context was chosen to start with as the context for the initial contextual inquiries. Then after this, a first custom project was initiated, yet, within totally different context compared to the first context. Then the input from this (as well as other early pilots) was considered as input for the cross-functional requirements process. In this process the unique customer cases disappear into the pool of other sources of input, e.g. from usability tests again with different users or user feedback process. So different users have influence during different phases of development and alongside the lifecycle of the product. To have a full development cycle with the same users (or even customers) is rather rare except with the very early pilot customers. Pilot customers are listened to very carefully (like in traditional custom IS development), but very soon alongside the product lifecycle the tensions arise between these unique pilot users and customers and the potential market of many customers. The real users' voices become 'drops in the ocean' when finally reaching the cross-functional decision process at best providing support as a strong argument for some special demand or characteristic of the new product. However, it is quite impossible to show which characteristics of the new product come from which users. This is not even in the interests of the company since the aim is towards generalized product with generalized requirements as well.

Case C: Traditional IT Product Business

This development context is examined in a large, global corporation. There are traditional organizational functions of product development companies such as hardware, software, marketing, customer support, documentation, etc. in the company. In this article, data gathered from two units is presented. The first unit was responsible for the concept definition phase of certain kind of product development projects, aiming at outlining new innovative applications, or even "a vision and direction where the world is to go" (Usability expert) to the product development projects. The second unit was responsible for user interface development of certain kinds of products. The work in the unit included software requirements specification, design, coding and testing of the user interface software of the product.

The work in the first unit started by the management stating the objectives for the project, and marketing outlining information about the target user segment: "The target segment was clearly identified and known by the project team. The segmentation was based on valid market research data." (Project documentation) The unit, afterwards, was responsible for field studies, user task redesign, user interface specification and usability evaluation of the solution. In the end, the result (i.e. specification) was delivered to the 'factory' (i.e. to product development), in which it was implemented in some future product, but this was not necessarily the case:

Our outputs do not automatically end up in any products or support them in any way. The products come out also without our job. But people still want gratification in a way that their work has some meaning, other than just finishing it, putting it to some drawer and accidentally coming back to it. (Project manager)

Therefore, the personnel were not sure what happened to the users' voices after being captured in their specification. Totally different people and units were responsible for the development after this point. However, the personnel were aware that there was also usability expertise in the 'factory', taking care of usability testing in the later phase of the development.

The personnel of this unit used contextual design method (Beyer & Holtzblatt, 1998) in their projects. Therefore, contextual inquiries were carried out, work models produced, user task redesigns in the form of visions and storyboards produced, and finally the system structure outlined and evaluated together with the users (cf. Beyer & Holtzblatt, 1998). The personnel traveled around the world while carrying out the contextual inquiries, trying to find appropriate people (current or potential consumer-users) to be observed. There was a professional, experienced group of usability experts and user interface designers in the unit, as well as several years' experience in using the method.

However, there were some difficulties in the cooperation between the usability oriented and design oriented people in the unit:

There are 'staid researchers', research oriented people, and in some other projects there are these 'careless designers'. (...) This 'research gang' questions existing things and wants to examine things. On the other hand, these designers like to do things that are fun. They don't have, like arguments, behind their decisions. Designers produce designs from a very creative point of view, not from the point of view of the user. (Usability expert)

There exists some unwillingness to carry out usability tests, because usability activities are perceived to be burdensome and dull. (...) Brainstorming sessions are their (designers) favorite sessions, those sessions in which relatively lightweight methods are used. (...) Ideating is fun, but systematically using certain methods seems to be unappealing to some of these 'ideators' (designers). (Usability expert)

In the second unit, management and marketing produced product specifications based on which projects started. Most of the personnel in the unit were software developers. However, there was also a group of four experienced usability experts in the unit. Their responsibility was to ensure the usability of the solution. They had carried out field studies and organized usability evaluation sessions. The users involved in these activities were workers of the existing customer organizations. The usability experts had also invited the developers to these sessions. However, these activities were not carried out as parts of specific projects. There were difficulties in getting access to the user organizations, due to which both usability testing and field visits were big events rarely organized.

Based on the data gathered, the usability experts had produced usability evaluation and field study reports. Based on the field study data, they had also produced a context of use document that described the users, their tasks, and the use environment. In addition, they had videotaped the field studies and the tapes were available to the developers. Furthermore, they had created a persona (cf. Cooper, 1999) called Eric to make the users visible to the developers.

However, the developers had criticized Eric for being "*too stupid*" (Usability expert) and dismissed him as "*a special case, which we don't need to serve*" (Usability expert)[4]. Furthermore, the documents and the videotapes that the usability experts had produced tended to be ignored by the developers. It was acknowledged that it was very challenging for the usability experts to ensure the usability of the solution that was being produced solely by the developers. The usability experts were only expected to provide feedback to the predefined design solutions; it was up to the developers to decide whether they took the feedback into account.

Another problem was that this unit alone could not ensure the usability of the product. Cooperation with other units was needed, but the other units did not understand the importance of this nor have the knowledge for doing this:

If you think of the problem, it is that our unit develops the user interfaces, and due to this the whole usability is our responsibility. They (other

units) don't understand that it is the whole product and all stakeholders who should put effort into making the product usable. If the other parts of the project do not support usability, we can only decorate in here. (Usability expert)

The usability specialists had taken the responsibility in organizing cooperation with the other units, but it was acknowledged that currently their work had not had a big impact and there was a long way to go to educate other units.

In all, in both units of this company, there seemed to be established ways of listening to the users. Interestingly, in both units there also was a strong focus in the development of the infrastructure related to 'listening to users' inside their organization. The usability experts emphasized that:

Here we have a quality organization which perceives quality within a rules-oriented approach. Numerical things are highlighted; bugs and stuff like that. We have quality plans and we report the bugs and follow the projects. (...) We have these control mechanisms, and they are very powerful. If you try to compete with them, and you are not in the control mechanisms, then you are left out. Because these control mechanisms set the pressures. (Usability expert)

The 'grand mission' in this unit was to "solve how usability can be very effectively integrated with other processes" (Project documentation). The unit had been involved in defining a new process model in which user-centered design activities were included. At the time of data gathering, the process was being implemented:

Now, when the new process is being implemented, now those (user-centered design activities) are planned, and then you have permission to do them and time to do them. They are included in the schedules. (Team leader)

Another challenge in this unit was the development, evaluation and documentation of methods, tools and techniques for user-centered design (Project documentation):

W have put a lot of effort on the improvement efforts and meta-level work related to context of use knowledge. We have spent a lot of time on that. And less time on concrete work with products and projects. (Usability expert)

We are used to having these tools before we start our work. We miss them and want to have them also here (in user-centered design)" (Manager)

Also in the other unit the usability experts had been active in improving the ways of working inside their organization. Again, interestingly, these improvements were not directly connected to listening to the users. Their preference for future improvements was related to the question of: "how to evaluate the product as an addition to the process? It is easy to evaluate a process, but how about its effectiveness?" (Project documentation) The problem was that in this unit "qualitative criteria (easy to use) are readily proposed, but they cannot be verified" (Project documentation). In addition:

We have bad quality measures. And when targets for individuals are defined and afterwards evaluated whether they are met, they are always quantitative. It is always certain document: whether it is produced. But the question should be: how has the content been produced, what methods have been used, and are they rational and generally acknowledged methods? We don't have measures for this type of things. (Usability expert)

The (usability) specialists have done these things, for example things to do with strategic planning. And they have initiated these process improvement efforts. (...) And the specialists shout that there should be more quality and improvement. (Usability expert)

Altogether, in this traditional product development company there seemed to be established ways of listening to the users, but the main emphasis, however, seemed to be in improving the internal infrastructure supporting this work.

DISCUSSION

This article has empirically examined the practice of 'listening to the voices of the users'; how it is accomplished in product based software development. The results are summarized in Table 2.

Development Contexts and Listening to the Users' Voices

Regarding the implications of these findings, first of all, one can argue that in these cases the degree of productization does not seem to clearly determine whether the users' voices are listened to or not. Each of the three empirical cases represent a different degree of productization: case A lowest, case C highest and case B in the middle of these two. Generally, one could assume that in custom IS development, in which the users are known from the beginning (Grudin, 1991), they would be listened to. However, in case A, in which the company had relied on the product delivery projects trying to desperately please the customer, the individual users were not necessarily listened to but instead the customers, and more recently the company had wanted to move farther away from both the users and the customers, and actually seemed to be using user-centered design for silencing both the individual users and the customers. Furthermore, in the traditional product development context in case C, i.e. in the large global corporation developing software products for international markets, there were established, working ways related to

Table 2. Summary of the empirical findings

	Case A	Case B	Case C
Development context	Moving from custom IS to product based business	Emerging new software product business	Traditional IT product business
Who are the users whose voices are listened to?	People in the existing domestic customer organizations	People in the potential, pilot and existing customer organizations in different countries	People in the existing customer organizations in different countries, and potential and existing consumer-user population around the world
When are the users' voices listened to?	During field studies and paper prototyping sessions in the existing customer organizations	During contextual inquiry in a potential customer organization, during close collaboration with pilot customers, during user feedback gathering and during usability testing	During field studies and usability testing in the existing customer organizations, and during contextual inquiries, paper prototyping sessions and usability testing in the potential and existing consumer-user population
What happens to the users' voices? Do they affect the development?	Becomes captured in the field study and usability testing documents and in the specifications, which do affect the prospective development work, unlike the other documents produced	Becomes captured in the documents produced during contextual design (e.g. affinity diagrams, work models) and pilot projects, and in the requirements database based on which specifications and design documents are produced	Becomes captured in the field study and usability testing documents, which tend not to have any impact, and in the documents produced during contextual design (e.g. affinity diagrams, work models) resulting in specifications, which probably do affect the prospective development work, but this is invisible to the people who made them
What are the challenges and particularities of this case?	Need to control the users and customers, silencing them instead of giving them a voice, cross-functional collaboration problematic	Cross-functional collaboration flexible yet challenging, user-centered design considered as a tool to solve the confusion between unique users vs. market of many users	Established ways of listening to the users, based on established functional structures, more focus on internal development than trying to listen to the users

'listening to the users', but the main emphasis seemed to be on the development of the internal infrastructure for user-centered design. In addition, the development seemed to be rather strictly isolated from the users; in one unit the usability experts tried to provide user data to the development, but this was perceived to be very challenging, the developers being solely responsible for the specifications and the software solution; in the other unit the concept definition team extensively gathered data from the users, based on which they produced their specifications, but afterwards the 'factory' took over the development work and it remained unclear whether the work of this team had any effect. The most emphasis or at least the most comprehensive approach to the listening to the users seemed to be in the development context characterized as 'emerging new software business' in case B, in which there was a generic solution continuously developed, but also individual customer implementation solutions delivered and data from these pilot customers gathered. In this context user-centered design was considered strategically important for the emerging new business for their emerging new product and therefore the company was very demanding when looking for better ways to integrate user-centered approach with their strategic, cross-functional decision-making processes. As one interesting indication of their commitment with the approach, during our research effort our main contact person representing the usability group was later nominated as the product manager for the new product.

Areas of Software Development and Listening to the Users' Voices

Regarding 'listening to the voices of the users' in the product development context, it was argued that there are three main areas of concern: requirements determination, design and evaluation. User contact during requirements determination was observable in each development context; the real or potential users were contacted during contextual inquiries or field studies. In addition, users were contacted and listened to during evaluations in each case; paper prototyping together with the real or potential users was carried out as well as more formal usability testing later on during the development life cycle. However, design together with the users was not mentioned in the cases. Even though researchers have suggested cooperative design also for the product development organizations, it has also already been noticed that this tends not to happen in practice (e.g. Bødker & Buur, 2002; Kyng, 1994). In case A, in which user-centered design was initially experimented with, it is no wonder that cooperative design methods were not mentioned. However, in the other two cases, which both also had a considerably long background in user-centered design as well as professional resources; it is interesting to observe that this area was still neglected.

Furthermore the areas of requirements determination, design and evaluation seem to be loosely connected in the software product development context (Molin-Juustila, 2006, p. 114) tending to be compartmentalized into organizational units with special expertise (e.g. marketing, development, and usability functions). From this perspective, related to the three areas of concern, i.e. requirements determination, design and evaluation, these three cases show that 'design' is typically carried by the developers themselves within their own organizational unit while expertise to make direct links with the users or customers is typically found in other units (e.g. marketing and usability functions). In fact, this was also visible in case A, even if the 'looseness' itself seemed to increase related to the degree of productization, being highest in case C and lowest in case A.

The Impact of the Users' Voices

In each of the cases, the understanding gained through 'listening the voices of the users' was captured in different kinds of (field study, usability testing) documents and reports, including specifi-

cations for the future products. It was emphasized that through these specifications, users' voices also might have some impact on the solution. The users voices captured in other kinds of documents did not necessarily have any impact on how the product was developed, which is a problem acknowledged already by many (e.g. Borgholm & Madsen, 1999; Bødker & Buur, 2002; Grønbak et al., 1993; Grudin, 1993; Kyng, 1994; Poltrock & Grudin, 1994). In the empirical material it was brought up that in many instances the users' voices were captured in documents, which people never read. In this case it is clear how the users' voices disappear, and don't therefore have any effect. The case B makes a difference here with the pilot customers the working with whom resembled a more iterative and collaborative approach where the users' voices were listened to quite carefully also having impact on the very first versions of the new product.

However, in other situations, and also in case B with the later versions of their new product, the problem seemed to be related to the different organizational functions and the challenges involved in the communication between them. For example, in the case C the communication between the concept definition team and the product development 'factory' relied solely on written specifications, which, of course, ensure certain kind of impact, but surely can't preserve the richness and the variety of the users' voices encountered during empirical inquiries. In case B, with later releases of the product, specific attention was paid to the gathering of user data from a multitude of sources, which then were collected into the requirements database and prospective specifications. The requirements database ensures that the users' voices do not get lost, but instead become captured as a basis for cross-functional decision-making. However, the requirements database becomes a collective repository with lots of input from many different sources (e.g. marketing, customer support) and therefore the cross-functional team can not take into account every individual requirement in the database. Also, it can be criticized that neither can this type of a requirements database preserve the richness and the variety of the users' voices very well.

Special Challenges in Listening to the Users' Voices in Product Based Software Development

The already recognized problem of separating the voices of the users' from the voices of the customers' (e.g. Poltrock & Grudin, 1994) was brought up in the cases. In case A, there seemed to be a tradition to please the customer, which had led the company to try to isolate the development almost entirely from the outside stakeholder groups, including both users and customers. Of course, this is unfortunate from the viewpoint of user-centered design. However, this well known confusion between users and customers is even further problematized when considering the market of many potential customers (case B) or consumers (case C). Especially in case B, where the degree of productization was in the middle, there was a clear confusion between unique (pilot) customers and some potential market segment that those customers possibly represented. Finding the right pilot customer to listen to was one of their main concerns in order to be able to define the 'perfect' target market for the early releases of their product.

Also the literature highlights this problem of identifying the market through user contacts. The users contacted and to be listened to as the representatives of the potential market, should be very carefully selected (e.g. Butler, 1996; MacCormack, 2001; Vredenburg, 2003). In case A, the users, however, were selected since they were located geographically near and therefore easily accessed. Also in case C it was emphasized that it is very difficult to negotiate access to the user organization, due to which one needs to settle with the ones with which one has succeeded in the negotiation. In these situations, however, one

should consider very carefully in which ways the sample and the understanding gained might be biased. Especially in case A, in which there was a desire to move towards product based business, this kind of considerations would be crucial when trying to figure out the market for the prospective products.

Regarding contextual inquiries and field studies, another requirement in 'listening to the voices of the users'' can be argued to be to understand the characteristics and needs of the real, individual users in depth. In this case, one could argue that an ideal is that every individual user is carefully listened to and served (Iivari & Iivari, 2006). Of course, this tends to be impossible in practice with a large user population. However, one can especially criticize the contextual design method (Beyer & Holtzblatt, 1998) for neglecting the individual users. In the method, the interest is on the general work practice of the users, which is to be supported and improved. The individual users with specific characteristics, aspiration and needs are not considered as important at all; the users are positioned only as the ones realizing the work practice of interest (Iivari & Iivari, 2006). The contextual design method was in use both in case B and C. In addition, one can argue that any description of typical users or user profiles necessitates generalization and abstraction, during which individual users' voices disappear. In addition, there was a lack of appreciation of individual users, their characteristics and needs in the cases revealed by their tendency to gather data from different users during different phases: some users were observed and interviewed, other users acted as test participants during usability evaluations. This indicates that users are perceived to form a mass that can be represented by any individual.

The literature has already highlighted the importance of cross-functional collaboration in product based software development (e.g. Hutchings & Knox, 1995; Karat & Karat, 2003; Molin-Juustila, 2006; Siegel & Dray, 2003). There is a need to understand not only the users, but also business and market factors and technological and design constraints (Siegel & Dray, 2003). In the empirical analysis, the difficulties involved with cross-functional collaboration clearly emerged. In case A, the developers did not accept or understand the value of user-centered design, as a result of which user-centered design activities were altogether abandoned. Also in case C there were problems in cooperation among the usability experts and developers, the developers not listening to the usability experts, and among the usability experts and designers, there being resistance among the designers towards user-centered design methods and attitude. However, the case B is different, since in this case the emphasis was particularly in improving the cross-functional collaboration. Even though solving the problems of cross-functional collaboration turned out to be challenging (e.g. cross-functional decision-making concerning the prioritization of the requirements), even more challenging than originally expected (see Molin-Juustila, 2006), with their already long history with user-centered approach they saw cross-functional collaboration and especially its improvements as a necessary next step towards more comprehensive user-centeredness.

The results of this study can be contrasted with the Scandinavian collective resources approach, as a result of which critical remarks can be made. First of all, one can argue that in the cases there were no mentions about workplace democracy or users' right to take part in the development. It was already also highlighted that participatory design was not mentioned in the cases: users did not take part in the design process together with the developers, even though they were listened to during the development. One of the most critical issues is that user involvement, altogether, seemed to be totally dependent on companies' will to allow that. However, should and could the companies be obliged to allow the users to take part in and influence the development of software products and systems? Could this even be made a regulated

or legislative duty (Molin-Juustila, Nuojua & Kuutti, 2008)?

CONCLUSION

This article critically examined the practice of 'listening to the voices of the users'; how it is accomplished in product based software development. First academic literature addressing the users' role in the product development context was reviewed. Afterwards, empirical analysis in three IT companies involved in product business but with different degrees of productization was carried out. In the analysis, the focus was on: 1) Where do the users' voices come from (who are the users whose voices are listened to)? 2) When are the users' voices listened to? 3) What happens to the users' voices; whether and how do they affect the development? 4) What are the challenges and particularities of each case? The empirical analysis revealed clear similarities but also differences between the cases. It was revealed that the degree of productization, although quite often used for differentiating product based software development contexts, is not the one and clear determinant whether and how the users are listened to. A multitude of challenges involved with listening to the users' voices in product based software development were identified.

Limitations of the Study

In this article we wish to highlight the complexity and confusion related to the concepts utilized in this study. During the literature review, it was evident that a multitude of terms are used when discussing 'listening the users' voices' in IT development; the researchers talk about e.g. user/human-centered design, user involvement, user participation and participatory design, among other terms. Also a multitude of different disciplines are involved, e.g. IS, HCI and PD traditions. This article analyzed this literature from the viewpoint of product based software development, attempting to make some sense to the vast amount of literatures and concepts. Related to the empirical cases this confusion with the concepts and their meaning was even more visible. It was not always possible to classify the practices according to these definitions and this is one of the reasons we decided to use the title "listening to the voices of users" instead of participatory or user-centered approach or any other of these widely used and well known concepts.

Practical Implications

These results are useful for people initiating or carrying out user-centered design or user involvement activities in product based software development organizations. The results hopefully help to understand the overall position of these activities from the perspective of the whole software product company. The results also reveal different ways for accomplishing the practice of 'listening to the voices of the users', as well as different motives for doing so, ranging from improving usability of the product to the strategic level decision-making related to finding the right market segment for the product. In addition, the problems encountered in the cases are also presented in the article, providing thus interesting information for practitioners, who work in a similar situation or context. The practitioners might try to prevent or minimize the risk of encountering these problems by becoming aware of their potential existence.

Future Research

This article is based on three cases representing the product based software development context with different degrees of productization. In the future, more cases could be included in the analysis. As was highlighted already in the introduction, the product development context includes development of a varying kinds of 'general products', 'packaged software', 'generic consumer products' or 'shrink wrap software'. Therefore, more variety,

the degree of productization (among other things), could be included in the empirical cases analyzed. Furthermore, an interesting path for future work would be to analyze the concept of 'software product' in depth. Clearly, there is variety what is included in this concept. In some products, software might only be the by-product in order to sell more hardware. On the other hand, plain product companies may not survive the bad times of decreasing revenues but instead the companies need to find more balanced combination of their product and the services related to it (Cusumano, 2003). However, when considering the future ubiquitous environments with embedded software and related short and long range communication technologies the whole concept of 'software product', not to mention its development context, becomes even more confusing.

Furthermore, a path for future work could be to carry out a more detailed analysis concentrating on only one case following 'the voice' of an individual user or few users, to examine what happens to it, how it is handled inside the product based software development organization and who, if anyone, actually listens to it. This is also very much related to the special challenge of cross-functional collaboration in product based software development, an area currently with only some preliminary research from the user-centered development point of view (Molin-Juustila, 2006) yet most certainly affecting the effect and impact of users' voices.

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ENDNOTES

1 Though Sawyer also gives other synonyms for both: "one-off" for custom or made-to-order, and "commercial" and "shrink-wrap" for packaged software (Sawyer 2001).

2 Within the field of HCI, a widely cited definition of usability specifies it as 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (ISO 1998).

3 These findings are in line with Bygstad and colleagues (2008)

4 All citations from the empirical material have been translated from Finnish to English by the authors

[5] It is acknowledged that personas can be very powerful tools in the design process, when used properly (Grudin & Pruitt 2002). In this case, however, personas were used in a limited sense, mainly for illustrating to the developers that the users of the company's products don't necessarily have any technical background (Project documentation)

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Chapter 9
Location-Based Mobile Storytelling

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ABSTRACT

This article describes an investigation in location-based mobile storytelling entitled Tracking Agama. Using a combination of SMS messaging, voice calls, and web log entries, Tracking Agama leads its participants on a narrative-based exploration of Los Angeles, in pursuit of a fabled urban researcher, "Agama." Participants use a bit of detective work to discover the keywords allowing access to Agama's voice-activated and phone-accessible audio diary entries; send and receive SMS messages from Agama and his assistant; and receive calls from the virtual characters.

LOCATION-BASED MOBILE STORYTELLING

Tracking Agama invites players to experience downtown Los Angeles like never before, perhaps even for the first time in their lives. This project was designed with the intention of getting people out into a city that often goes unexplored or overlooked, even though it is full of so many hidden treasures. Players are asked to interact with a narrative and become part of a puzzle that will lead them through both new and familiar places, and to experience them in unexpected ways. Mobile technology offers us a platform to do this. Our ultimate goal is to get people out of their cars, into the downtown area, away from their daily routine, and maybe even ride public transportation. Los Angeles often becomes synonymous with Hollywood, actors, cars and traffic, even though so much of Los Angeles history is rooted in the downtown area. We've focused on a few downtown locations, integrating an intriguing narrative, urban legends and historical information with the hopes of offering a new kind of experience to our

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players—one in which our players will look upon their city differently, exploring its layers of fiction, myth, history, architecture and topography.

BACKGROUND

Perhaps the best known mobile experiences are the pervasive games designed by Swedish company It's Alive! and the British group Blast Theory. *Botfighters* (It'sAlive), in many ways, is very similar to a video game like *Halo*, but based on live action and played in the real world. Location information, referencing a fictional future world, and game play battles are handled through the mobile phone, and with a periodically updated web-based backstory offers new missions and recontextualizes game world developments. Blast Theory's projects, including *Uncle Roy All Around You* and *I Like Frank* among others, work like cooperative treasure hunts with online and street players having access to different elements and developing cooperation strategies via SMS messaging. These projects are distinctly games, both in terms of their marketing and the structure of the experience they offer their participants. And while they contain story elements to offer a more complete imaginative world, these features are secondary to the gameplay.

With their procedural and participatory environments oriented around spatial exploration, these mobile games fit new media theorist Lev Manovich's contention that, in the new cultural order, database is the primary structuring device, subordinating narrative to a secondary (and competitive) role.[1] Spatial annotation projects, such as *Yellow Arrow*, *[murmur],* and *Urban Tapestries,* also seem to privilege a database structure. These projects allow the participant to author personal diary-like episodes into the database of materials, available to future navigators of the same urban terrain. Again, much like the pervasive games of It's Alive! and Blast Theory, these projects have story elements mixed in their database structure and exploratory method of participation. All of these projects, though, seem distinctly different from the story experience of a novel or film.

We can turn to film theorist Edward Branigan's narrative schema and modes of collecting and understanding data to understand how these pervasive games and spatial annotation projects utilize narrative components. Branigan suggests that a narrative is comprised of a series of episodes put together as a focused chain. An episode contains all that happens to a character in a particular place or time and a focused chain of episodes exhibits a clear continuing center.[2] These mobile experiences, though they might contain some combination of episodes, unfocused chains and focused chains, would fail the Branigan test as a complete or complex narrative structure in a traditional conception of narrative (though the episodes and unfocused chains of events are narrative-like and the back-story would qualify as a simple narrative). *Botfighters* represents an example, similar to many video games, in which a computational structure works in tandem with narrative or narrative-like components to create the complete experience.

As our interest was in mobile storytelling, we looked for other projects that seemed organized around this principle. The GPS-enabled, tablet-PC based mobile project *34N118W* shares the database structure exhibited by these mobile games but introduces specific fictional stories as the primary data element encountered by the participant. Here, the specific focus is on the participant encountering fictional stories related to a small neighborhood, rather than scoring points, shooting "enemies," or listening to widely divergent personal anecdotes. The grid of the downtown area contains the data set—a combination of recorded text and visual correlations. The participant serves as the search engine, walking through this grid of data elements, encountering them in the sequence of his or her own choosing. In this way, *34N118W* shares the characteristics of the digital environment outlined above in terms of the mobile games. The tablet PC

executes a regular series of procedural functions to properly depict the participant's location on the map, as well as play the audio elements at the appropriate place. The participatory and spatial elements exist physically in terms of perambulation, metaphorically in terms of searching this database, and interpretively (what creator Jeremy Hight might call "archeologically") in terms of considering the told and untold stories relating to the place, the point at which narrative exists as a form of expression in this piece. Yet, the stories are individual episodes not structured in a focused chain, leading us to design a new kind of mobile entertainment project.

Can a non-sequential, locative media, database structure be combined with a narrative structure soundly rooted in the principles of cause-and-effect, along with character growth and development, and thus representing a equal hybrid of database and traditional narrative structure? This combination lies at the heart of the student project *Tracking Agama*, an alternative reality fiction[3] in which participants access pieces of the story by mobile phone, through entering codes, exchanging text messages with the host computer, and receiving phone calls. The participant obtains codes by solving puzzles embedded within the story, which successively give access to more and more "story nuggets".

Tracking Agama shares *34N11W*'s dual design structure as both an interface to a multimedia database and a navigation method through spatialized representations. The story nuggets consist of audio (recordings made by Agama called "AgamaNotes" and calls from Shufelt), website text, and text message. The mobile phone serves as the interface for accessing this information and receiving instructions or puzzles about further action to take or information to discover. In pursuing this action or information, the participant travels to six locations in Los Angeles. The AgamaNotes offer insight into the character's state of mind, consideration of particular landmarks, imaginative use of the landmarks as settings for further fictions and subtly suggest to the participant alternative ways of looking at the location. The city becomes represented not only by the text evident on tourist placards, but through layered context delivered to the participant in the space and closely associated with physical exertion of navigating the locale (much like *34N118W*).

Applying Branigan's models, we see the AgamaNotes as collecting Agama's experiences, thoughts and sometimes events (such as when a kidnapping interrupts Agama's recording), in a particular setting--episodes. The calls from Shufelt in combination with the tasks completed by the participant reveal the causal connections between the episodes, and successive episodes depict the growth and change of the characters (such as the revelation that Shufelt, initially positioned as a friend of Agama, is in fact his enemy).

Above and beyond the simple narrative of a series of episodes arranged in a focused chain, *Tracking Agama* exhibits a complex narrative structure with a not-necessarily sequential arrangement of Branigan's component schema, including abstract, orientation, initiating event, goal, complicating action, and climax/resolution. These components comprise a cognitive scheme into which a reader/viewer places data elements to comprehend spatial, temporal and causal connections—in short, a mode of understanding. (In classical narratives, these components are often encountered by the reader/viewer sequentially.) Branigan suggests that our minds process different arrangements of data elements and corresponding categories (the components listed above) until achieving a combination that seems correct (comprehension). In *Tracking Agama*, we employed this theory as a design model by distributing character, plot, and thematic data across spatial and temporal zones. This structure requires the participant to constantly try out different arrangements until arriving at an understanding—a narrative jigsaw puzzle. The narration consists of the participant's accessing of the various story nuggets and piecing together the complex temporal structure that incorporates

historical events, recent fictional events (such as the initiating event of Agama's kidnapping heard over the phone as the participant listens to Agama's musings about Union Station), and developing fictional events (such as Shufelt's requests for research and detective assistance).

MECHANICS OF THE EXPERIENCE

Tracking Agama begins with a research weblog published by the story's protagonist, Agama. Agama, as a newcomer to Los Angeles, becomes enthralled with the mysteries and urban legends of the downtown area. As he begins to unearth some information that was well buried (with good reason) he becomes entangled in a web of secrets, elaborate cover-ups and urban legends he believes to be legitimate. The deeper Agama digs, the more haunted he becomes by his own research, leading him into a downward spiral towards insanity or perhaps a catastrophic encounter with the supernatural. But just when it seems Agama has gone off the deep end, a mysterious post (see Figure 1) appears on his weblog, posted by a stranger determined to enlist the help of others to save his friend Agama.

This final post, authored by "Shufelt", a "friend and collaborator", contains a phone number and some key words. This phone number acts as an invitation to become part of the mystery, and it is at this point that we hope our potential players will be intrigued enough to pick up their phones, dial the number and follow prompts to enter the words provided. This phone number serves as an access point to Agama's voice messaging system, which he uses as a voice recorder for his research. The player therefore gains access to many of Agama's research notes and can retrace his steps to help solve the mystery of his disappearance. The first message sends the player off to their first location, and from there they must begin to piece together the story by finding clues and codes embedded in the various locations around downtown Los Angeles.

These clues and codes can be entered into the mobile phone as either SMS messages or as codes entered into Agama's voice mail box, accessed

Figure 1. Final post to Agama's weblog containing a phone number the player is meant to call (actual text located at end of this document)

via the phone number posted on the weblog. By sending a SMS message or entering a code, the player triggers one of many possible responses, including a response SMS from Shufelt or Agama or a return phone call from a story character, each giving more clues or instructions for finding Agama.

After dialing the phone number posted by Shufelt, speaking the words "red line" and "mirror", and listening to the message, the player is directed to Union Station in search of a piece of public art. When the player arrives to Union Station via the Red Line subway, they emerge from underground and immediately see a large sculptural piece of art as described in the first AgamaNote accessed. From the AgamaNote titled "mirror", the player knows to look for the title of the artwork. After speaking the word "Riverbench"(the title of the artwork) to the AgamaNote phone system, the player first hears another clue, but then hears what sounds like a fearful Agama struggling to escape from someone or something. Since each of Agama's recorded notes is dated, our intent was to keep the player motivated by introducing a clue to the place and date of Agama's disappearance. This also introduces a sense of urgency to continue looking for clues in hopes of finding Agama, or to at least protect the research he was conducting, which the player can identify as the obvious explanation for Agama's disappearance.

At this point the player begins to piece together the clues they have already heard into a cognitive framework for understanding. Simultaneously, they continue their exploration of Union Station by seeking out the clue alluded to in the AgamaNote (just before they hear the Agama struggle with his assailant). The date/time stamp accompanying each AgamaNote serves as a boundary or guide, assisting the player's construction of the story. With each clue uncovered the player learns a bit more about Agama, as well as the history of Los Angeles, quirky urban legends and little known facts about some of Los Angeles' most stunning architecture.

In approaching this project from the perspective of Mihaly Csikszentmihalyi's theory of Flow, *Tracking Agama* requires a delicate balance between both the components of Flow theory and a less structured format of undefined goals and the element of surprise. For a player to successfully experience *flow*, Csikszentmihalyi[4] outlines eight components that must be successfully met. Amongst these components are: a clear set of rules; concentration and focus; distorted sense of time; direct and immediate feedback; sense of personal control over a situation; a balance between ability level and challenge; and lastly, the activity must be intrinsically rewarding.

Though *Tracking Agama* does rely upon distortion of time in the AgamaNote system, direct feedback via the instantaneous information received by calling in clues and text messages, and a balance between ability level and challenge in the form of progressive difficulty in clues, this game also relies upon elements in direct opposition to some of the components of experiencing Flow. For example, *Tracking Agama* requires the player to learn a set of rules as they go along as part of the puzzle. When the player is first introduced to the phone number that will be their main source of clues throughout the game, they are offered a limited rule set that they learn to build upon after experiencing the first few clues. Furthermore, the player is not expected to feel as if they have control over the situation. In fact, the opposite is intended in that the player should always feel a sense of urgency in which they never know where they might need to go next, but know that someone, though a fictitious character, needs their help in a potentially life-threatening situation. Ultimately, though, it is our intention that the player does feel intrinsically rewarded as they do discover the rhythm of the game and move closer to solving the puzzles, while also learning about Los Angeles in a captivating way. In this way, *Tracking Agama* exists at the intersection of games and narratives: narratives reveal their underlying logic as they progress and as the reader or viewer success-

fully constructs the applicable cognitive schema; games articulate their logic from the outset, and the player's challenge is to master their control of that logic. *Tracking Agama* simultaneously exploits both of these traits.

As Csikszentmihalyi points out, not all of his defined components must be met to experience a sense of Flow. As Ambient Intelligent Environments become more ubiquitous in location-specific games and experience, we would assert that flow can still be successfully reached through a balance of components that might be in direct contradiction of each other. *Tracking Agama* strives to create a new kind of experience in which a player must negotiate the use of mobile technology as a delivery mechanism for storytelling while being in the physical locations of that story. To this end, we believe that our players can experience a sense of flow by successfully balancing competing components.

SYSTEM CONFIGURATION

Tracking Agama is designed to be used by the widest possible audience, and therefore utilizes a very simple hardware/software configuration. In addition, any SMS-enabled mobile phone can be used to access *Tracking Agama.* The technical system for tracking agama was created with commercial, off-the-shelf technology and services, along with some VoiceXML (VXML) programming. It relies chiefly on two major components, a java based mail server, and a voice-enabled server application written in VXML.

Text Messaging

The Java Apache Mail Enterprise Server (JAMES), is responsible for the text messaging aspects of the game, receiving incoming SMS messages, and parsing them to look for the specific codes the user is supposed to submit. Based on those codes, the application sends either a text message response back to the player, or, by using an Outbound mail java class handled by a voice application deployment service (*Tracking Agama* was originally developed and tested using a developer account from the provider BeVocal), makes a phone call to the user. When the player answers this call, they are handed over to the VXML system, which plays audio files, or performs text-to-speech synthesis, depending on the code initially input.

Agama Notes

The second component of the system -- the Agama Notes system, which the protagonist uses as a research tool -- also relies on the commercial voice application deployment service and the VXML architecture. To access an AgamaNote, a player dials an 800 number. This call is received by the voice application deployment service, which points the call to a page on the TrackingAgama web server. This web page is written in vxml, and performs a variety of functions, such as prompting the user to enter a code, as well as playing the pre-recorded Agama notes themselves. Since the vxml pages are simple scripts interpreted by a web browser, the system also uses a PHP front-end and a MYSQL back-end to store useful information about each player, such as their phone number, the date and time they started playing, and their current location in the game.[5]

Goals and Theory

One of our primary goals was to address physical space, in this case 6 locations in downtown LA, and attempt to drive a "second look" at these spaces. So often, the cell phone and other mobile communications technology is cited as source of dislocation from our physical environment, so we took it as our challenge to design a project wherein the mobile platform became a conduit for engagement with the surroundings, thus simultaneously rethinking the space and the options for mobile technology. With this emphasis, distinguishing

between a 'space' and a 'place' became a useful idea in conceptualizing Tracking Agama. Space has physical dimension, shape, boundaries, but place a personal, or societal or cultural resonance or context. Our goal was to use narrative delivery via cell phone in the physical *space* to modulate the understanding (via history, urban legend, new fiction, and puzzle elements) of the location as a *place*. For example, how many people consider the supernatural origins of the Bradbury Building while inside and experiencing its unique design, then try and connect to anything else in LA?

Because one of our goals was to offer as much flexibility in terms of engagement to our participant, and we hoped to accommodate both the person who wanted to explore the whole story in one afternoon as well as the person who wanted to read the weblog one night, visit the library on a lunch break, or explore Union Station and Angel's Flight on a weekend morning, we decided upon an episodic narrative structure—even micro-episodic. We used the idea of "story nuggets" in the form of both the AgamaNotes and ShufeltCalls, which were designed to offer tiny chunks of story the participant would access in the space and on the move.

Tracking Agama exhibits an intersection of game and narrative design. The narrative pathways are available to the users to pursue on their terms, but, whereas narratives usually conceal their internal logic to be revealed or discovered as the narrative progresses and games reveal their internal logic and invite participation within those boundaries, *Tracking Agama* does a little of both. First, the player must master the keyword selection pattern used by the character Agama. Then, it is through player action deciphering puzzles by combining the keyword scheme with exploration of the location, that the narrative logic is revealed. Thus, the player produces the narrative by his or her actions, becoming an author in a way, since only certain aspects of the entire narrative will be evident--those that the player has successfully solved.

CONCLUSION

By way of conclusion, we might ask ourselves why so much attention is and recently has been placed on interactivity and narrative. As mentioned at the outset, narrative is a method of arranging information to promote understanding—a discursive patterning, to quote film, culture and new media theorist Marsha Kinder, "of all sensory input and objects of knowledge".[6] Traditionally, we have understood narrative to construct this pattern with a particular logic of causality, temporality and spatiality—a beginning, a middle and an end, cause and effect,. But postmodern culture's heavily mediated state destroys and explodes these traditional patterns. More than simply a technological feature, interactive narrative responds to deeper fissures and negotiations of authorship, authenticity, veracity and the authority to tell stories. Similar features, particularly the desire and capability to have at least some minor influence, motivate, at least in part, the explosion of reality television (think *American Idol*), blogging (think of BBC and CNN dependence on bloggers for tsunami coverage) and are contributing motivators towards interactive narrative. As narrative deals with negotiating these aspects of culture it must change in response to this developing landscape and morph from the more structured and presented notions of a contained and authored narrative offered on the page or cinema/television screen, to one that accommodates a cooperative effort between creator and participant, and thus the experiential element of the narrative structure becomes a crucial and a foregrounded aspect for consideration. We propose that mobile narratives, with their emphasis on an experiential component, direct engagement with new articulations of relationships between space and time and especially the postmodern city, and their naturalized interface device of the phone handset are particularly salient examples of a developing art form negotiating, patterning and understanding our changing experience.

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1. Manovich, Lev (2001). *The Language of New Media*. Cambridge: The MIT Press.
2. Branigan, Edward (1992). *Narrative Comprehension and Film.* London and New York: Routledge. pp. 18-20.
3. This term is adapted from "alternate reality game", which describes games that blur the line between game events and real world events, such as "The Beast", I Love Bees and the game depicted in the film The Game (David Fincher, 1997), starring Michael Douglas]
4. Csikszentmihalyi, Mihaly (1990). Flow: The Psychology of Optimal Experience. New York: Harper and Row.
5. trackingagama.net is powered by the weblog software Movable Type 3.1 and MYSQL. The server itself is running Apache 2.0 on Red Hat Linux 9.0.
6. Kinder, Marsha (2003). "Honoring the Past and Creating the Future in Cyberspace: New Technologies and Cultural Specificity". *The Contemporary Pacific*, *15*(1), 97.

APPENDIX

Sample from Weblog

[Final Post]
July 30, 2005
help

To all who might read this: My friend and collaborator, Agama, the creator of this blog, has been out of contact for sometime. If you've read the blog, you know of my friend's interest in the occult, the supernatural and the mysterious. Recently, his messages had been strange - paranoid even. As if he was being chased or stalked. Silly. Except he claimed to have found the lost half of a map that would unlock a great mystery. It would confer great power and knowledge upon whomever learns the truth of this mystery. I suppose Agama's fears might not have been unfounded?

I've been trying to unlock Agama's voice memo system and finally have been successful! He uses keywords as the trigger code, something evident in the location he records the note or pertinent about the subject he's talking about. So, you dial his AgamaNote number, then speak the keyword and the associated AgamaNote plays.

I am house-bound and cannot follow Agama's trail. If you're willing to help me track down my friend, I can assure you we will all share in the riches when we find his secrets.

Thinking about conversations I've had with Agama, and reading the blog, I think I've found two keywords for AgamaNotes. One is an early one, in which he describes the Red Line. The second is hard to make out, but I'm sure he's talking about the mirror he found.

Here's the AgamaNote phone number: 877-730-XXXX

Try these two code words:

Mirror and Red Line.

Those are the only two vague words I could make work. Try using specific words found in the locations from here on out.

Sounds like he was going to hide the mirror where it would blend in with some artifacts, maybe in a piece of art? Did he say it was at Union Station?

If you'd like to help, I can be contacted by text message. Try texting those keywords to me. Example: send the text message 'red line mirror' to me at: agama@mail.trackingagama.net

When you're done with a location, text me the keywords for that location, just like you've just done with "red line mirror". That way I can do some research on these words, remember conversations I've had with Agama, and help guide you a bit.

Posted by shufelt on July 30, 2005 | Comments (13)

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Section 2

Philosophical Aspects

Chapter 10
The Case for Open Access Networks

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ABSTRACT

Efforts to keep the broadband Internet a free and open public utility are much in the news. In the context of the Network Society, the authors examine some of the publicly stated arguments and positions being taken in the articulation of "net neutrality" and "open source" practices and principles. The article explores the difficult technical challenges present in maintaining "open access" telecommunications networks using proprietary technologies. From a global perspective, industry groups have strong incentives to work together to adopt universal technical standards. With more open technical standards, open source applications and products can be accelerated and made more pervasive. Collaboration among businesses, national governments, and public sectors are seen as key to implementing policies that lead to public participation in economic and social development both locally and globally. The principal means by which all these approaches can be sustained is to keep the Internet accessible, free and open for all.

INTRODUCTION

Debates about the Internet and its role in modern society continue unabated as stakeholders try to influence the shape of things to come. Originally conceived as an open and neutral carrier of information, access to the Internet of the future is no longer guaranteed.

An essential tool of modern society, the Internet potentially impacts all spheres of activity, whether private or public, whether for leisure or work. To ensure that individuals and communities gain maximum benefit from the Internet, governments are finding themselves under pressure to provide enabling legislation. This article addresses the

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dilemmas faced by policy makers who see the innovative potential of open access networks but must bow to the economic and technical realities of commercial sectors who do not find all markets profitable and who must manage their networks for maximum value wherever they choose to install them.

To set the stage, the basic idea of the Network Society and the network economy are described, as are the principal stakeholders of the Internet and the controversies that surround the principles of universal access. The context of this debate is framed in terms of the $4.7 billion bid on the 700 MHz frequencies in U.S. markets by Google Inc. in 2008, followed by a discussion of the three building blocks of open access networks: net neutrality, standards-setting, and non-proprietary technologies and software. The article concludes with some insights that can help inform future policy decisions.

DEVELOPMENT OF THE NETWORK SOCIETY

The Network Society is a dependent social structure using interconnecting digital technologies to process and distribute information (Castells, 2006, p. 7). In essence, the Network Society makes use of information and communication technologies (ICTs) to gain greater openness, adaptability and flexibility for itself. Despite Castells' optimistic view of the Network Society, he has encouraged policy makers to reflect before acting:

...the key question is how to proceed to maximize the changes for fulfilling the collective and individual projects that express social needs and values under the new structural conditions (p. 16).

An important component of the Network Society is the network economy in which knowledge and other intangible assets have become the most important productive factor (Mandeville, 2005). Intangible assets include intellectual property, human and social capital, information economics, brand names, customer databases, core competencies, and business relationships. Organizations operate in a network of relationships and alliances that allow them to compete and innovate. They practice both collaboration and competition, and emphasize openness with close partners and limited proprietary access with competitors and customers. In other words, for-profit organizations may argue for controlled access to networks to generate revenues and maintain a competitive advantage. It depends on where these organizations are located in the Internet structures (Barry, 2008) and where elements of true competition exist.

Castells and followers have tended to view global forces as dominant, with nation states and regional bodies serving as powerful players through their legislative and regulatory powers and public sectors (Castells & Cardoso, 2006). However, other stakeholders (civil liberty groups, industry associations, organizations for disabled people and trade unions) attempt to influence the dominant players (Skogerbo & Storsul, 2000). Equally true is the decision-making that takes place at the local community level which is tied not just to technology and economy, but also to social well-being and basic community values (Jain, Mandviwalla & Banker, 2007). Numerous such examples are supplied by the Intelligent Community Forum, a non-profit think tank and promoter of the broadband economy in local communities throughout the world **(**www.intelligentcommunity.org**).** Thus, the policy decisions that shape the Internet impact on all levels of social and economic organization.

Debates over railroad (Suomi, 2005) and telephone services (Preston & Flynn, 2000) have historically centered on the importance of these public services to the well being of all citizens and communities, and the role of government in assuring accessibility. Additional justification for universal service is found in its economic impact through innovation and entrepreneurial activities

(Bar & Riis, 2000). This historical background has set the tone for the current debate on the Internet and the mesh of telecommunication networks that compose it. The stakes are high: realizing the potential of the Internet for greater access, innovation, creativity and information dissemination and exchange (Lessig, 2005).

In the Winter of 2008, Google Inc., a ten-year-old dot.com start up, crystallized this debate by submitting a $4.7 billion bid on a block of spectrum at auction by the United States Federal Communications Commission (FCC), with the intent to assure that the Internet remained an "open access network." At auction was a nationwide swath of the 700 MHz spectrum becoming available when local television stations convert to digital broadcasting. The repurposing of the old analog TV channels, presumably to accelerate development of next generation wireless services, represents broadband spectrum many stakeholders are hoping will be used to facilitate economic and social development and address digital divide issues across the country.

In a letter to the FCC Chairman Kevin Martin in July 2007, Google CEO Eric Schmidt said his company would be making a financial commitment to assure that certain "open platform" conditions were adopted in the spectrum auction (Wilson, 2007). The conditions Google was seeking included:

- **Open Applications**: Consumers should be able to download and utilize any software applications, content, or services they desire;
- **Open Devices**: Consumers should be able to utilize a handheld communications device with whatever wireless network they prefer;
- **Open Services**: Third Parties (resellers) should be able to acquire wireless services from a 700 MHz licensee on a wholesale basis, based on reasonably non-discriminatory commercial terms; and
- **Open Networks**: Third parties (like Internet service providers) should be able to interconnect at any technically feasible point in a 700 MHz licensee's wireless network.

Although the FCC did not adopt the specific conditions advocated by Google and its partners, the Commission rules set for the auction did specify that a $4.6 billion bid for the prized C-block of frequencies would ensure that the winning bidder will create a broadband network "open to any device or application."

This prized spectrum block was acquired in Spring 2008, as many had predicted, by telecommunications giant Verizon Inc. at a price greater than the Google bid of $4.7 billion, with AT&T also claiming large swaths of the national wireless 700 MHz spectrum. TheRegister.co.uk quoted Google's Washington telecom and media counsel Joseph Faber as saying "We congratulate the winners and look forward to a more open wireless world. As a result of the auction, consumers whose devices use the C-block of spectrum soon will be able to use any wireless device they wish, and download to their devices any applications and content they wish. Consumers soon should begin enjoying new, Internet-like freedom to get the most out of their mobile phones and other wireless devices" (Metz, 2008).

Google and partners were articulating the basis for a new economic and social order in which the democratic values of "open access" and "open society" are promoted by public policy. That is, in networked societies, where all nations and all peoples are connected by one form or the other of the Internet, the public good is best enabled by policies and regulations that support "open communications." In the remainder of this article, three themes that underlie the concept of open networks are investigated: net neutrality, standards setting, and non-proprietary technologies and software.

NET NEUTRALITY

As one of the most powerful instruments of creative destruction in the new digital age, the Internet has emerged as a lawyer's Mecca. Opportunities are almost endless for legal litigation, legislation, court findings, arbitration, and negotiation—the result of Internet threats to the status quo in almost every sector of media and communications. Thus, public policy as well as corporate practice is very much in flux in the area of cyberspace law and regulation.

Among Western countries, most Internet champions want the Internet left alone. The content rights holders, the service providers, and the equipment manufacturers all have been asking for time and space to prove that the market can solve whatever problems arise without government intervention. In the U.S., the Congress, the Federal Communications Commission, the Federal Trade Commission, the Securities and Exchange Commission, and the Federal courts have exercised great restraint in tampering with the way the Internet is evolving. On both the Republican and Democratic sides of the legislative aisle, elected representatives regularly state their preference for letting the technology and the market develop unfettered, intervening only when absolutely necessary to aid public access, protect intellectual property and public safety, and sometimes to insure competition and innovation.

One contentious exception is over "net neutrality," the Internet's openness to content, applications and equipment from any source. In this case, officials are under pressure to prohibit any monopolizing practices that might interfere with equal and open public access to the Internet. One concern is that those who own and therefore control the networks will establish differential pricing for the user public based on slower (narrowband) and faster (broadband) lanes on the Internet. Under the Internet pricing models being advanced by the telco and cable ISPs, for example, the ISPs will also be able to charge higher rates to such companies as Amazon.com and eBay for faster access to their customers, creating a tiered system of content providers, based on ability to pay (Kennard, 2006).

Google CEO Eric Schmidt explained what is at stake from the perspective of the content providers. "Network neutrality is the principle that Internet users should be in control of what content they view and what applications they use on the Internet. The Internet has operated according to this neutrality principle since its earliest days. Indeed, it is this neutrality that has allowed many companies, including Google, to launch, grow and innovate" (Schmidt, 2007, 1).

Google and other advocates for an open Internet have argued in the U.S. Congress that by setting up toll-booths on the Internet, both consumers and content providers have to pay extra to travel on the same information highways that are provided free in such countries as Estonia, Japan and Korea. Rather than broadband access being managed as an essential universal service, as are public utilities like water, electricity and the public highways, the Internet will be segmented into differentiated services for which premium prices must be paid by those who use the faster lanes. The effect, they argue, could be to suppress innovation while creating an elite class of users (Schatz, 2008).

The plans of U.S. telephone companies Verizon and AT&T, cable operators Comcast and Time Warner, and other last mile service providers owning the distribution networks are facing fierce protest from those who want to see fast Internet services available to all "as a matter of public policy." Critics are complaining that the promises of telcos and cable operators to lay broadband infrastructures in exchange for tax credits and a relaxed regulatory environment have not been met. Free market principles, they argue, especially in the less populated and less affluent communities of the U.S., have failed to deliver on equal access expectations. The effect is that the U.S. has fallen behind its competitor nations in broadband pen-

etration, and moves to charge differential prices will push the nation even further away from the prospect of universal service. On their side, the carriers counter-argue that their shareholders are the ones footing the bill in building the broadband infrastructure, and that they deserve to be rewarded for their efforts.

The worries of concerned legislators were expressed in 2007 by North Dakota Senator Byron Dorgan, who voiced the following three reservations: that the network operators might get the idea they could control who should gain access to the Internet, that they could control what devices users would be able to use to connect to the Internet, and that they could put additional requirements, such as demanding that users sign up for TV service or phone service, as a condition of access. Dorgan said,

The success of the Internet has been its openness and the ability of anyone anywhere in this country to go on the Internet and reach the world…..If the big interests who control the pipes become gatekeepers who erect tolls, it will have a significant impact on the Internet as we know it (Bylund, 2007, 1).

Dorgan represents a state that has a large rural population, with many farms and villages that are beyond the current reach of telcos and cable companies offering high-speed Internet, in part because those companies are focusing on the easier-to-reach and more affluent urban populations. The telecommunications providers, often complicit with the U.S. Federal Communications Commission, have sought to paint a picture of broadband coverage and access in the state (and across the nation) as being more pervasive and more competitive than it is in fact.

Tom Lowry took the FCC Chairman Kevin Martin to task in a Business Week editorial in December 2007. Observing that the U.S. is falling even further behind in high-speed Internet availability, speed and cost, he wrote,

The latest rankings by the Organization for Economic Cooperation & Development show the U.S. at 15 in terms of broadband penetration – down from 4 in 2000. Average speeds in Japan are 20 times faster than in the U.S., and South Koreans pay nine times less per megabit than Americans do (Lowery, 2007, 76).

Google and Yahoo were among the first to take the sides of the general public and the dot.com content providers who could be disadvantaged by the implementation of tiered Internet access. In 2007, in an open communication to its users with copies to Internet regulators, the Google CEO wrote:

Today the Internet is an information highway where anybody—no matter how large or small, how traditional or unconventional— has equal access. But the phone and cable monopolies, who control almost all Internet access, want the power to choose who gets access to high-speed lanes and whose content gets seen first and fastest. They want to build a two-tiered system and block the on-ramps for those who can't pay.

In our view, the broadband companies should not be permitted to use their market power to discriminate against competing applications or content. Just as telephone companies are not permitted to tell consumers who they can call or what they can say, broadband carriers should not be allowed to use their market power to control activity online. Today, the neutrality of the Internet is at stake as the broadband carriers want Congress's permission to determine what gets to you first and fastest. Put simply, this would fundamentally alter the openness of the Internet (Schmidt, 2007, 1).

Schmidt quoted Tim Berners-Lee, inventor of the World Wide Web, who said, "The neutral communications medium is essential to our society. It is the basis of a fair competitive market economy. It is the basis of democracy, by which a community

should decide what to do. It is the basis of science, by which humankind should decide what is true. Let us protect the neutrality of the net" (Schmidt, 2007, 1). As yet, however, there is no consensus on the evidence that net neutrality has been harmed (Brito & Ellig, 2007). There is no consensus on the appropriate regulatory measures to be taken (Barry, 2008) or whether market forces (Singer, 2007) and innovation (Owen, 2007) can correct the short-term damage to the Internet's openness.

This conflict is not a recent confrontation between the carriers, content and service providers, consumers and consumer advocates. For more than a decade these factions have been publicly debating "what" is the Internet, "who" should control it and "how" it should be regulated. These debates continue and the results remain uncertain. What follows is a discussion of two additional issues that will factor into public policy considerations, namely, standards-setting, and non-proprietary technologies and software.

STANDARDS-SETTING

The development and adoption of technical standards for delivering information around the world is one of the great achievements of collaborative society. What makes the Internet so powerful is that it has been adopted globally as the electronic network of choice for home users as well as business and other social institutions, and the technology persists in its relentless penetration into even the most remote of societies. One of the reasons for the unprecedented diffusion and adoption rate of Internet products and services is that they are based on a universal standard. An important constraint on the international exchange of information was overcome with the adoption of TCP/IP (transmission control protocol/Internet protocol). This standard emerged from a government lab of a single country but its success is due to the fact that it has been embraced and sustained as a global public utility.

Quality of service on the early Internet was not a big issue, since few knew what to expect and were only learning what this new kind of electronic network could do. When NSFnet was transferred from the supervision of the U.S. National Science Foundation to commercial service in 1992, the prime objective and the great achievement of early TCP/IP standards setting was ensuring that computer files got to their destination. Gaining a modicum of predictability, consistency and reliability with data traveling over dial-up telephone networks was considered a major engineering feat, which it was. "Best effort" was all that anyone could count on, with success determined by whether the transmissions were received or not, and little more than that (Flournoy, 2004).

Achieving higher transport efficiencies and increasing the volume of delivery while maintaining predictable, consistent and reliable behaviour in a packet-based environment was not—and is not—easy to realise. The challenge wasn't just that IP-technologies had to be developed from scratch, but that the public switched telephone system represented an inhospitable transport infrastructure that had to be accommodated. As it has turned out, multiple incompatible infrastructures, namely telephone, cable, wireless, broadcast, satellite, and power line systems, had to be reconditioned for the Internet to reach everybody and work effectively.

The Internet Engineering Taskforce (IETF) is one of several organizations working to improve Internet performance (www.ietf.org). A successful approach has been to segment Internet traffic so that certain types of transmissions are given preferential treatment. Unlike broadcasting, there is a direct relationship between the number of subscribers and the total amount of bandwidth available for use on the Internet. On publicly shared bi-directional media, such as cable and wireless media, Internet subscribers behaving as "bandwidth hogs" can consume all the available network resources, or significantly slow the download and upload speeds of other users operating on the same shared platform (Flournoy, 2004, p.365).

Where bandwidth is constrained, the IETF strategy has been to differentiate classes of data service that can be given higher-precedence at the expense of those of lower-precedence. Just as e-mail—which can be managed intermittently—places fewer demands on the network than streaming movies that must play continuously in near real-time, it is a matter for service providers to work out with clients what is a fair allocation of bandwidth per user, per class of service.

Another strategy involves the development of better bandwidth management tools to ensure users have access to the applications they need when networks become congested. Streaming media helps Web pages appear more life-like, interactive, and appealing, and the number of these pages is growing daily. But for the majority of Web users, acquisition of dense data streams is not yet an option. The problem is not with the end-user software or the server sending the data, but insufficient network capacity to handle transmitted packets of such magnitude.

Interoperability among the various telephone, cable, terrestrial wireless and satellite networks is an event eagerly awaited among consumers. Although access via a common network is on the drawing boards of a few smart communities, realization is still a long way off for the majority.

One service where equipment and software interoperability is much discussed today is the mobile Internet. For the time being, the portable Internet is an application so splintered by competing offerings that neither customers nor businesses know when to enter the market and how to make informed purchase decisions. IEEE Communications notes the following organisations, in addition to the Internet Engineering Taskforce (IETF), that are participating in shaping the next-generation wireless networks that connect users to the Internet:

- WiFi Forum
- WiMax Forum
- Third Generation Partnership Project (3GPP and 3GPP2)
- Institute for Electrical and Electronics Engineering (IEEE)
- Open Mobile Alliance (OMA)
- Unlicenced Mobile Access (UMA)
- Fixed Mobile Wireless Convergence Forum

Each of these advocacy organisations consists of "interest groups" hoping to develop specifications for infrastructure and access. What will emerge will be the architectures, protocols and standards for applications made possible by the wireless Internet, including VoIP, messaging, movie downloads, peer-to-peer file sharing, conferencing, and multiplayer gaming (Mohan, 2006, 64-65).

The WiMax Forum is already looking at the 700 MHz spectrum for certification, with the idea of creating new opportunities for MiMax vendors to sell their 4G (next generation) wireless gear. Some of the bidders in the FCC auction of 2008 were eager to increase the bandwidth capacities of their local cellular phone services; others were wanting to use the 700 MHz frequencies to extend their two-way networks over greater distances, which these former TV channels could make possible. Since operator transmission and consumer receiver systems for 700 MHz technologies have yet to be developed, the question of "How are we going to do this?" immediately comes into play. The promise of a lot more spectrum and much faster communication is there to entice consumers but the hard work of standards-setting and field-testing is yet to be done.

The public may wish government bodies to enter the fray to settle some of these issues, but the reality is that few governments have the expertise or the willingness to take on the task. Instead, such standardization bodies as the IEEE and the IETF rise to the occasion, in this case, working to find appropriate Internet-based architectures capable of seamlessly delivering broadband services over

disparate wireless and wireline networks that will link to and support all types of end-user devices. While achieving workable standards is a slow, deliberative process, partnerships do seem to be emerging involving both public and private sectors that advance the "open access" agenda because it is in everybody's best interest to do so. This gradual merging of interests for Internet standards is similar to the process that surrounded the first standard in information and security management, the BS7799 British standard which later became the international ISL 17799 (Backhouse, Hsu & Silva, 2005).

NON-PROPRIETARY TECHNOLOGIES AND SOFTWARE

The development of open source applications, products and devices, and the more open government and business cultures that support them, have been greatly accelerated as a result of universal technical standards.

The term "open source" refers most commonly to the source code of software made publicly available with little or no intellectual property restrictions. Since software represents the basic instructions for digital networking, making the source code more widely available is thought by some to be the fastest, most efficient means to stimulate innovation and entrepreneurship in bringing new products and services to the market, through either incremental individual effort or collaboration. Willinsky (2005) has argued that this approach is really an old idea made new, as shown by the many examples where teams of scientists historically provided their ideas to the science community and the general public. However, Willinsky also noted how the 1980s economy introduced more stringent intellectual property rights to increase profits for private sector owners of knowledge.

According to the Linux Information Project, open source software's source code is freely available for anyone to inspect and study, possibly to modify and improve. A common example is software for computer operating systems and application programs whose code is written in one of the thousands of programming languages available. "Most open source software is also free software. Free software is software for which everyone has the right not only to inspect and study the source code but also to use it for any desired purpose without monetary or other restrictions. These other purposes include making as many copies as desired, installing on as many computers as desired, modifying (including extending) in any desired way, and redistributing in its original or modified form" (Open Source Definition, 2007). There are five business models being used today (Watson et al., 2008):

a. Proprietary systems where customers purchase the right to use them;
b. Open communities where volunteers develop content for little to no commercial interest;
c. Corporate distribution where private sector takes advantage of content provided by open communities and offers support, distribution, and skills to users;
d. Sponsored open source where companies provide older software and sometimes some of their own knowledge workers to continue to work on code, most likely with the hopes that it can be further developed into new opportunities;
e. Second-generation open source – these are professionally developed open source codes and the firms holding the licensing rights realize the majority of their revenues through complementary services.

Clearly, open source and open access have created new opportunities for various segments of the population. However, despite a lack of clear statistics, it appears that the majority of the work on software being used by consumers is proprietary. Linux software and the involvement

of companies such as IBM in promoting open source concepts notwithstanding, the majority of current open source software is the product of open communities in small projects.

In practice, it has become difficult to keep free software free (Stallman, 2006). Much of the world is still exploring and imagining business models for open source. Open community projects that are considered valuable are pursued by corporations who wish to realize some profits through corporate distribution and the provision of support services, or to control users and restrict use. Although open source and open access are important concepts for the network economy, their implementation and development are still in the infancy stage and have yet to yield the expected synergistic outcomes.

Willinsky (2005) has reported that "articles which are made open access are cited more often than those that can only be viewed by subscription" (p. 3). This fact was confirmed by Harnad et al (2008), who also discussed the loss of research impact resulting from libraries' inability to afford the 25,000+ journals available worldwide. Open access is a solution, but Harnad et al estimate that only 39 percent of university authors currently post **one** of their articles to open access self-archiving sites, and only 10% of all journals are "gold" open access journals. They define "green" journals as those that permit posting to open access archives, while 'gold' journals create their own content and recover costs in other ways (Harnad et al, 2008). Again, open source offers a bright future for innovation, for decreasing research impact loss, and for improved consumer access, but it is not mainstream at this time.

In 2006, the European Union commissioned a study on the "Economic Impact of Open Source Software on Innovation and the Competitiveness of the Information and Communication Technologies (ICT) Sector." UNU-Merit of the Netherlands prepared the final report, concluding that the information economy represented approximately 10% of the EU's GDP and accounted for more than half of its economic growth. The report noted that "Software is one of the key elements driving ICT's role in the economy, and the structure, competitiveness and performance of the ICT industry has the potential to be strongly affected by FLOSS (Free/Libre/Open Source Software)" (Ghosh, 2006, 2-12).

FLOSS, in this case, referred to open source software that is freely available and free of charge. The Executive Summary drew multiple conclusions and numerous recommendations were made. Among the most important was the proposition that:

Policy strategies focus mainly on correcting current policies and practises that implicitly or explicitly favour proprietary software—for example, discouraging public R&D funding and public software procurement that is currently often anti-competitive; not penalising the open source software in innovation and R&D incentives; encouraging partnerships between large firms, SMEs and the FLOSS community; avoiding lifelong vendor lock-in in educational systems by teaching students skills, not specific applications; and encouraging participation in FLOSS-like communities. (Ghosh, 9-12).

As one of the principal drivers of convergence within computer and telecommunications systems, the Internet is responsible for much of the momentum toward open source software. In the old days, PCs using specialised chips ran proprietary software, while the legacy phone systems of telecom companies had their own chips running their own brand of software. When the Internet arrived and proved capable of linking any kind of computer to any other kind of digital platform, consumers adopted the idea that this was an operating system that ought to be free and open, available to everybody for whatever use, wherever they were. It was perhaps from this point on that the user community began to think, and eventually argue, that the Internet is a necessary service and must be treated like a public utility.

Even Microsoft accepted some of the basic principles of open source for the Internet. In 2006, the company released its "Microsoft Open Specification Promise," a document affirming that Microsoft would not sue anyone who created software based on Web services technologies, a set of communication protocols designed by Microsoft and other vendors. Jason Matusow, Microsoft's director of standards affairs, explained that Microsoft spends more than $6 billion a year on research and development and remains committed to generating intellectual property. But, he said, the company has chosen a "spectrum approach" to it "which ranges from traditional IP licensing to more permissive usage terms that mimic open-source practices" (LaMonica, 2006, 1).

In summary, growing public expectations of the Internet have led to global commitments and many practices aimed at keeping the Internet open as an all-society resource. This idea is guided by the belief that open technologies are not only the most efficient means to stimulate innovation and entrepreneurship, they are key to achieving a more sustainable future for communities and nations in which public participation, accountability and trust are valued.

CONCLUSION

In the context of the Network Society, the Internet has much to offer in terms of innovation, creativity and information dissemination, that is, if it remains an open system. Lawrence Lessig, Professor at Stanford Law School and founder of the Center for the Internet and Society,has given much thought to the ways that governments and commerce are forcing the Internet into a space that is more predictable and regulated, pointing out that a passive public may lose some of the freedom the Internet now guarantees (Lessig, 2006).

The most plausible and promising solution at the societal level is greater collaboration between and among national governments, businesses and public sectors in establishing Internet policies and practices that will enable greater public participation in economic and social development both locally and globally. Guided by such a policy/practice framework, open source applications, products and a collaborative culture can be accelerated and made more pervasive by adopting more open technical standards. Keeping the Internet accessible, free and open as a public utility will be critical to assuring that the goals of the Network Society are met. The forces of globalization at work are pushing for more integration of social and economic activities, and therefore create the necessity for open networks. However, the dynamics of power among the many stakeholders will determine the extent of openness at the local, national and regional levels of organization (Backhouse, Hsu & Silva, 2005).

While open networks are part of a desirable future, they are likely to be more effective if such other complementary issues are addressed as "last mile" and "first mile" connectivity and measurement of the Internet's contribution to economic and social development. These worthy issues were considered outside the terms of reference of this article.

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Chapter 11
Counter-Surveillance Strategies Adopted by Child Pornographers

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ABSTRACT

On the one side, it could be argued that ICT provide a perceived anonymity for people downloading and distributing child abusive material, also labelled child pornography. While, on the other side the technology offers powerful surveillance mechanisms to monitor these activities and thus constitutes a powerful tool for law enforcement. This paper aims to explore how offenders manage the risk of surveillance when downloading, distributing and exchanging child abusive material. Critical research with a focus on panopticon is used as a theoretical framework. The data is drawn from interviews with offenders, convicted of child pornography. The findings show that the offenders have developed technological and social strategies to reduce the risk of surveillance and addresses the need of a new theoretical concept better adjusted to surveillance practices that allow the many to watch the many. The ultimate motivation for researching this topic is to contribute to the development of effective child protection strategies.

INTRODUCTION

The widespread dissemination and use of information and communication technologies (ICT) (Knights & Murray, 1994) in combination with technological advances have facilitated for individuals with a sexual interest in children to produce, download, distribute and exchange child abusive material (Taylor & Quayle, 2003; Sheldon & Howitt, 2007; Gillspie, 2008). Another characteristic of the technology is that it easily can be used to create networks where people with a sexual

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interest in children can meet other like-minded individuals (Thomas & Loader, 2000). Research shows that these kind of networks are considered important by people with a sexual interest in children, since they offer the possibility to share and exchange child abusive material regardless of national boundaries (Taylor & Quayle, 2003; Eneman, 2008). Murray (2006) highlights the dualistic nature of ICT and uses the metaphor of a double-edged sword. One could argue that, on the one side, the technology provides 'perceived anonymity' (Sheldon & Howitt, 2007) or 'apparent cover of anonymity' (Gillespie, 2008), accessibility and affordability. Another feature of the technology is that it reduces the social exposure for people downloading and distributing child abusive material (Taylor & Quayle, 2003; Adam, 2005; Eneman, 2008). Whilst, on the other side the technology offers powerful surveillance mechanisms that can be used to monitor these activities and thus constitute a powerful tool for law enforcement in crime detection (Gillespie, 2008; Lyon, 2006; Thomas & Loader, 2000). Contemporary surveillance systems have become less obvious and overt, and more systematic and subtle in our everyday life (Lyon, 2001; Haggerty, 2006). Consequently, even that people are aware of the risk of being monitored when downloading and/or distributing child abusive material, they do not know exactly when they are subject of surveillance or how comprehensive others' knowledge of them actually is (Lyon, 1994).

The research topic of this article is child abusive material (Quayle et al, 2006; 2008), also labelled child pornography. Gillespie (2008) argues that child pornography is 'an extremely controversial label' and that professionals tend not to use it since it reduces the gravity of what the material portrays and invites comparisons with adult pornography. The term child pornography is not unproblematic and there is not one single definition of it. Interpol has formulated the following useful definition of child pornography: "Child pornography is created as a consequence of the sexual exploitation or abuse of a child. It can be defined as any means of depicting or promoting the sexual exploitation of a child, including written or audio material, which focuses on the child's sexual behaviour or genitals" (Sheldon & Howitt, 2007). This definition highlights that child pornography can exist in different forms such as visual depictions, audio depictions and textual depictions (Gillespie, 2008). Quayle et al (2008) have, in the recent thematic paper on *Child Pornography and Sexual Exploitation of Children Online*, recognised that there has been a significant change in the discourse used to describe the material portraying sexual abuse and/or exploitation of children. They have identified that the terms 'abusive images' and 'abusive material' now are widely used by professionals. It should be emphasized that not all sexual depictions of children are visual, therefore the latter term 'abusive material' is more appropriate to use since it also capture non-visual material such as audio and text (Sheldon & Howitt, 2007). Most jurisdictions use the term 'child pornography' (Gillespie, 2008). This article will primarily use the term 'child abusive material' but the term 'child pornography' will also be used due to that it is the legal definition used in Sweden. I do however agree with Gillespie (2008) and Quayle et al (2006; 2008) that the term child pornography is an inadequate term. The research topic of child abusive material is studied in relation to ICT usage. When using the term ICT it is important to be specific and point out that ICT is not one homogenous technology (Gillespie, 2008; Eneman, 2006). ICT consists of several different technologies, which have different characteristics, and there are also variations in how different technologies are interpreted and used (Monteiro & Hanseth, 1995; Walsham, 2004).

According to current Swedish legal position: production, distribution and possession of child pornography are criminalised. The Swedish legislation has however been proven to be inadequate in parts (Eneman, 2005), and has not been adjusted to tackle the contemporary technological chal-

lenges (Gillespie, 2005; 2008). The limitations refer to the lack of legal regulation of viewing child pornography online and the current classification of child pornography as a 'crime against public order' and not as a sexual crime. England and Wales solved the issue of viewing child pornography online by inserting the verb 'to make' into the legislation to more effectively adjust it to modern advanced technology (Gillespie, 2005; 2008). Besides being a criminal offence in many Western countries, child pornography is also a phenomenon that is strongly unacceptable in society (Taylor and Quayle, 2003). To sum up, the implication is that people who download, distribute and exchange child abusive material, also labelled 'child pornographers' (Sheldon & Howitt, 2007), have strong incitement to protect their identity to reduce the risk of being detected and thereby be prosecuted for the committed crime.

My ultimate motivation (Walsham, 2005; Stahl, 2008) for researching this topic is to contribute with knowledge to the development of effective child protection strategies (Taylor & Quayle, 2003; Gillespie, 2008). Adequate knowledge can paradoxically only be obtained by studying the offenders' behaviour. This article aims therefore to explore the offenders' relationship toward the risk of surveillance by focusing on the following question: How offenders manage the risk of surveillance when downloading, distributing and exchanging child abusive material?

This article contributes to the theoretical field of critical information systems research (CISR) by exploring how the idea of panopticon (Foucault, 1979) can be applied to better understand the offenders' behaviour to manage surveillance issues related to child abusive material. Brief reflections upon the application of emancipation in relation to the studied topic will also be made (Alvesson & Deetz, 2000; Stahl, 2008). Furthermore the article aims to contribute to the debate of this topical issue and thereby support policy developments on a national and international level. It is of critical importance to study the offenders' use of ICT as part of their offending behaviour (Sheldon & Howitt, 2007). The development of effective legal and technological regulation models for preventing child abuse crime via ICT are dependent on our understanding of the offenders ICT usage (Eneman & Gillespie, 2009). The article is organised as follows: in the next section the theoretical framework of critical information systems research is presented with a focus on the theoretical concept of panopticon, followed by a description of the research strategy. Then the findings are presented, followed by a discussion and finally the article closes with a conclusion.

THEORETICAL FRAMEWORK

Critical IS Research

An emerging research field within the IS discipline, relevant for this study, is critical IS research (CISR) (Howcroft & Trauth 2005). CISR can be seen as a reaction to the mainstream IS research which tends to assume that technological innovation is 'inherently desirable' and beneficial to all (McGrath, 2005). The offenders' usage of ICT for child abusive material is an illustrative example of how well established usage of ICT becomes the foundation for harmful content. CISR is based on 'critical theory' (Horkheimer and Adorno, 1972; Klein and Huynh 2004; Croon- Fors, 2006). 'Critical theory' is not a unified theory 'but rather a set of loosely linked principles' (Klecun, 2005), with a commonality 'to change the status quo and promote emancipation' (Alvesson & Deetz, 2000; Stahl, 2008). Critical IS researchers use a wide spectrum of critical social theories (for example Bourdieu, Foucault, Habermas) to critically question established assumptions about the technology, its use and its implications (Cecez-Kecmanovic, 2005, Willcocks, 2006). Engaging in CISR entails the study of the research object with the aid of concepts relevant to critical theory, for example domination, power, control, emancipation etc

(Cecez-Kecmanovic, 2005). In addition to using relevant concepts, the research object should be placed in a wider historical, political, social and economic context (Alvesson & Deetz, 2000). A wider discussion of the historical, social and political context of child pornography can be found in Taylor and Quayle (2003) and Sheldon and Howitt (2007). By critically questioning 'social realities' and provide alternative insights how these 'realities' are historically, politically and socially constructed and strongly shaped by asymmetries of power in society, we are able to move beyond established definitions and assumptions and can achieve emancipation from traditional existing structures (Cecez-Kecmanovic, 2005; Alvesson & Deetz, 2000).

The central aim in critical IS research is its deep interest of emancipation (Stahl, 2008; Alvesson & Deetz, 2000). Stahl (2008) highlights some of the fundamental problems involved with the critical intention to emancipate, for example when the research subjects do not prefer to be emancipated. The emancipatory perspective in this article refers to emancipation on a societal level to effectively protect children through legal and technological regulations (Gillespie, 2008). The rationale to study the offenders' surveillance practices is to obtain insights about their behaviour that can be used in the development of effective societal child protection strategies.

Surveillance and Panopticon

Surveillance is not a new phenomenon, humans have always kept an eye on each other with purpose to control their surrounding (Lyon 1994). The diffusion of ICT in society has however changed the conditions for surveillance radically (Lyon, 2006). One of the most important differences is that today with the use of ICT, the surveillance systems have become less obvious, more systematic and subtle in our everyday life (Haggerty, 2006). Accordingly, people seldom know exactly when they are subjects of surveillance or how comprehensive others' knowledge of them actually is (Lyon 1994). Both Murray (2006) and Lyon (2006) accentuate the dualistic nature of surveillance technologies. Lyon (2006) claims that surveillance technologies have 'two faces' and can be used to control unwanted behaviour, such as illegal activities, but at the same time the technology can be used to facilitate such illegal activities (Lyon, 2001). One of the most unparalleled metaphors of the power of surveillance in the contemporary world is panopticon (Foucault, 1979; Lyon, 2006). The panopticon was originally an architecture design developed by Bentham as a special surveillance tower for a prison (Foucault, 1979). This architecture consists of a central visible surveillance tower and a courtyard surrounded by an outer ring of cells (Willcocks, 2004). The issue of visibility is of vital importance in the panopticon design, since it constantly reminds the prisoners of the possibility of being observed (Foucault, 1979). The design is based upon the principle that the few guards in the tower could watch the many prisoners in the cells, while the observed could not communicate with each other, nor see the observers, but are constantly aware of the risk of being monitored by the guards (Willcocks, 2004). With this design, surveillance became automated and depersonalized as the identity of the observer remains hidden (Lyon, 2001).

Foucault (1979) reinvented the concept of panopticon as a metaphor for 'modern disciplinary societies'. Panopticon can be seen as 'the illusion of constant surveillance', since the prisoners are constantly aware of the risk of being monitored regardless if they de facto are monitored or not (Foucault, 1979; Whitaker, 1999). The feeling of constant surveillance creates a 'permanent panopticon', where the prisoners act as if they are constantly monitored (Jonsson, 2006). The panopticon design constitutes a power mechanism that aims to control and discipline the prisoners' behaviours (Willcocks, 2004). As the prisoners fear that they might be watched, and fear punishment for transgressions, they internalize rules (Foucault

1979). According to Foucault (1979) power should be seen as something that is exercised rather than possessed in the panoptic environment. The power is exercised and maintained by the individuals in the panoptic environment. In Foucault's point of view, power relations should not be seen as merely negative but productive as well (Foucault, 1979). The panopticon design constituted an automatisation of the surveillance systems. While the design of panopticon allows the few to watch the many, the concept of synopticon (Mathieson, 1997) refers to surveillance practices where the many watch the few (for example through television). Mathieson (1997) argues however that these two systems should not be seen as each others contrasts, since they can interact intimately and strengthening each other (Lyon, 2003). Mathieson (1997) emphasizes the parallels between synopticon and panopticon. They have developed through the same period, from 1800 to 2000, and both have been 'technologically upgraded and intensified in the later twentieth century' (Lyon, 2003). Another common characteristic is that they can both be used as means of power (Lyon, 2003).

Surveillance, Panopticon and ICT

Through the use of ICT the surveillance capabilities have been expanded and further automated (Lyon, 2006). ICT enables many processes and tasks to be performed at the same time and can be used to large-scale collection and storage of data (Jonsson, 2006). The technology also allows for data to rapidly flow within and between different systems. Jonsson (2006) describes how ubiquitous environments can be seen as panoptic environments since they enable a form of surveillance, which persists across time and space where people have to assume that they can be monitored the whole time. The issue of visibility, a central visible surveillance tower, is one of the major differences between the original panopticon and surveillance systems based on ICT (Lyon, 2006). ICT-based surveillance systems are often concealed in the environment and are thus invisible for the users. Jonsson (2006) claims that a consequence of this, when the surveillance mechanisms are embedded in the environment, is that the users are aware that surveillance potentially can take place at any time, performed by unknown actors and for unknown purpose. Ball (2006) describes how powerful panopticon structures can elicit active resistance, where strategies to avoid surveillance are developed. Research shows that users in ICT-based environments can circumvent surveillance capabilities in the environment (Timmons, 2003), by finding out when they are being monitored and organise collective resistance (Bain & Taylor, 2000). This highlights that it is a mistake to believe that surveillance systems result in complete disciplinary power (Lyon, 2006).

Critique of Panopticon

Even though the panopticon is a strong metaphor to conceptualize and understand surveillance practices it has been criticised for its limitations to adequately understand contemporary technological societies (Lyon, 2006; Haggerty, 2006). The critique is based upon the argument that we must 'move beyond' panopticon, since the concept does not reflect all aspects of computerized surveillance. Poster (1995) introduced the concept 'super panopticon' to illustrate how databases enhance the surveillance capabilities. The 'postmodern panopticon' is another concept presented by Albrechtslund (2005) to highlight the new dimension introduced by ubiquitous computing. Despite its critique, the panopticon concept refuses to go away and the reasons for this are manifold but clearly one of them is that panopticon is such a rich multifaceted concept (Lyon, 2006). It can be used for interpretation in a number of ways and in different contexts. Lyon (2006) argues that it is impossible to evade some interaction with the panopticon, either historically or in today's analyses of surveillance. Following the same vein, Boyne (2000) claims that it is best

to 'accept the panoptic presence, even if only as the ghost lurking within the post-panoptic world'.

Panopticon in Different Contexts

Willcocks (2006) argues that despite that Foucault himself wrote little directly about ICT, the work of Foucault is useful for the IS discipline in contemporary social studies of ICT. The concept of panopticon has been used in the analysis of different contexts such as prisons (Foucault, 1979), workplaces (Zuboff, 1988; Doolin, 1998; Jonsson, 2006; Ball, 2006) and in other public spaces (Koskela, 2006). Adam (2005) has applied a similar surveillance and control perspective in her studies of cyberstalking and Internet pornography. Adam's focus is upon the offenders' possibility to carry out surveillance on potential victims in this technological environment. In the light of the risk of being monitored when carrying out a criminal offence such as child pornography, this article applies the concept of panopticon. The motivation to use this concept is to obtain insights of how the individual offender manage the risk of surveillance when downloading, distributing and exchanging child abusive material by using ICT (Foucault, 1979; Lyon, 2006; Willcocks, 2006; Jonsson, 2006; Brooke, 2002).

RESEARCH METHODOLOGY

Researching the 'world of child pornography' (Taylor & Quayle, 2003) involves both certain practical and ethical considerations. This includes for example how to gain access to people who have experience from this world as they can be characterised as a 'hard to reach group' for people outside this world (Taylor & Quayle, 2003; Wilson & Jones, 2008). Due to that the production, distribution and possession of child pornography is a criminal offence in most Western countries, it is unlikely that people involved in this world would be willing to discuss their activities prior convictions. It would also be an extremely difficult and complex issue, practically, ethically and legally, for a researcher to try and gain access to non-convicted persons who have experience of producing and/or downloading and/or distributing and/or exchanging child abusive material. The approach used within this study has been to interview offenders convicted of child pornography (Taylor & Quayle, 2003; Noaks & Wincup, 2004; Wilson & Jones, 2008). It could be argued that offenders who have been involved in activities related to the world of child pornography are key experts and thus can provide information about their activities and behaviour within this world (Wilson & Jones, 2008). The motivation to interview convicted offenders was to obtain information that increase the understanding about how the individual offender manage the risk of surveillance when downloading, distributing and/or exchanging child abusive material.

Data Collection

The data was collected through semi-structured interviews with fifteen male offenders (Taylor & Quayle, 2003; Noaks & Wincup, 2004) aged 19 to 55 years old. They have all been convicted of production and/or, distribution and/or possession of child pornography, where ICT has been used. Of these fifteen offenders, eleven were also convicted for other sexual offences, mainly sexual abuse against children. These other offences have however not been in focus in this article. The offenders came from a variety of demographic backgrounds and their engagement with treatment programmes also varied. The researcher gained access to the offenders through prison psychologists at the prison and probation services. Noaks & Wincup (2004) emphasize that it is important that researcher address the responsibilities they have to their respondents. This includes ensuring that the relationship between the researcher, who collects the data, and the respondent, who provides the data, is clear and professional. This

was achieved by providing all the respondents, prior the interviews, with an information letter about the study and the principle with informed consent. (Brantsaeter, 2001; Taylor & Quayle, 2003; Noaks & Wincup, 2004). The letter contained information about (1) the purpose with the study and the interviews, (2) how the data would be used and stored, (3) the issue of confidentiality, (4) that the participation was voluntary and that the respondents could withdraw at any time and if so none of the data would have been used and finally (5) information how to get in contact with the researcher at a later stage if the respondent would like to comment and/or ask anything in relation to the study.

All the interviews took place in the prison, either in the visiting room or in the prison psychologist's office. The interviews, each lasting between 1, 5-2 hours, were in eleven cases tape recorded and later transcribed. In four cases, where the respondents did not want the interview to be tape recorded, field notes were taken and carefully written out immediately after the interview (Silverman, 2005; Noaks & Wincup, 2004). The same researcher has both interviewed the respondents and transcribed the data (Taylor & Quayle, 2003). The purpose with the interviews was to obtain a deeper understanding of the individual offender's management of the risk of surveillance when downloading, distributing and exchanging child abusive material. During the interviews the respondents were asked questions regarding their individual experience, understanding and management of the risk of surveillance in the specific context. Open-ended questions were used rather than closed questions, and efforts were made to 'elicit stories' from the respondents (Taylor & Quayle, 2003; Noaks & Wincup, 2004). To avoid eliciting 'one-word answers' (Hollway & Jefferson, 2000), the open-ended questions were designed like 'tell me about your experiences of avoiding surveillance when downloading child pornography'. Follow-up questions were used to further develop the respondents' stories (Taylor & Quayle, 2003). Since this study is part of a wider ongoing research project, exploring the offenders' use of ICT for child abusive material, the interviews covered more issues than the surveillance related ones.

Data Analysis

The process of analysis should not be seen as a distinct stage, but as an ongoing process that permeates every stage in the research study (Noaks & Wincup, 2004). The process of transcription offered the opportunity for initial reflection on the data. Once the data was transcribed, it was first read and re-read and initially notes were taken to comment the material. In the next stage the material was structured and coded in relation to the research question and the data sorted into emerging categories (Taylor & Quayle, 2003; Noaks & Wincup, 2004). This was influenced by theoretical concepts, such as surveillance, power, control and resistance etc, and a search of patterns within the data (Coffey & Atkinson, 1996). During the last stage subjective meanings were searched and differences and similarities were identified among the categories identified in the previous stage (Taylor & Quayle, 2003; Silverman, 2005). In this study, the researcher has used certain theoretical concepts, which have worked as themes, both in the design of the data gathering and when analysing the data.

Critical Reflections

When reflecting on this approach critically, it means that the researcher went into the area with certain preconceived ideas and a thematic focus when analysing the collected data. One of the potential pitfalls with using a 'theoretically unformed empirical research' (Noaks & Wincup, 2004) as an approach is that the researcher only focus upon themes known in advance and misses other

relevant themes in the data. The researcher has however tried to combine a 'theoretical informed empirical research' approach with 'openness and flexibility, (Coffey & Atkinson, 1996) in the search of themes in the data. An alternative approach could have been the use of a combination of analytic strategies. Such a 'triangulation' approach could have provided varying perspectives and as such alternative insights of the research subject (Coffey & Atkinson, 1996).

It is also important with critical awareness of the selection of respondents. All the respondents in this study have been arrested and convicted of child pornography and in many cases, as mentioned above, also for other sexual offences. It should be acknowledged that arrested and convicted offenders only represent a fraction of all child pornographers and that child pornography and other sexual crimes have a very low reporting rate (Quayle et al., 2006; Terry & Tallon, 2004).

Ethical Reflections

This study follows the ethical rules and guidelines for research, formulated by the Swedish Research Council[1]. As described above, all the respondents were prior their involvement in the study provided with information about the purpose of the study and how the material will be used and stored. Furthermore the respondents have given their consent to participate in the study. Another important consideration for this study has been to ensure confidentiality for the respondents. All identifying information has been removed or changed to ensure this. As described above this article is part of a wider ongoing project, which is approved by the Ethical Committee at the University of Gothenburg. The interviews have provided a rich source of information about the individual offenders' behaviour when managing the risk of surveillance, which would have been difficult to obtain ethically in any other way.

FINDINGS

Before presenting the result regarding how the offenders manage the risk of being under surveillance, this first section presents findings that illustrate the offenders' awareness of the risk of being monitored. During the interviews a recurring theme was the tension between how to be able to conduct the desired activities at the same time as avoiding being revealed. The findings show that surveillance and anonymity are considered as important and serious issues among all the respondents. In the interviews the offenders expressed concern about the risk of being under surveillance when downloading child abusive material. It is considered important among the offenders to protect their identity and to reduce the risk of being detected. One respondent expressed his concern of surveillance as follows:

Yes, one always thinks about it. Every time you put on the computer. You notice how it blinks like hell and one starts to wonder who the hell it is, sometimes one wonders if it is the cop. Of course one thinks of it, every time one is out there (Interview C)

This illustrates a constant awareness over the risk of being monitored. It also highlights the uncertainty of not knowing who the other persons are in the environment. The other respondents confirmed this constant worrying. They are well aware that production, distribution and possession of child pornography is a criminal offence according to Swedish legislation and therefore they know that they can be monitored at any time. The following quotation illustrates how the awareness of the risk of surveillance is expressed:

Of course I have felt chased. Sometimes I have felt jittery, when it has been a lot of raids. Then it is only a matter of time, one can be totally jittery. But then one thinks that it won't happen to me, but that's what everybody says. (Interview J)

The anxiousness of being monitored appears in different ways. Common issues that are expressed by the quotations above are feelings of being chased, feeling jittery and being under stress. The later quotation adds another dimension, which illustrates an interesting conflict. The respondent describes the feeling of being chased and that it is only a matter of time before getting caught and at the same time he thinks that it won't happen to him. However, the awareness of the risk of surveillance does not seem to refrain the offenders from their involvement in the illegal activities. One the one hand they express serious concern of the risk of being monitored and getting caught, but on the other hand they seem to persuade themselves that it will not happen to them.

As this section has shown the offenders are aware of the risk of being observed. This result is however not very surprising, i.e. that people who are involved in criminal activities are aware and anxious of the risk of being monitored. The awareness does not seem to act as a deterrent for not downloading, distributing and exchanging child abusive material, instead different strategies have been developed and adopted by the offenders.

Developed Strategies

Two principal strategies relating to how the respondents manage the risk of surveillance emerged during the analysis: technological and social strategies. The strategies are often used in a combination, which further indicates the importance of studying the social behaviour and social context, which affect the development and adoption of technological strategies (MacKenzie & Wajcman, 2002).

Technological Strategies

Technology Choice

All the respondents state that it is important to use secure technology and consequently it is also important to avoid insecure technologies. The respondents express that they are careful in their choice of technology. The technology choice is based on their belief that it is a more secure technology to use, i.e. that it is more difficult for law enforcement to monitor their activities. When talking about the use and security level among different types of ICT one respondent expressed his experience of choosing secure technology like this:

One quickly learns which technology one should use to not be visible. (Interview F)

This illustrates that the offenders view certain technologies as insecure and others as more secure, and that this is something they learn quickly. The technologies that are considered more secure, make the user more invisible and act as a shield for surveillance systems. When talking about insecure and secure technologies the respondents were unanimous in their attitude against World Wide Web. One respondent expressed his concern as follows:

Web pages are not to think of, they are too insecure. (Interview B)

This quotation shows that the respondents exclude certain technologies since they are considered to be insecure. This quotation indicates that this particular technology, World Wide Web, is not even an alternative due to the insecurity. The concern of using insecure technology is confirmed in the following quotation, but this quotation also shows the offender's awareness of the consequences of using insecure technologies.

And yet one knows that if one use for example WinMX [freeware peer-to-peer file sharing program], and if one meets the wrong person on the other side one is screwed up. If loading up to a board without encryption, one is also totally screwed up. If I start downloading from a news

server, I am logged everywhere. Sometimes one does not think about it. (Interview E)

What is shown here is the offender's awareness of the risk of using insecure technology, and consequently that the risk of getting caught is increased by using insecure technology. The quotation also illuminates the fear of not knowing whom the other person really is that the respondent is exchanging material with. Awareness and concern are expressed over being logged, i.e. that data is collected about the respondent's activities when using insecure technology. It is however interesting to note that despite the awareness of the risks, the respondent says that he sometimes does not think about the risks but just do it.

Advice and Recommendations Regarding Technology Use

Users, who initially don't possess adequate knowledge about which technology that is preferable to use to enhance the security, can obtain advice and recommendations from other users.

During one of the first occasion when I was out looking for something to download, I talked with a person who had greater experience of this than me. He gave me tip-off which technology I should use and which to avoid. (Interview N)

This supports the idea that people who are part of the 'world of child pornography' (Taylor and Quayle, 2003) advice each other regarding technological issues, based on the rationale to enhance the protection of their identity. The inclination to help each other can be explained by the fact that advising other in their environment can also be seen as a protection of themselves. This is due to the fact that production, distribution and possession of child pornography is a criminal offence in many countries, and if one is caught several others also risk to get caught if there are any traceable connections.

Obligatory Rules Regarding Technology Use

Besides the advice and recommendations there are a further dimension, with obligatory rules which the user is obliged to follow. Within this network it was obligatory to follow the guidelines in the manual regarding the technology use. It is interesting to note that the members actually are forced to use certain types of technology, otherwise they risk to be excluded from the network. The purpose with these obligatory rules is to ensure a high level of security for all the members within the network.

Everything is built from the ground, all these boards had programmers. One chap who writes the scripts and who is responsible for it. There was another chap who was responsible for a manual with guidelines which everybody were forced to use, about secure technology. (Interview K)

Another interesting aspect shown here is how the network is organised, with certain persons responsible for different aspects. Within this particular network there were for example programmers responsible for the scripts. Another person was responsible for the manual. Respondents who have been member in other networks confirmed that it is common with this kind of social organisation.

Social Strategies

Use of Personal Information

If we move beyond the technological strategies the findings show that the offenders also have developed and adopted different social strategies. As mentioned before, the technological and social strategies are often used in a combination and it is important to understand both the technological and the social aspects of the offenders' behaviour since the two aspects are strongly connected and affect each other. The awareness of the surveil-

lance risk and the incitement to protect the identity affects the offenders' behaviour when interacting with other. One approach that is commonly practiced among the respondents is to be careful with revealing personal information about oneself when interacting with others. This is due to the fact that they almost never can be sure who the other person really is. One respondent expressed it like this:

I have never revealed my real identity and I know that nobody else does it either, it's the way it is you don't think about it. (Interview G)

This statement shows that the offenders are careful with revealing personal information that can reveal their identity. It also shows that this approach is considered to be generally accepted among the users.

Use of Alias

One effect of being careful with personal information is that the offenders use several different alias instead, to enhance the protection of their identity. The risk of getting caught is considered to be reduced when using several alias instead of always using the same. The use of different alias is illustrated in following quotation:

I have different names. A sometimes, B sometimes, C sometimes, it varies. One just picks a name. Unfortunately I can't remember all the names right now, they are too many. No, I can't say that I have used any specific name more than the other. (Interview O)

This respondent claims that he does not use any particular alias more than the other. This is however not a common approach among the other respondents, instead they state that they have one or two alias that they use more frequently. This behaviour can be explained by the fact that it is considered important to build up a reputation connected to the used alias to gain status among like-minded in the environment (Taylor & Quayle, 2003; Eneman, 2005).

Rules for Interaction

Rules for interaction constitute a further dimension of social strategies that are used within closed networks. The purpose with the rules is to enhance the collective security for the users within the network. Following quotation exemplifies what sort of interaction that the rules attempts to regulate:

It's just the way it is, there has to be certain rules for how it should work, what is allowed and what is not. It is the main administrators that create the rules. For example, there are rules that forbid buying and selling. Payment is never allowed. If one is to sell or buy material, there has to be some personal information and then it is a risk of being revealed in some way. We are in fact not allowed to exchange names and telephone numbers and stuff like that, but people do that anyway after a while. (Interview L)

Rules are considered necessary for the network to work safety. Once again we see example of the social organisation of these networks. Main administrators are responsible for creating the rules. Technological rules were presented earlier, which purpose is to regulate the technology used among the users to enhance the security. In this example the rules attempts to regulate what interactions that should be allowed in the network. Buying and selling are forbidden, since such transactions often require a certain amount of personal information and consequently enhance the risk of being revealed. It is also possible to discern a conflict here since the respondent express that the users do not always follow the rules.

Use of Languages

The following quotation is an illustrative example where the offenders carry out counter-surveillance towards their environment, with the purpose to reduce the risk of being monitored. All the offenders in this study are aware of the possibility to carry out surveillance as a form of counter-strategy. They also state that they have monitored other users' behaviour in the ICT-based environment. The following quotation shows how the use of language is monitored:

At least he is English-speaking, it's obvious in the way he writes. Most write in English, but you notice that some make spelling mistakes. Germans don't master English, it's obvious. They write really bad, Frenchmen as well. They mix terribly. One can tell directly that English is not their native language. (Interview I)

The respondent is attentive and observes another user's language usage during their interaction. What is observed is how well the user master the English-language, by spelling correctly. Based on this observation the respondent draws certain conclusions regarding the nationality of the user. This constitute an interesting example of how the offenders are able to discern further information about the other users during their interaction, besides the information actually written.

Use of Patterns

Besides the possibility to observe the language usage, other behaviour have also been observed among the offenders:

I am quite sure that it was the same person. We were several that suspected that. Well, the way these two persons loaded up stuff. Sometimes it was the same places and everything. It is too similar for two different persons to do exactly like that. (Interview I)

This is an illustrative example of how the technology is used to observe another user's behaviour when uploading material. The offenders are attentive and suspicious of certain behaviours in their environment. Furthermore, what is shown is that several users have observed this particular user's behaviour and that they have also discussed this user's behaviour with each other.

DISCUSSION

In this section, the findings will mainly be discussed in relation to the theoretical concept of panopticon. The section will also conclude with some brief reflections regarding the application of the concept of emancipation on this topic.

Feeling of Constant Surveillance

One of the main principles with the panopticon design is to mediate a feeling of 'constant surveillance', where the individuals may not really being observed, they just think or imagine that they are (Foucault 1979, Lyon, 2006). The offenders' statements are well in line with this principle. The results show that they are constantly aware of the risk of being monitored, which confirms the feeling of 'constant surveillance'. Panopticon aims to control and discipline undesirable behaviour by making the prisoners act as if they were observed (Foucault, 1979). The offenders' awareness of the constant risk of being monitored indicates that the 'power mechanism' of panopticon works in ICT-based environments (Willcocks, 2004). However, the 'power mechanism' doesn't seem to act as a deterrent for the offenders. The results show that they have developed and adopted resistance in form of different strategies to be able to continue with their activities. This illuminates that it is a mistake to believe that panoptic environments result in complete disciplinary power (Lyon, 2006; Jonsson, 2006).

Resistance of Surveillance

Powerful panopticon structures can elicit resistance (Foucault, 1979). Ball (2006) describes how the knowledge about the risk of being exposed of surveillance can evoke active resistance among those who believe that they might be monitored. As the findings show the offenders have developed and adopted different strategies to circumvent the risk of being observed, to be able to continue with their activities. Two principal strategies have been identified: technological and social strategies, and they are commonly used in a combination. The developed strategies constitute an illustrative example of the offenders' active resistance of the surveillance capabilities in the environment. Some of the strategies are developed on an individual basis while other can be seen as the organisation of a collective resistance (Bain & Taylor, 2000). The offenders' purpose, with these developed strategies, is to reduce the risk of being visible when carrying out their activities. For the offenders it is important to be as invisible as possible when carrying out their activities, since many actions surrounding the phenomenon is a criminal offence (Taylor & Quayle, 2003).

The development and use of strategies such as 'technology choice' and 'use of alias' are based on the belief that the use of secure technologies, such as encryption etc, make them invisible for surveillance systems in the environment. Some of the identified strategies may seem obvious such as the importance of using 'secure technology', carefulness with 'personal information' and 'use of alias' etc. It is however important to develop knowledge, based on empirical material, about the offenders technology use for child abusive material. The development of technological and legal regulation models (Gillespie, 2008) must be based on adequate knowledge, empirically underpinned, regarding the offenders' behaviour otherwise these regulation models risk being ineffective. The result from this article shows that the offenders are aware that certain technologies are more insecure to use and that they risk being visible for surveillance systems if using them. Therefore, they avoid using technologies such as World Wide Web. This result also highlights why technological regulation such as different Internet Service Provider's (ISPs) filtering techniques, which block the access via World Wide Web to certain websites containing child abusive material, don't work effectively (Eneman, 2006).

The Issue of Visibility

Certain differences have been identified between the original panopticon design and contemporary surveillance structures based on ICT. The issue of visibility is one of the main differences (Willcocks, 2004). In the original panopticon the surveillance tower is visible, whereas in ICT-based environments the surveillance capabilities is invisible 'embedded' in the environment (Jonsson, 2006). The result shows that the offenders feel a constant risk of surveillance, despite that the surveillance systems often are invisible in the environment. This result indicates that the issue of visibility of surveillance systems should no be considered as a decisive aspect regarding surveillance systems in ICT-based environments. Another aspect that differs is that the prisoners in the original panopticon design could not communicate with each other, nor see the observers. As this research shows, the offenders have communicated with each other regarding surveillance issues. An example of this is when they discuss another user's language use. The two examples with the observation of another person's language use and the observation of another person's behaviour when uploading material show how the offenders have adopted counter-surveillance as a strategy to monitor other persons and their behaviour in the environment.

Usefulness of Panopticon

For the purpose of this article, the concept of panopticon was useful in the organisation and

coding of the empirical material since it helped the researcher to identify and reflect upon elements such as power, control, discipline and resistance, which are central to adequately understand surveillance practices. It is however important to reflect of the risk, when using theoretical concepts, that the researcher focuses too much upon these concepts and therefore risks to miss other relevant themes in the material. Besides being useful in the analysis, the concept was also useful in the discussion since it helped the researcher to focus upon the important elements, mentioned above, which are central components for the understanding of surveillance practices.

Limitations of Panopticon

One of the main principles of the panopticon design is that it allow for 'the few guards to watch the many prisoners' (Foucault, 1979). One of the characteristics with contemporary technological environments is that it enables for the many to watch the many. According to this, it is important to question whether panopticon is the most useful concept to fully understand the contemporary surveillance practices or if we should listen to the voices raised which claims that it is time to 'move beyond panopticon' (Lyon 2006, Haggerty 2006). However, despite its critique and limitations the concept of panopticon can be used as a powerful concept to understand some of the complex issues of surveillance in contemporary society (Lyon, 2006; Koskela, 2006; Boyne, 2000). Despite that panopticon has been useful to understand some of the complex issues of the offenders surveillance practice, this article claims that we need a new concept. We now have the concept of 'synopticon' for studying surveillance practices where 'the many watch the few' (Mathieson, 1997) and the concept of 'panopticon' where 'the few watch the many' (Foucault, 1979). What is needed, is a third concept that acts as a complement to these two and that can be used to better understand contemporary complex surveillance practises where the many watches the many.

Emancipation

Finally, this topic constitutes an illustrative example of the complexity involved with the critical intention of emancipation (Alvesson & Deetz, 2000) within the field of critical IS research. Stahl (2008) argues that there are certain 'fundamental problems' involved when carrying out critical empirical IS research and accentuates that there are certain ethical concerns involved in the application of the emancipatory perspective. He highlights the complexity that arises when for example the researcher's ambition is to emancipate the research subjects whereas the research subjects don't wishes to be emancipated. The emancipatory perspective in this article refers to emancipation on a societal level (Alvesson & Deetz, 2000) to effectively protect children through legal and technological regulations (Gillespie, 2008). The researchers motivation to study the offenders practice has been to obtain knowledge about their technological and social behaviour in relation to the research question, since this kind of knowledge based on empirical findings is critical in the development of effective child protection strategies (Taylor & Quayle, 2003). The issue of emancipation in relation to the different stakeholders in the context of child abusive material is a complex issue that will be explored in more detail in future studies.

CONCLUSION

The aim of this article was to explore how offenders manage the risk of surveillance when downloading, distributing and exchanging child abusive material. The topic is strongly related to issues such as use, misuse and regulation of ICT and hence highly relevant and interesting for critical information system researchers. Child

pornography is an emotional topic where moral opinions tend to dominate the debate rather than empirical based research. In summary, the article shows that the risk of surveillance does not act as a deterrent for the offenders, instead they behave as active actors and have developed resistance to reduce the risk of being monitored. Two principal strategies, technological and social, were identified which the offenders have developed to reduce the risk of being monitored when downloading, distributing and exchanging child abusive material. This emphasizes that it is a mistake to believe that panoptic environments automatically result in disciplinary power.

The theoretical contribution of the article is to show how critical ideas such as Foucault's concept of panopticon can be used to highlight issues related to misuse of ICT. The concept of panopticon has been useful to better understand the offenders' surveillance practice, since it enabled the researcher to identify, reflect and understand how central elements such as power, control, discipline and resistance affect the offenders' behaviour and shape their surveillance practice. However, this article argues that a new concept with a critical edge is needed to better understand contemporary complex surveillance practices that allow for the many to watch the many. To be useful for its purpose, the concept should be designed to act as a complement to panopticon and synopticon.

Furthermore, the article highlights the complexity involved in the critical intention to emancipate. The ultimate goal for critical researchers is to contribute to the transformative praxis and therefore it is important to be explicit with who is going to be emancipated and why. The emancipatory perspective in this article refers to emancipation on a societal level to effectively protect children through legal and technological regulations. In this article the researcher has studied the offenders practice to be able to obtain insights about their behaviour that can be used in the development of effective preventative child protection strategies. Further critical studies are called for to investigate the complexity that can arise when applying the concept of emancipation within the area of child abusive material.

Critical reflection of the conducted research is considered as an important part of critical research. Following that vein, it should be acknowledged that the article has not covered all possible angles such as the economic, historical, political and social context, which are considered central for a critical investigation of a social phenomenon. A more detailed ethical analysis of the topic may also have helped highlighting certain issues. A critical reflection of the selection of respondents, i.e. indicates that the result from this study is perhaps more representative of convicted offenders rather than of non-convicted offenders downloading, distributing and exchanging child abusive material. Which raises the question if non-convicted offenders have developed and use different and more advanced strategies to avoid being detected.

Despite certain limitations of this article, it will hopefully make an important contribution to the theoretical field of critical information systems research by showing the relevance of critical research when applied to misuse of ICT and to the debate surrounding child abusive material by providing insights of offenders behaviour when downloading, distributing and exchanging child abusive material.

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ENDNOTE

[1] http://www.codex.vr.se/codex_eng/codex/index.html

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Chapter 12
A Multi-Facet Analysis of Factors Affecting the Adoption of Multimedia Messaging Service (MMS)

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ABSTRACT

Mobile applications such as multimedia messaging service (MMS) promises a new way to share rich content of information that enhances its users' personal connectivity experiences as well as productivity. However, the adoption of MMS seems to be unexpectedly slow (Bonte, 2008). As mobile phones become ever smarter (or complex) in functions, understanding the adoption behaviors of complex mobile services such as MMS becomes utterly important to both practitioners and academic. This chapter introduces a multi-facet model for MMS adoption by integrating the well-known behavioral models such as TAM and TPB with other factors including intrinsic motivation, personal innovativeness and critical mass. An internet survey of 213 subjects with prior experience in MMS usage found strong support for the proposed model. The results show that the adopter's attitude toward MMS is the most dominating factor in shaping his/her intention to use MMS, followed by subjective norm and perceived behavioral control. Moreover, the results further suggest adopter's intrinsic motivation is the most important motivating factor for attitude toward using MMS. Implications of these findings are discussed for researchers and practitioners.

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INTRODUCTION

In recent years mobile communication has experienced a tremendous growth and quickly become the preferred means for voice communication around the world. According to Pyramid Research, the number of mobile subscriptions outpaced the numbers of fixed lines in service in many countries since 2002 (Ebrahim, 2004). This explosive penetration rate of mobile device motivates practitioners as well as researchers to innovate and provide increasingly diverse services. Data communication is among one of them. With its rapid improvement in bandwidth and handset functions, mobile device is able to surf online, get emails, and send multimedia messages.

Take multimedia messaging service (MMS) for example. It is a global messaging standard that sends multimedia messages between mobile devices. By using this technology, users can exchange rich contents (e.g., color pictures, audio/video, and animations) anytime, anywhere. This leap in messaging capabilities not only enriches mobile phone user's personal connectivity experiences (e.g., sharing photos), but it also enhances his/her productivity (e.g., sending rich-text files) (Lee et al., 2007). The penetration of MMS applications is affecting our everyday life in many ways. The city of New York, for example, makes good uses of multimedia messages and upgraded its 911 emergency call centers to handle picture messaging so that pictures, instead of voices, could be sent using MMS during emergency (Mobiletracker, 2007).

The potential adoption of MMS seems to promise an important source of revenue for network operators as well as content and services providers. JupiterResearch estimates that the volume of MMS messages will reach €4.1 Billion in Europe by 2011, accounted for 42 percent of European active mobile phone users (Husson et al., 2007). The use of MMS in marketing also promises potential returns for business sectors. BMW, for example, increased its winter tire sale volume by effectively sending MMS ads to its new car owners (Ahonen and Moore, 2008). Thus, mobile marketing using MMS opens another window of opportunity for all industries.

As promising as it may seem, achieving widespread penetrations for mobile services such as MMS are not without obstacle. In fact, statistics show overall adoption of MMS is still significantly below the level for short messaging service (SMS) (Strother and Ask, 2008). Major hurdles such as lacks of device penetration and interoperability between carriers as well as price issues have slowed down the adoption rate (Husson et al., 2007). While adoption seems slower than expected (Bonte, 2008), mobile industries, on the other hand, have different expectations for MMS future. According to Charles Lafage, Senior Analyst at Juniper Research, and MMS specialist, "picture-messaging has a great potential as it satisfies a widespread customer need: to share the precious moments of our everyday lives" (Cellula.co.za 2004). Achieving this sense of sharing is getting ever so easy as nowadays about half of mobile phones sold had integrated cameras (Strother and Ask, 2008). As the progressive mobile technology provides a perfect adoption atmosphere for MMS (Kou and Yu, 2006), it becomes more and more compelling to look into the factors affecting the adoption of MMS.

While some attention has been paid in the past to research issues related to MMS users adoption behavior (Hsu et al., 2007; Lee et al., 2007), little research has been done on multi-facet perspectives to explore actual adopters' behaviors on MMS. For example, Hsu et al. (2007) applied innovation diffusion theory (IDT) to examine customer intention to use MMS. Additionally, Lee et al. (2007) applied motivational theory and media richness theory to investigate the acceptance of MMS. Their study also revealed that media richness was empirically shown to determine the technology acceptance model (TAM) factors such as perceived usefulness, perceived ease of use and enjoyment. These two studies highlight the technical values

of exploring MMS because the Hsu et al. (2007) emphasized the nature of innovative technology and Lee et al. (2007) stressed the importance of technology acceptance. Nevertheless, according to a recent cross-country study of handset usages, people send MMS messages to far few persons as compared to other types of message services (i.e. SMS) since most MMS messages are considered more personal (Verkasalo and Hämmäinen, 2007). Thus, to gain a comprehensive understanding of MMS adoption behavior, one needs to look into this issue from both technical view point and non-technical factors. Moreover, due to its demand in platform specification, the use of MMS also will be affected by network effect. That is, the more people adopt MMS, the higher interpersonal communications value MMS will be perceived. Thus, how well MMS is received socially becomes an important factor in adopting this service. To achieve this goal, we proposed and empirically tested a behavioral model based on technology acceptance model (TAM), theory of planned behavior (TPB) and other related literature in attempt to better understand the adoption of MMS. In addition, this study further investigates the purposes and problems of using MMS. Findings from this study could be of immense managerial use in developing strategies to promote mobile services such as MMS.

THEORETICAL BACKGROUND

For past decades many MIS researchers applied Davis' technology acceptance model (TAM) and Ajzen's theory of planned behavior (TPB) as theoretical foundations to explore user's IT/IS acceptance behavior (e.g. Hsu and Lin, 2008; Lin and Lu, 2000; Pavlou and Fygenson, 2006). Moreover, studies based on these two theories incorporate additional variables to help explain the user's behavior of IT/IS usage for specific context (e.g. Wang et al. 2006). In this study, these two prevalent theories and additional variables such as intrinsic motivation, personal innovativeness and perceived critical mass will be used to develop a richer understanding of MMS acceptance.

Technology Acceptance Model

The technology acceptance model (TAM) has received considerable attention of researchers in the Information System (IS) field since its adoption since 1989 (e.g Gefen, and Straub, 1997; Pikkarainenk et al., 2004; Lai and Li, 2005; Hsu and Lu, 2007). Previous studies have empirically confirmed the TAM's validity in explaining the individual's acceptance of various IT/IS (e.g., Lin and Lu, 2000; Moon and Kim, 2001; Hsu and Lu, 2004; Kim et al., 2007; Hernandez et al., 2008). TAM is an adaptation of the theory of reasoned action (TRA) (Fishbein and Ajzen, 1975) from psychology specifically tailored to model user acceptance of IT/IS. TRA postulates that belief (individual's subjective probability of the consequence if a particular behavior is performed) influences attitude (individual's positive and negative feelings if a particular behavior is performed), which in turn shapes a behavioral intention (Fishbein and Ajzen 1975). Davis (1989) adapted the belief-attitude-intention- behavior causal chain to predict user acceptance of IT/IS. He used the cost-benefit paradigm and self-efficacy theory to propose two influential beliefs: perceived usefulness (PU) and perceived ease of use (PE). PU is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance", and PE as "the degree to which a person believes that using a particular system would be free of effort". According to TAM, the system usage is determined by individuals' attitudes toward using the system and PU. Meanwhile, attitude toward using the system is jointly determined by PU and PE.

While TAM has been widely applied in acceptance behavior across a broad range of information technology, much research extends TAM to enhance the understanding of user acceptance

behavior for specific contexts (Luo and Strong 2000; Chen et al. 2002; Kaasinen 2005; Hsu and Lin, 2008). For example, Moon and Kim (2001) proposed a variable 'playfulness' for studying WWW acceptance. Extending WWW factors into the TAM model enabled better explanation of WWW usage behavior. In this study, comparing to task-oriented IS, factors contributing to the acceptance of a mobile application are likely to vary sharply according to purpose of usage, innovation and communication effects. Thus, intrinsic motivation, personal innovativeness and perceived critical mass were proposed in terms of following reasons.

1. **Purpose of MMS usage:** Traditionally, the main reason for using mobile devices such as cell phones, laptops, GPS and PDA was to enhance communication effectiveness and work productivity such as banking and commerce (Lo'pez-Nicola's et al., 2008). However, with the arrival of the third generation (3G) standards and technology for mobile communication, the use of mobile devices is not only just for work, but also for entertainment. For example, MMS users send text messages and multimedia messages incorporating pictures, voice recordings, animated characters, and video clips to others (Cry et al., 2006). Intrinsic motivations such as enjoyment seem to play an influential role in intention to use because users can enjoy multimedia effects via colorful graphics, animation and ring tones.
2. **Innovation:** MMS, like many innovative mobile applications, requires the users to learn and configure their own handsets. As mentioned earlier, one of the hurdles that delays the wide spreads of MMS adoption is the complexity of use for end users (Husson et al., 2007). Therefore, the adoption of MMS will require individual's willingness to put into effort to adopt. In innovation diffusion research, personal innovativeness is identified as an important determinant influencing the acceptance of innovation (Rogers, 2003). Individual who possesses higher degree of personal innovativeness will be more willing to accept the challenge and learn to use new technology. As the result, personal innovativeness may play a significant role in adopting MMS.
3. **Value-added by communication:** The successful adoption of network-based applications (such as telephone and facsimile) requires the development of a network externality, which refers to the fact that the value of technology to a user increases with the number of its adopters (Luo and Strong, 2000). Mobile applications such as MMS, mobile games and mobile video telephony also require network effects to succeed. As MMS increases in popularity, for example, it becomes increasingly valuable and attracts more users to adopt. MMS users may develop perceived critical mass via communications with others. Perception of critical mass is rapidly strengthened as more people connect in everyday activities.

Theory of Planned Behavior

The theory of planned behavior (TPB) has also been widely studied in social psychology to explain an individual's behavior (Hsu and Chiu, 2004; Luarn and Lin, 2005). TPB extends from TRA by incorporating an additional construct, namely perceived behavioral control (PBC), to account for situations in which an individual is able to control the performance of behavior personally (Ajzen, 1991). According to TPB, an individual's behavioral intention is jointly determined or predicted by attitude, subjective norms (SN), and PBC. Attitude refers to an individual's positive or negative evaluation of the performance effect of a particular behavior. SN refers to an individual's perception that important others would approve or disapprove of his or her performing a given

behavior. PBC refers to the belief that one is able to control personally the performance of a behavior.

In subsequent studies, TPB has been decomposed to incorporate additional variables with specific contexts to improve the understanding of IT usage. For example, Hsu and Chiu (2004) decompose the SN component into interpersonal norm and subjective norm and PBC component into self-efficacy and perceived controllability for studying e-service acceptance. In addition, combining the technology acceptance model (TAM) has also received considerable attention over the years. For example, Riemenschneider et al. (2003) identified the appended model (TAM and TPB combined) performed a better understanding of user's behavioral intention to adoption decisions in small business than either model alone. Similarly, the study by Chau and Hu (2002) showed the similar results in adopting telemedicine technology. In this study, therefore, we integrate TPB constructs such as SN and PBC and extended TAM into a more comprehensive model for investigating user's acceptance of MMS.

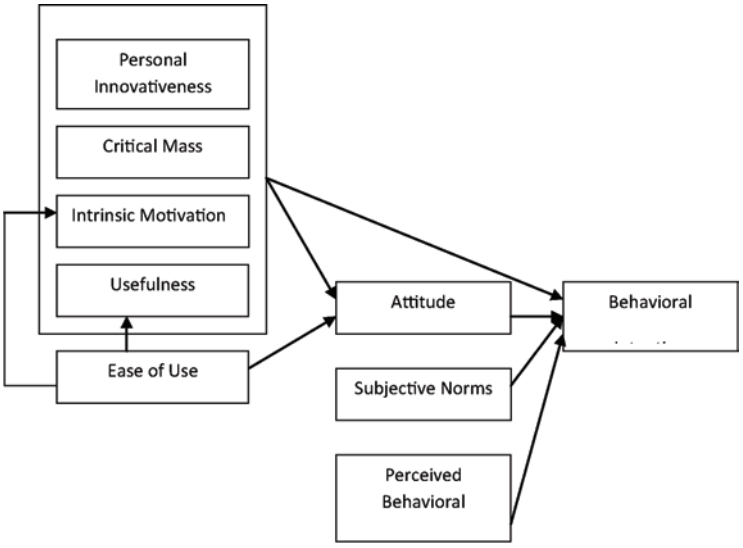
CONCEPTUAL MODEL AND HYPOTHESES DEVELOPMENT

Figure 1 illustrates the research model, which was built based on TAM and TPB. It asserts that the intention to use a MMS is a function of its perceived usefulness, ease of use, intrinsic motivation, critical mass and personal innovativeness by an individual and TPB constructs such as subjective norms, perceived behavioral control and attitude. The definition of constructs, network of relationships illustrated in the model, and the rationale for the proposed links are explained in the following section.

TAM Constructs

Perceived usefulness is defined as the degree to which a person believes that using a MMS would enhance his or her job performance and communication effectiveness. Perceived ease of use is defined as the degree to which a person believes that using MMS would be free of effort. Additionally, attitude here is defined as user preferences regarding MMS usage. Intention is the extent to which the user would like to reuse

Figure 1. Research model



MMS in the future. Previous empirical studies applying TAM have empirically confirmed that the significant relationship between these constructs (Lin and Lu, 2000; Pin and Lin, 2005). Therefore, it is one of our research intentions to verify the following TAM hypothesized relationship in the context of MMS.

H1a: Perceived usefulness will positively affect customer attitude toward using MMS.
H1b: Perceived usefulness will positively affect customer intention to use MMS.
H2a: Perceived ease of use will positively affect customer perceived usefulness.
H2b: Perceived ease of use will positively affect customer attitude toward using MMS.
H3: Attitude will positively affect customer intention to use MMS.

Intrinsic Motivation

While extrinsic motivation (i.e., perceived usefulness) emphasizes performing a behavior to achieve specific goals/rewards (Vellerand, 1997), intrinsic motivation (i.e., perceived enjoyment) refers to the pleasure and satisfaction from performing a behavior (Deci and Ryan, 1987). User may engage in MMS usage if it yields fun and enjoyment. Past studies have verified that the use of computer technology was influenced by intrinsic motivation (Davis et al. 1992; Venkatesh et al., 2002; Lee et al., 2005). In addition, perceive ease of use may have influence on intrinsic motivation because MMS that is difficult to use is less likely to be perceived as enjoyment. Teo et al. (1999) present and empirically evaluate a conceptual model of factors contributing to acceptance of Internet. Their findings show that ease of use has significant effects on perceived enjoyment. Accordingly, we hypothesize:

H4a: intrinsic motivation will positively affect customer attitudes toward using MMS.
H4b: intrinsic motivation will positively affect customer intention to use MMS.
H4c: Perceived ease of use will positively affect customer intrinsic motivation.

Personal Innovativeness

Personal innovativeness, which defined as the degree of the willingness of a user trying out any new IT (Agarwal and Prasad, 1998), often plays an influential role in the new IT usage. Personal innovativeness is seen as one of the individual's trait. As noted by Rogers (2003), innovators who own this trait are able to cope with high levels of uncertainty and develop more positive intentions toward acceptance. As a new IT such as MMS announces in market, most people have not much information or experience to help them develop clear perception. Individual's trait of innovativeness may play an important factor that drives them to adoption owing to sheer curiosity and boldness. In addition, past empirical studies also verified that adopter innovativeness significantly affects perceptions and behavior toward the innovation (Agarwal and Karahanna, 2000; Lu et al., 2005). Therefore, we hypothesize:

H5a: Personal innovativeness will positively affect customer attitude toward using MMS.
H5b: Personal innovativeness will positively affect customer intention to use MMS.

Perceived Critical Mass

Perceived critical mass denotes the extent to which the user believes that most of his/her peers are using MMS. A user may develop this perception from communication channels such as interpersonal network, mass media and web sites other than direct observation of usage. For example, a person may get an impression that MMS is widely used from his/her surrounding because many advertisements were announced or his/her family/friends were talking about it. Luo and Strong (2000)

pointed out that the users may develop perceived critical mass through interactions with others in the context of groupware. The findings of their study showed that perceived critical mass had a significant effect on intention to use. Therefore, we hypothesize:

H6a: Perceived critical mass will positively affect customer attitude toward using MMS.
H6b: Perceived critical mass will positively affect customer intention to use MMS.

TPB Constructs

Prior research provides evidence for the notion that subjective norms have a significant impact on intentions to adopt IT. Subjective norm is defined as the degree to which the user perceives that others approve of their usage of MMS. Hsu and Lu (2004) showed that subjective norm was a significant determinant of intention to play online games. Its significance in affecting IT adoption was also confirmed by several empirical studies (e.g., Venkatesh and Morris, 2000; Lucas and Spitler, 2000).

Moreover, while the formation of individual intention to perform behavior is influenced by subjective norm in TPB, PBC also plays another key role to determine user's behavioral intention to adopt. Here, PBC refers to user's perception of the ease of difficulty of using MMS. It is to reflect individual's possessed resources (i.e. money, time, skills) or opportunities necessary for using MMS. PBC has also empirically confirmed the significant effect on user's intention to adoption IT (Riemenschneider et al., 2003; Hsu and Kuo, 2002). Therefore, we hypothesize:

H7a: Subjective norm will positively affect customer intention to use a MMS toward using MMS.
H7b: Perceived behavior control will positively affect customer intention to use MMS.

METHODOLOGY

Sample

Empirical data was collected by conducting an online field survey of MMS users. The questionnaire was designed based on prior related literature and placed on the home page of a web site. A program using Javascript was developed to collect and tabulate the data. In order to effectively target our subject (MMS users) and increase the response rate, we placed messages on several heavily trafficked online message boards on popular mobile-related web sites and mobile-related bulletin board systems (BBS) where active mobile phone users usually visit for two months. These survey sites were chosen because of their wide reach and tolerance of such survey advertisement messages. The message outlined the aim of this study, provided a hyperlink to the survey form, and as an incentive, offered respondents an opportunity to join a draw for prizes. The following sections describe the demographic profile as well as the general perception of our sample.

Demographic Profile

The purpose of our study is to better understand the MMS adoption behavior. Therefore, we only collected and analyzed responses of subjects with some MMS experiences. This yielded 213 usable responses. Of which, 61.5% of the respondents were male, and 38.5% were female. 55.4% respondents ranged from 16 to 25 years of age. 70% had completed college, university degree or graduated degree. Table 1 summarizes the profile of the respondents. The composition of our sample was similar to the result of the survey on the profile of populations of mobile application users as conducted by Find.org (www.find.org.tw), a popular research site in Taiwan (FIND, 2004).

The demographic profile presented that users are relatively young and generally well educated. In general, young users (age 16-25) easily accept

Table 1. Demographic profile

	Frequency	Percent (%)
Gender		
Male	131	61.5
Female	82	38.5
Age		
Under 15	1	0.5
16-25	118	55.4
26-35	85	39.9
36-45	9	4.2
Over 45	0	0
Education		
High school or less	42	29.7
Some college	28	13.1
Bachelor's degree	105	49.3
Graduate degree	38	17.8
Monthly income		
Under NT10000	88	41.3
NT10000-NT30000	49	23.0
NT30000-NT50000	56	26.3
NT50000-NT80000	15	7.0
Over NT80000	5	2.3
Experience in cell phone use		
Under 1 year	11	5.2
1-2 years	10	4.7
2 years -3years	19	8.9
3 years – 4 years	26	12.2
Over 4 years	47	69.0
Expenditure for cell phone use per month		
Under NT100	6	2.8
NT100-NT300	29	13.6
NT300-NT500	45	21.1
NT500-NT1000	71	33.3
NT1000-NT2000	44	20.7
Over NT2000	18	8.5
Experience in MMS use		
Under 3 months	74	34.7
3 months – 6 months	42	19.7
6 months -1year	44	20.7
1 year – 2 years	35	14.4
Over 2 years	18	8.5

continues in next column

Table 1. continued

	Frequency	Percent (%)
Expenditure for MMS use per month		
Under NT100	132	62.0
NT100-NT300	53	24.9
NT300-NT600	19	8.9
NT600-NT900	5	2.3
Over NT900	4	1.9
Target users of MMS		
Friends or Classmates	160	75.1
Family	14	6.6
Work-related partner	18	8.5
Internet friends	3	1.4
Others	18	8.5
US$ 1 = NT$ 32.7 in Nov 2008.		

new technology although they have not much income to spare. The data showed that most users spent less than NT$300 (The acronym NT$ is New Taiwan dollar) on monthly MMS expenditure. Nevertheless, understanding the needs and preferences of these innovative users is important and desirable because such young users will eventually become the active mobile application users as well as influential consumers in the mobile application field.

Purposes and Problems of Using MMS

Since understanding MMS adoption is the main purpose of this study, our questionnaire was therefore designed to obtain the following information:

1. Purposes: To find out users' purposes of using MMS, users were asked why they use MMS.
2. Problems: To investigate the problems of MMS usage, users were asked what they perceived to be the main hurdles to adopt MMS

Table 2 and 3 present the results of our investigation. Table 2 shows that the top 3 reasons of using MMS are exchanging photo messages, obtaining personalized services and getting audio/video clips. As high as 93% of MMS users uses MMS to exchange digital photos. This seems to be a popular trend considering as many as half of mobile phones sold nowadays had integrated cameras (Strother and Ask, 2008). 70% of respondents indicate that they have used MMS for personalized services (e.g., screen personalization services). 55% of the respondents use MMS to enjoy video clips. 39% uses MMS for emails. Respondents also use MMS for obtaining games (30%), news (16%), GIS services (25%) as well as completing transactions (28%). Only 23.5% respondents claimed to use MMS for work related services. From the results of the data, we can conclude that respondents use MMS mainly for the enrichment of personal messages.

The respondents' perceptions of the problems for using MMS are tabulated in Table 3. The top 3 hurdles for adopting MMS are incompatibility of mobile handsets, high cost of MMS services and not enough subscribers due to network effect. The result is in tune with the general understanding of the main setbacks for slow demands for MMS services (Husson, et al., 2007). Other concerns include poor transmission quality (46%), incompatible services across mobile phone operators (46%), small screen for displaying multimedia messages (44%), and slow transmission rate (41%). Some respondents think that the alternatives such as Internet are widely available and feel no immediate need to use MMS services (38%).

Table 2. Purposes of using MMS

Items		*Numbers of respondents*	*Percent*
Exchange photo message	*	199	93.4%
Obtain personalized service	*	150	70.4%
Exchange audio/video messages	*	117	54.9%
Send/Receive emails		83	39.0%
Play games		64	30.0%
mCommerce Transaction		60	28.2%
GIS services		54	25.4%
Work related services		50	23.5%
News		35	16.4%
* denotes top 3 rankings			

Measurement Development

The questionnaires were developed from literature, and the list of items is displayed in Table 3. Many related studies developed and validated instruments for measuring TAM and TPB constructs. This includes perceived usefulness, perceived ease of use, subjective norms, perceived behavioral control, attitude and intention (Liker and Sindi, 1997; Hsu and Lu, 2004). Hence, items in the instrument were derived form existing literature and modified to suit the context of our study. Furthermore, to develop a scale to measure intrinsic motivation, personal innovativeness and perceived critical mass, we utilized measures of Venkatesh et al. (2002), Agarwal and Prasad (1998) and Luo and Strong (2000), with modifications to suit the setting of MMS. Each item was measured on a

Table 3. Problems of using MMS

Items		*Numbers of respondents*	*Percent*
Incompatibility of mobile handset	*	162	76.1%
High costs of MMS services and handsets	*	124	58.2%
Not enough subscribers	*	107	50.2%
Poor transmission quality		99	46.5%
Incompatibility of service carriers		98	46.0%
Small display of mobile handset		93	43.7%
Slow transmission rate		88	41.3%
Other alternatives (e.g., Internet) are available		80	37.6%
* denotes top 3 rankings			

five-point Likert scale, ranging from "disagree strongly" (1) to "agree strongly" (5).

Before conducting the main survey, we performed both a pre-test and pilot test to validate the instrument. The pre-test involved ten respondents who were experienced users in MMS. Respondents were asked to comment on listed items that corresponded to the constructs, including scales wording, instrument length, and questionnaire format. Finally, to further reduce possible ambiguity, a pilot test that involved 119 self-selected respondents was performed.

Table 4. Descriptive statistics

	Means	S.D.
Usefulness	3.19	.95
Ease of use	3.99	.89
Intrinsic motivation	3.89	.90
Personal innovativeness	4.10	.82
Perceived critical mass	2.68	1.07
Subjective norms	3.49	.86
Perceived behavioral control	3.65	.95
Attitude	3.72	.92
Behavioral intention	3.62	.87

RESULTS

Descriptive Statistics

Table 4 presents the means and standard deviations of the constructs. On average, users responded positively to using MMS (the averages are all greater than 3 out of 5, except for perceived critical mass). Rationally, respondents have high degree of personal innovativeness because they are relatively young and well-educated. Therefore, they usually tend to accept innovation in new market. In addition, owing to the major target users of MMS were respondents' friends and classmates, respondents would feel normative effects from interacting with target users if they were involved in mobile activities. Finally, the means of perceived critical mass was slightly lower than average. This may explain that the MMS is still in its infancy stage of mobile application life cycle and many respondents do not feel critical mass was reached.

Analytic Strategy for Assessing the Model

The proposed model was analyzed primarily using the structural equation modeling (SEM). SEM is a powerful second-generation multivariate technique for analyzing causal models involving an estimation of the two-stage model-building process, in which measurement model is tested before testing the structural model. The measurement model is estimated using confirmatory factor analysis to test whether the constructs possessed sufficient validation and reliability. Internal consistency, convergence reliability, discriminant validity were performed to ensure data validation and reliability. Subsequently, the structural model is to investigate the strength and direction of the relationship among the theoretical constructs (Joresko and Sorbom, 1996). Such analyzed technique has been widely applied by IS researchers in recent years (Hsu and Lu, 2004; Yang et al., 2005). In our study, LISREL 8.7 was used to assess the measurement and the structural model.

The Measurement Model

The test results of the measurement model are showed in Table 5. Data show that item reliabilities range from 0.86 to 0.99, which exceeds the acceptable value of 0.50. The internal consistency of the measurement model was assessed by computing the composite reliability. Consistent with the recommendations of Fornell (1982), all composite reliabilities were above the benchmark of 0.60. The average variance extracted for all constructs exceeded the threshold value of 0.5 recommended by Fornell and Larcker (1981). Since the three values of reliability were above the

recommended thresholds, the scales for evaluating these constructs were deemed to exhibit adequate convergence reliability.

Table 6 shows the correlations for the constructs studied with the average variance extracted (AVE) indicated in the diagonals. The results show that the variances extracted by constructs are greater

Table 5. Item reliabilities, composite reliability and AVE

Items	Item reliability	Composite reliability	Average variance extracted
Perceived usefulness (PU)			
1. Using MMS improves my performance in my job/life. 2. Using MMS enhances my effectiveness in my job/life.	0.97 0.88	0.924	0.859
Perceived ease of use (PE)			
1. Learning to use MMS is easy for me. 2. It is easy to use MMS.	0.95 0.92	0.935	0.879
Intrinsic motivation (IM)			
1. The actual process of using MMS is pleasant. 2. I have fun using MMS.	0.91 0.95	0.930	0.869
Personal innovativeness (PI)			
1. If I heard about a new information technology, I would look for ways to experiment with it. 2. In general, I have the willingness to try any new information technology.	0.94 0.93	0.935	0.879
Subjective norm (SN)			
1. People who influence my behavior think that I should use MMS. 2. People who are important to me think that I should use MMS.	0.93 0.90	0.907	0.831
Perceived critical mass (PCM)			
1. Most people in my community use MMS frequently. 2. Most people in my class/office use MMS frequently.	0.95 0.93	0.938	0.884
Perceived behavioral control (PBC)			
1. I would be able to use MMS. 2. Using MMS is entirely within my control.	0.99 0.86	0.921	0.855
Attitude (ATT)			
1. I feel good about using MMS. 2. I think positively towards using MMS.	0.97 0.97	0.966	0.935
Intention (INT)			
1. I plan to use MMS in the future. 2. I expect my use of MMS to continue in the future.	0.77 0.87	0.805	0.674

Table 6. Discriminant validity

	PU	PE	IM	PI	PCM	SN	PBC	ATT	INT
PU	0.859								
PE	0.064	0.879							
IM	0.267	0.195	0.869						
PI	0.050	0.145	0.156	0.879					
PCM	0.226	0.091	0.142	0.018	0.884				
SN	0.291	0.083	0.263	0.087	0.304	0.831			
PBC	0.117	0.360	0.281	0.206	0.136	0.239	0.855		
ATT	0.312	0.172	0.592	0.150	0.214	0.417	0.316	0.935	
INT	0.272	0.106	0.403	0.100	0.251	0.423	0.339	0.663	0.674
AVEs are shown in diagonal; All correlations are significant at 0.05 or lower									

than any squared correlation among constructs (Igbaria and Iivari, 1995). This implies that constructs are empirically distinct. In summary, the measurement model test, including convergent and discriminant validity measures, is satisfactory.

The fitness measures for the measurement models are shown in Table 7. For models with good fit, it is suggested that χ^2/df should not exceed 5 (Bentler, 1989). Bentler (1989) suggested that model fit indices should be used, and scores of 0.9 or higher on NFI, NNFI, CFI should be considered evidence of good fit. All the fitness measures are acceptable. The only exception was GIF index, which was slightly below 0.8 (Seyal, 2002). Consequently, all the measures taken in this work show that the model provides a decent fit to the data.

Tests of the Structural Model

We examined the structural equation model by testing the hypothesized relationships among various constructs, as shown in Figure 2. The results showed that attitude, subjective norm and perceived behavioral control had significant effects on the intention to use (β=0.43, $p<0.001$; β=0.11, $p<0.05$; β=0.07, $p<0.05$), supporting Hypotheses 3, 7a, 7b. Together, these three paths accounted for approximately 88% of the variance on intention to use. In addition, the results showed that usefulness (β=0.17, $p<0.001$), intrinsic motivation (β=0.94, $p<0.001$), personal innovativeness (β=0.06, $p<0.01$) and critical mass (β=0.31, $p<0.001$) significantly affected attitude, providing supports for Hypotheses 1a, 4a, 5a and 6a. The model accounts for 73% of the variance in attitude. Unexpectedly, these four perceptions had no direct influence on intention. Hypotheses 1b, 4b, 5b, and 6b are not support. However, they influenced the intention to use indirectly through attitude, as shown in Table 8.

Perceived ease of use influences both usefulness and intrinsic motivation significantly (β=0.32, $p<0.001$; β=0.46, $p<0.001$), supporting Hypotheses 2a and 4c. Contrary to expectations, perceived

Table 7. Overall fits of the model

Fit index	Recommended criteria	Results	Suggested by authors
χ^2/df	< 5	4.943	Bentler (1989)
GFI	> 0.8	0.77	Seyal (2002)
NFI	> 0.9	0.93	Bentler and Bonett (1980)
NNFI	> 0.9	0.94	Bentler and Bonett (1980)
RM-SEA	< 0.05	0.00	Bagozzi and Yi (1988)

Figure 2. Results of structural equation modeling analysis

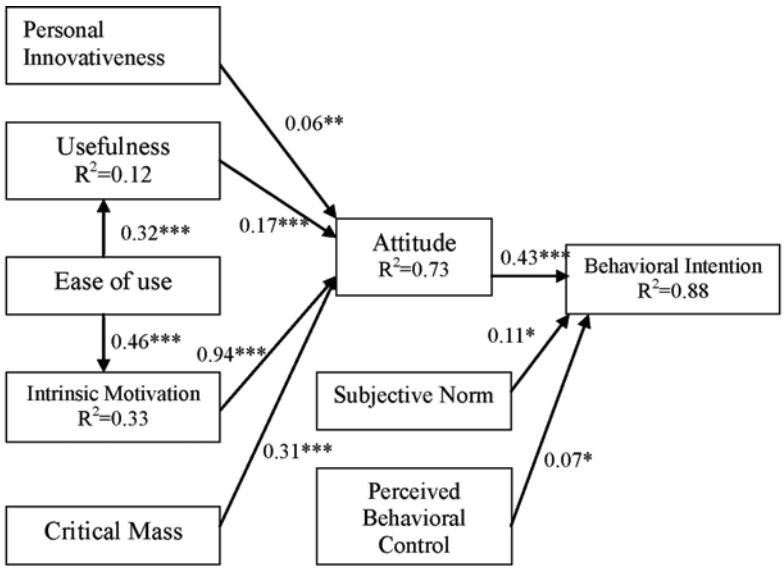


Table 8. Effects on intention to use MMS (n=213)

Construct	Direct effects	Indirect effects	Total effects
Perceived ease of use	0	0.19***	0.19***
Perceived usefulness	0	0.07**	0.07**
Intrinsic motivation	0	0.40***	0.40***
Personal innovativeness	0	0.03*	0.03*
Critical mass	0.08	0.13***	0.21***
Subjective norm	0.11*	0	0.11*
Perceived behavioral control	0.07*	0	0.07*
Attitude	0.43***	0	0.43***
* p < 0.05; ** p< 0.01; *** p<0.00			

ease of use has no direct influence on attitude. Therefore, Hypothesis 2b is not support. Nevertheless, perceived ease of use has indirect effect on intention to use MMS (β=0.19, p<0.001), as shown in Table 8.

DISCUSSION

This chapter proposes a behavioral model to generate better insights into understanding Internet users' adoptions on MMS. The results show a number of interesting findings.

First, intention to adopt MMS services is associated with attitudes, subjective norm and perceived behavioral control (R^2 = 0.88) with attitudinal factors as the most dominating one (β=0.43). This once again confirmed the significant role attitudes play in mediating beliefs and the intention to use (Cheong and Park, 2005; Ajzen and Fishbein, 1980). Therefore, understanding what factors influencing user's attitude becomes imperative to the successful promotion of MMS.

Subjective norm is the second influential factor (β=0.11) to adopter's intention to use MMS in the future. The result indicates that the importance of referential group in affecting individual's IT adoption cannot be neglected (Teo and Pok, 2003). The small coefficient of PBC (β=0.07) may suggest that knowing how to use MMS is merely a basic requirement for future usage of MMS and

will not contribute significantly to boost adopter's intention to use MMS.

The findings of study also identified some salient antecedents of attitudes. It includes personal innovativeness, usefulness, intrinsic motivation and critical mass. Together, they explain 73% of the variance in respondents' attitudes toward MMS. Among those antecedents, intrinsic motivation was found to be the most significant influencer on attitudes, with coefficient much higher than others (β= 0.94). This finding not only coincides with most respondents' purposes of using MMS which is to enhance their social lives (see Table 2), but it also provides an important message to MMS practitioners. The most effective way to promote adopters' positive attitude toward MMS will be to enhance their perceptions of the enjoyment MMS will bring to their everyday lives. This will in turn strengthen their intentions to use MMS.

Moreover, according to the results of this study, adopters' perception of how popular MMS is (i.e., critical mass) is also an important factor in influencing their attitudes toward adopting this service (β= 0.31). This finding is in tune with the significance of network externalities (or so called network effects), where "the value of a product to one user depends on how many other users there are" (Shapiro and Varian 1999, p. 13). Communication technologies such as MMS need to achieve critical mass to grow explosively. Therefore, MMS practitioners need to focus on developing strategies to publicize and popularize the functions of MMS to general public.

Although the perception of his/her personal innovativeness is also a significant factor in shaping respondent's positive attitudes toward MMS, it is not as a strong influencer (β= 0.06) as others. This result is interesting but not unexpected. The samples in our study are MMS adopters and possess high scores in personal innovativeness (see Table 4). Therefore, the characteristic of personal innovativeness becomes a necessary but not significant factor in influencing his/her attitude toward MMS usage.

One thing worth noting is that although personal innovativeness, critical mass, intrinsic motivation as well as perceived usefulness are significant factors in affecting mobile phone users' attitude toward using MMS services, none of these four factors has any significant influence on the user's intention to use MMS. Instead, they exert their influence indirectly through attitudes. Thus, to increase mobile phone user's intention to use MMS, the practitioners should focus their resources in developing effective strategies to cultivate their customer's favorable feeling toward MMS.

IMPLICATIONS

Industries such as consumer products are always eager to find out what make adopters adopt a new IT. This study incorporated TAM and TPB and proposed a model to investigate into the adoption of a new IT service (i.e., MMS) in a wireless context. The results may provide following research as well as managerial implications.

Implications for Researchers

This study combined TAM and TPB in attempt to better understand the adoption of MMS. The findings showed that the proposed model exhibits a high predictive capability for explaining MMS adoption intention with attitude as the most influential factor. This once again reconfirms the role of the attitude in predicting the intention and, thus, future studies in technology acceptance should consider attitude as an important predictor of individual's behavioral intention.

Implications for MMS Practitioners

This study also provides some interesting insights that are valuable for practitioners when promoting MMS services. First, the study found intrinsic motivation as the dominating factor to influence

potential adopter's attitude toward MMS. Thus, to increase adopter's willingness to use MMS, the practitioners need to create a positive view that emphasizes mostly on the entertaining capabilities which MMS can facilitate in everyday life. Strategies could include making sending/receiving MMS messages as easy as possible, publicizing the rich experiences to use MMS in life, and etc.

Second, this study confirmed the importance of network effects. Like other communications technologies, MMS needs to achieve critical mass to grow explosively. Potential adopter's perception of how popular MMS is (i.e., critical mass) will influence his/her attitude toward MMS, and thus become critical in promoting this services. MMS practitioners, therefore, need to put in more effort to make MMS known.

LIMITATIONS AND FUTURE RESEARCH

Though the results have demonstrated some interesting findings, the factors identified as possible influences on the MMS adoption are not exhaustive. Examples of such factors include compatibility (Rogers, 2003), costs (Constantinides, 2002; Cheong and Park, 2005) and image (Moore and Benbasat, 1991; Teo and Pok, 2003).

The results of this study need to be interpreted with caution due to the following limitations. First, this study was conducted online using self-report scale to measure research variables. Some of the results might have a common method bias. Second, MMS was the IT analyzed in this study; care should be exercised when generalizing these results to other settings. However, results consistent with other related researches and thus enhance confidence in the findings. Thus, the results can still provide insights into the adoption of IT of similar nature.

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Chapter 13
The Benefits of (Automated) Dialogue

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ABSTRACT

The authors compared user evaluation of a text based dialogue system with a simple pick list for the same task. The authors matched the systems in terms of key factors, such as design for Usability, and took into account individual differences between participants that might have influenced their perception, such as Locus of Control, Experience and Personality. They found participants rated the text based dialogue system as being more informative, more credible, less frustrating and more persuasive than the simple pick list system. Participants' ratings were dependent on their Personality, Locus of Control and reported level of physical activity. Participants did not differentiate between the systems in terms of their ease of use, indicating the other observed differences were not due to a simple difference in Usability. This study demonstrated the benefits of including automated dialogue in a system designed to help people find solutions for their exercise barriers. Further work is required to establish in what other situations dialogue provides a benefit.

INTRODUCTION

The potential for commercial application of automated interfaces that use text or speech-based dialogue to exchange information and guide users is increasing as people become more familiar with computers and the internet (McTear, 2004; Bickmore and Giorgino, 2006). From a technical perspective the field is fairly mature, with a body of research on the implementation of automated dialogue (Androutsopoulos and Aretoulaki, 2003), and recent advances on the underlying dimensions influencing its efficacy (e.g. De Boni, Richardson and Hurling, 2007). Research on dialogue content

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has explored the role of empathy (Liu and Picard, 2005), the use of 'small talk' (Bickmore and Picard 2004), trust (Bickmore and Cassell 2001), emotions, personalisation and narration (Stock, 1996), information exchange and 'like-mindedness' (Svennevig, 1999). Turunen et al. (2004) examined the role of user experience, tailoring system output to differentiate between novices and experts, whilst Bernsen and Dybkjær (1996) compared co-operation between humans with that between humans and computers, highlighting that, in the latter, a clear communication of what the system can do should enhance the interaction.

De Boni et al. (2007) have shown that dialogue systems using relationship maintenance (e.g. elements of continuity between sessions) and appropriately positioned humour have a more positive impact on users' perception of the dialogue. There has however been much less (if any) evaluation of the benefits of dialogue versus simpler forms of information exchange, such as a pick list of alternatives. Here we report a study directly comparing user perception of two systems, both designed to help identify solutions to overcome exercise barriers, but one guiding the user via an automated text based dialogue whilst the other employed a simple list of alternatives. We expected that user perception of dialogue versus simple pick-list systems might be dependent on the domain (e.g. railway times versus beliefs about exercising), the context (e.g. relaxed private versus rushed public situations) and the individual (e.g. degree of perceived control over own behaviour). In this study we constrained the domain (to finding solutions for exercise barriers) and the context (both were internet based systems used in the privacy of the user's own home) and searched the literature for evidence on key factors that might influence user perception. First, we briefly reviewed the efficacy of Automated Behaviour Change Programs to determine the likely benefit of including dialogue-like elements, before considering the role of Individual Differences (such as Locus of Control, Self Efficacy and Personality). Finally we reviewed Usability Guidelines for computer based programs so that we could develop systems that were easy to use, and to minimise the influence of this factor when comparing the two types of system. We briefly summarise the literature in each of these areas and its bearing on our experiment design.

Automated Behaviour Change Programs

There is growing evidence for the potential of automated behaviour change programs. For example Tate, Jackvony and Wing (2006) conducted a randomized trial comparing e-mail counselling, computer-automated tailored counselling and no counselling in an internet weight loss program. At three month follow up they found the computer-automated feedback group had achieved a similar weight loss to the group receiving e-mail from a 'real' counsellor, and was much better than the group who received no counselling. However, at six month follow up the group who had contact with a real counsellor via e-mail had lost significantly more weight than the other two groups. This study indicated that automated feedback can improve the efficacy of internet based services that cannot offer contact with a real therapist, but that more research is required to prolong its impact after 3 months.

Marcus et al. (2007) compared tailored internet and tailored print based physical activity interventions. At six months that the group using the tailored website reported higher levels of physical activity than the group receiving tailored printed material or those viewing the standard site. However, at twelve month follow up there was no significance between the three groups.

Personalisation of computer based systems has been the object of research for a number of years, with some arguing that they would be more effective if they were able to recognise and respond to a user's emotional state. Nass and Lee (2001) found that when a computer's personality

matched that of the user, the computer 'voice' was regarded as more attractive, credible, and informative. De Boni et al (2007) found that a system with relationship maintenance elements (e.g. continuity of information between sessions) was perceived to be more polite, professional, considerate, and more socially engaging. When humorous elements were present participants rated the system as more enjoyable to use, less impersonal and less abrupt.

In summary, research into automated behaviour change systems has demonstrated that they can have an impact on health behaviours. However, further work is required for automated behaviour change systems to match the efficacy of access to a real therapist and more research is needed to prolong the impact of automated feedback beyond three months. Automated dialogue components might be able to help improve the efficacy of internet based systems, where there is no access to a real therapist, and so extend the impact of tailored feedback. If automated dialogue systems can increase the level of participant engagement and perhaps even increase the perceived credibility of advice provided, then they could help move automated behaviour change systems closer to the longer term efficacy achieved by systems that incorporate real therapists.

Individual Differences

Locus of Control (Rotter, 1966) theory identifies two thinking styles that influence an individual's perception of the world. Those with an internal locus ('Internals') tend to believe that positive or negative events are consequences of their own actions, whereas those with an external locus ('Externals') are more likely to consider themselves to be influenced by external events. Externals are further subdivided into those who believe they are greatly influenced by chance events and those that believe they are strongly influenced by 'powerful others'. Rotter's original Locus of Control scale has been modified and used in a number of studies. Sonstroem and Walker (1973) found that Internals had more favourable attitudes towards physical activity, and engaged in more voluntary exercise than Externals. Furnham and Kirkcaldy (1997) looked at age and sex differences in health beliefs. They found that men were more likely to have an external focus, for example believing that doctors have more control over ailments. Burk and Kimiecik (1994) found that an internal health Locus of Control was significantly related with health value.

Studies have shown a difference in users' attitude to computers due to their Locus of Control (Potosky and Bobko, 2001). Internals had more positive attitudes towards computers than Externals; which may be due to Internals having greater motivation to master computing situations. Hoffman, Novak and Schlosser (2003) used Locus of Control to predict internet use. They found that people with an internal Locus of Control tended to use the internet more instrumentally to supplement other activities such as shopping or information gathering, whereas people with an external Locus of Control used the internet more ritualistically as a substitute for other activities e.g. meeting friends or family. Charlton (2005) found that Internals have more computer confidence and less anxiety associated with computer use.

In Bandura's (1997) social cognitive theory, Self Efficacy is defined as the belief in one's capabilities to organize and execute the courses of action required to produce given achievements. Compeau, Higgins and Huff (1999) suggested that computer Self Efficacy is an individual's judgement of their capabilities to use computers in diverse situations. Hong (2006) investigated the influence of Self Efficacy and search task on locating credible health-related information online. She found that, when presented with a more complex search task, the participants with high computer Self Efficacy located web-sites that were more likely to adhere to industry standards. Eastin and LaRose (2000) found that prior internet experience, outcome expectancies and internet use

were all significantly and positively correlated to computer Self Efficacy. In order to minimise variation due to level of computer self-efficacy the participants in a study can be recruited to have roughly similar levels of experience.

Personality dimensions can be considered to measure a person's predisposition to react to their environment with a reasonably consistent pattern of emotion, thought, and behaviour. Moon and Nass (1996) found people responded to computer personalities in the same way as human personalities, and were more attracted to computer systems that became more like them in a series of interactions. This finding supports Fogg's (2003) similarity principle; that 'people are more readily persuaded by computing technology products that are similar to themselves.

Hamburger, Wainapel and Fox (2002) found that introverted and neurotic people tended to locate their 'real me' on the internet, whereas extraverts and non-neurotics tended to locate their 'real me' through traditional face-to-face social interaction. Hamburger and Ben-Artzi (2000) found extraversion was positively related to the use of leisure services, whereas neuroticism was negatively related to use of information services. These studies indicate that Personality may act as a moderating variable for the level of interest people have in using computer based systems and the impact such systems have on them.

Usability Guidelines

Norman (1998) noted that understanding motives, interests and needs, can help improve the functionality of a system, and so recommended a user centred design cycle (Lidwell, Holden and Butler, 2003) when developing systems. Through the use of prototyping and repeated testing of new variants, system design can be fine-tuned to meet requirements, and subsequently tested through controlled interactions with the target users (Nielsen, 1993). Adequate investment of time in usability testing before running the main experiment itself can help reduce the influence of unwanted variables, such as sentence length (Ling and van Schaik, 2006) and visual attention (Scott, 1993; Wolfe, 1994).

Usability issues need to be considered both in the initial design of a system and in evaluative questionnaires used to compare systems, in order to draw inferences on underlying affective and cognitive processing preferences without heavy contamination due to differences in perceived ease of use of the systems.

IMPLICATIONS OF LITERATURE REVIEW AND AIMS FOR THIS STUDY

Participant perception of a system designed to help them overcome barriers to exercise might well be influenced by their Locus of Control; we expected Internals to be more likely to engage in a process that emphasises personal control of their behaviour, as this fits with their sense of personal agency in the world. Internals may also be more motivated to master the experience of using a computer program and so rate the outcome of the experience more positively.

As Externals are more likely to consider their behaviour is influenced by chance events and powerful others, we expected they would rate the Solution Advisor (the automated dialogue system) more positively than the Solution Selector (a simple pick list of alternatives), as the Solution Advisor represents an external expert guiding them to a solution. We expected Internals to rate the Solution Selector more positively as it provides more opportunity to explore a wide range of potential solutions rather than being guided as in the Solution Advisor.

We also expected people with prior internet experience to have a higher level of self-efficacy with respect to use of computer programs, which in turn would influence their appraisal of the systems being evaluated in this study. In order to minimise variation due to level of computer

self-efficacy a recruitment filter was applied such that all participants had roughly similar levels of internet experience. The level of participant physical activity might also influence their perception of the systems, with, for example, those already engaged in high levels of physical activity being more motivated to engage with systems focused on area where their self-efficacy is established. Therefore, we included a measure of current level of physical activity in the initial set of questionnaires.

Research into the efficacy of fully automated online behaviour change programs indicates that they can be effective, certainly in the short term, but that new strategies are required to achieve the longer term efficacy achieved by programs where participants are provided with messages written by a real therapist, i.e. semi-automated programs. Most of the currently reported programs use automated messages delivered by email as an alternative to messages from real therapists.

One route to improving the impact of these automated messages is tailoring the content to the individual, based on their current state and history. In addition the message information could be delivered via a web based text dialogue system, such as that explored within this study. Although this study does not measure the behavioural impact of the advice given, we were reassured from our review that improvement to the perception of a message provision system has the potential to contribute to development of more effective behaviour change systems.

Research indicated that both the Personality of the user and the perceived Personality of the system may influence user perception. Participants may be more attracted to a program that they view to be more similar to their own Personality. In particular, 'introverts' and 'less emotionally stable people' may differ to extroverts and more emotionally stable people in their perception of computer programs. However, there does not appear to be a strong consensus in the literature on exactly how Personality dimensions influence user perception of an internet based system, and so initially we planned to explore whether there was any impact, rather than hypothesising an influence in a particular direction for a particular Personality dimension.

There is a large amount of research into effective design for computer based systems that use a screen as the primary mode of communication with the user. As participant experience with one type of system (i.e. the Solution Advisor or Solution Selector) might have influenced their approach when experiencing the next type of system, we employed a balanced experiment design with half of the participants using the Solution Advisor first and half using the Solution Selector first. As text length and format can influence user ability to attend to and process information, we ensured that, wherever possible, the same size text and font style were used in the text based dialogue and simple pick list systems. Many other factors have been shown to influence effective screen design; we followed the principles of good interface development by obtaining user feedback during the design of both systems, and included measures related to ease of use in the evaluative questionnaire.

Finally, from our review we identified that we could add to the literature by directly comparing a text based dialogue system with a simple pick list alternative for the same task. Matching the systems in terms of key factors, such as design for usability, and taking into account individual differences, such as Locus of Control, experience and Personality, would allow us to examine whether the communication medium per *se* (automated dialogue or simple pick-list) influenced user perception.

THE SYSTEMS

The automated text based dialogue system used in this study was an exercise advisor service (Solution Advisor) that engaged participants in

a natural language conversation to help them overcome their barriers to exercise, taken from De Boni et al. (2007). The Solution Advisor guided the participant to identify barriers that were stopping them from exercising and then proposed appropriate solutions. The solutions were contained in a database compiled by domain experts. A combination of shallow parsing and statistical natural language processing methods were used to assign participant text to one of the barrier categories, and then one of the solutions for that barrier was offered.

The Solution Selector (taken from Hurling, Fairley and Dias 2006) was a simple pick list with Tabs for different types of Barriers and their associated solutions through which the user could "surf" to find a solution they considered appropriate (Figure 1).

The Solution Selector was part of an automated system with proven efficacy for helping users changing their level of physical activity (as described by Hurling, Catt, De Boni, Fairley, Hurst, Murray, Richardson and Sodhi, 2007). The same set of barriers and solutions were used in the Solution Selector and Solution Advisor.

To minimize variation between user experiences, no scrolling was involved during any of the interactions. This ensured that each task required the same attention to the Solution Advisor's dialogue (Figure 2) or the Solution Selector interface, leading to a roughly similar cognitive load on the user in terms of the length and type of task that was required (following the design principles identified in the literature review). This approach ensured consistency and standardization while maximizing the user's exposure to the alternative experiences.

Before starting the experiment, we assessed the usability of both interfaces in a series of pilot studies, following the principles identified in the literature review. This provided feedback on factors such as the size of the text, navigation, information organization, control, page layout, appearance, readability, quality and enjoyment (Weir, Anderson and Jack, 2006).

This initial phase, to ensure similar usability levels between the two types of interface, allowed

Figure 1. Example screenshot of interaction with solution selector

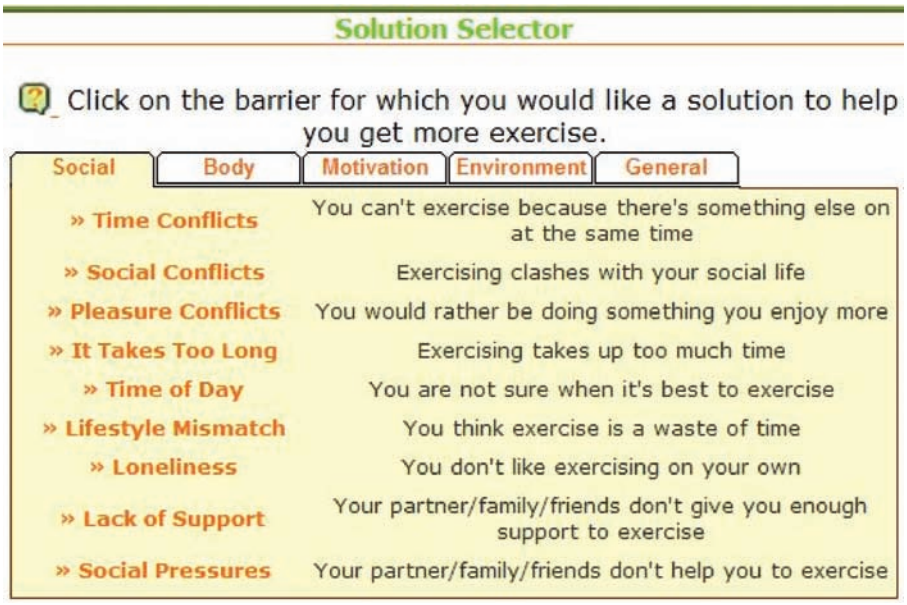
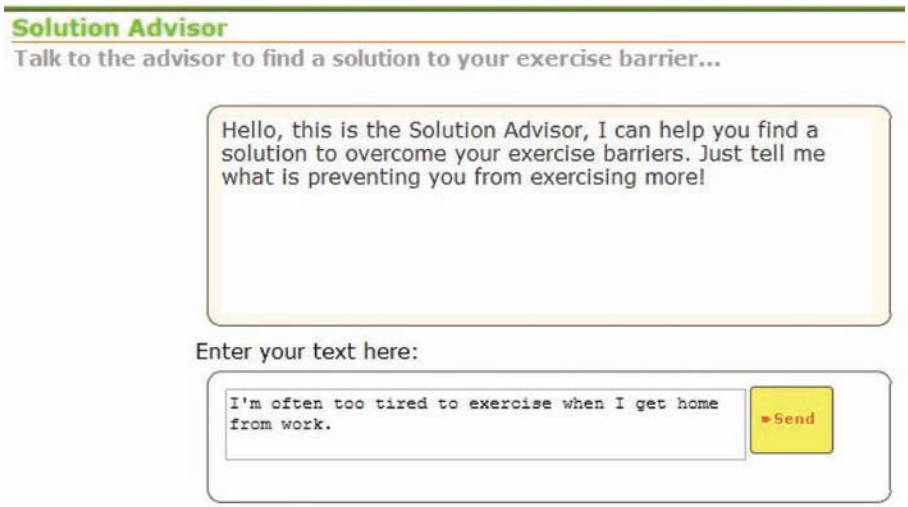


Figure 2. Example screen shot of interaction with solution advisor



us to focus in the main experiment on the impact of automated dialogue versus a simple pick list, without the concern that differences in usability level would swamp the influence of these different interfaces.

For experimental control purposes the interface was of a minimalist format with, for the Solution Advisor, the webpage showing only the dialogue box with a comment from the system and the communication box for the user with a send button. A reminder of the task was also provided on screen.

EXPERIMENT DESIGN

In this study we compare user perception of two systems designed to help identify barriers to exercise and suggest solutions to overcome them. One was a text based dialogue system whilst the other was a simple pick list with no structured dialogue. Our aim was to evaluate whether user perception of an internet based behaviour change system might be enhanced by the inclusion of automated dialogue-like elements.

From our review of the literature we identified Locus of Control and Personality as two potentially moderating variables to be considered in our comparison of dialogue and pick list systems. We expected an individual's Locus of Control would affect the way they perceive and approach environmental mastery, with those people with an internal locus being more motivated.

The General Health Locus of Control (18 items; Wallston and Wallston 1978) was used to evaluate Locus of Control. This produces a score for each participant for each of three scales: Internal, Chance and Powerful-others. Additionally, the scale scores can be standardised to classify individuals to one of the three groups. Some researchers compare the Internal group against both other groups combined (which can be considered to be 'Externals'). In our results we consider all three groups to permit comparison of the two subtypes of Externals, as these may have different motivations behind their perception of the systems.

The Ten Item Personality Inventory (TIPI) was used to evaluate the Big Five Personality domains (Gosling, Rentfrow and Swann, 2003). This inventory generates a score for each of five Personality dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability and Openness to Experiences. Norms are also avail-

able, such that individuals can be categorised as low or high for each scale. Note that we used this short scale to measure Personality, as although multiple item scales are usually more reliable and psychometrically superior to individual scale items (Robins, Hendin and Trzesniewski, 2001) they are also more likely to induce "fatigue, frustration and boredom" due to the repetitive nature of the items. Each Personality dimension can be summarised as follows. The extraverted dimension relates to enthusiasm (that is sociable, assertive, talkative, active and NOT reserved or shy). Agreeableness refers to being kind (that is, trusting, generous, sympathetic, cooperative and NOT aggressive or cold). Conscientiousness implies organised (that is, hard working, responsible, self- disciplined, thorough and NOT careless or impulsive). Emotionally stable refers to calm (that is, relaxed, self confident, and NOT anxious, moody, easily upset or easily stressed). The Open to Experience dimension implies imaginative (that is curious, reflective, creative, deep, open minded, and NOT conventional).

We collated information on participant level of activity via the short International Physical Activity Questionnaire (7 items; IPAQ). Although the intensity of certain activities is commonly characterized as light, moderate, or vigorous, many activities can be classified in any one or all three categories simply on the basis of the level of personal effort involved in carrying out the activity (i.e. how hard one is working to do the activity). For example, you can bicycle at intensities ranging from very light to very vigorous. The IPAQ uses the MET (METabolic equivalent); a unit that estimates the amount of oxygen used by the body during physical activity. One MET is equivalent to the energy (oxygen) used by the body as you sit quietly, perhaps while talking on the phone or reading a book. The harder your body works during the activity, the higher the MET. Any activity that burns three to six METs is considered moderate-intensity physical activity. Any activity that burns more than six METs is considered vigorous-intensity physical activity.

In addition to calculation of the total, vigorous and moderate METS and hours of sitting, participants were median-split (by gender) into high and low activity groups by total METs. This information was obtained to check whether participants with different levels of physical activity perceived the systems differently.

The flow of the experiment was as follows. Participants were recruited by telephone from an existing panel on the books of a local agency. They were introduced to the study purpose (that it was to evaluate two internet services designed to help identify solutions for exercise barriers) and given instructions on the tasks they would be asked to complete. Participants then completed on-line versions of the IPAQ, Locus of Control and TIPI questionnaires, before beginning their tasks with either the Solution Advisor or Solution Selector (balanced for order) and completing a feedback questionnaire. The participants then completed the tasks for the system they had not yet seen and completed the same feedback questionnaire. Participants were then briefed on the purpose of the experiment, thanked and received payment.

Before being assigned tasks with the systems, participants were asked to think of three barriers that they might typically encounter when planning to exercise. This differed from other research (e.g. De Boni et al, 2007) in which exercise barriers were provided to participants. We used participant generated barriers in this study to make the interaction feel more natural (i.e. looking for personally meaningful barriers) and to increase the sense of involvement with the systems. The disadvantage of this approach is lower consistency of experience between participants and higher probability of the system failing to accurately categorise the participant's barrier. Once the user had thought of and recorded three barriers to exercise they were introduced to either the Solution Advisor or Solution Selector and reminded of their first barrier for which to find a solution. For example;

The following system is the Solution Advisor / Solution Selector, please use this to find solutions to the three barriers that you provided previously. As a reminder, the barrier that you are currently working on will appear at the bottom left of the screen.

We displayed the task (including the participants' barrier topic) on the left hand side of the screen, to reduce the chance of participants forgetting the focus of their current activity. The text of the task was saved as an image so that participants were unable to cut and paste the task into their dialogue box. This ensured that participants were required to actively engage with the system rather than passively 'cutting and pasting'.

Participants were asked to find a solution to each of their barriers using the service allocated to them, after which they completed the feedback questionnaire which consisted of 34 Likert style questionnaires rated on a 7 point scale (see Appendix), balanced for positive and negative questions.

The 34 items were drawn from existing questionnaires. The items were modified to suit the purposes of this study, i.e. the comparison of a text-based automated dialogue system with a simple pick-list. For example, we drew on research by Lewis (2002) who analysed five years of research of speech dictation systems to develop the PSSUQ (Post-Study System Usability Questionnaire), with three main factors relating to system usefulness, information quality, and interface quality. We also used items from Love, Dutton, Foster, Jack and Stentiford (1994) who developed an evaluation questionnaire for automated telephone services, that were subsequently modified for computer interfaces (Love 1997). Our 34 item questionnaire was developed for onscreen delivery, allowing error-free data entry and a faster data preparation and analysis process.

In summary, the aim of our study was to assess user's preferences between two different ways of acquiring the same information. Participants were directed to use either a text based dialogue system (called the Solution Advisor) or a simple pick list system (called the Solution Selector), filling out an evaluative questionnaire (with 34 items) immediately after each experience.

The main hypotheses were:

H1: *Participants will rate the two systems (Solution Advisor and Solution Selector) differently in terms of how positive they are about their ability to provide credible and persuasive information on exercise barriers and solutions, but will not differ in terms of how easy the systems are to use, indicating that any differences are due to information processing routes rather than usability.*

H2: *Participants differential rating of the two types of systems will depend on their Locus of Control, such that participants who are high on internal Locus of Control will rate the Solution Selector more positively than the Solution Advisor (H2a), because the Solution Selector mode of interaction requires the participant to exert a personal choice over a solution to their barrier. Whereas participants who are high on external Locus of Control will rate the Solution Advisor more positively than the Solution Selector (H2b) as the Solution Advisor mode of interaction represents an external source "telling" the participant the solution to their barrier.*

In addition it was hypothesised that:

H3: *Participant rating of the Solution Advisor and Solution Selector will depend on their Personality.*

H4: *Participant rating of the Solution Advisor and Solution Selector will depend on their level of physical activity.*

These last two hypotheses were speculative, in that we were not clear how (i.e. in what direction) Personality dimensions or activity level would influence participant rating of the two systems.

PARTICIPANT SAMPLE

Criteria for Inclusion

Participants were screened by telephone from an existing agency panel, with inclusion criteria as follows. Participants were required to be weekly users of at least one internet site, to reduce variability in experience and navigation skills. Participants were between 18 and 60 years old. Participants were actively seeking to improve the amount of exercise they do. This ensured a realistic scenario for the two systems under investigation. 176 female and 206 male participants completed the study.

Classification of Participants

From responses to the IPAQ questionnaire 200 participants were categorised as undertaking low METS (Metabolic EquivalenT Scores) activity and 182 participants as high level METS activity. There were 132 Internal Locus of Control participants, and 250 External Locus of Control (120 Chance and 130 Powerful-others).

RESULTS

For the following results all degrees of freedom are 361 and correlations are based on all 382 participants. We used an analysis of variance mixed model with gender, system type, order of use, and the gender by system type interaction as fixed effects. Participant was modelled as a random effect. Locus of control (3 levels), extraversion, agreeableness, conscientiousness, emotional stability, openness and physical activity (all high or low) were all fitted as fixed effects along with their interactions with system type.

Item Clusters

Responses to the 34 items from the evaluative questionnaire (completed after each interactive session) were clustered using a hierarchical, iterative approach based on principal components (VARCLUS procedure in SAS software version 9.1.3 from SAS Institute, Cary N.C. USA). The first principal component (PC) is the direction through the data that explains most of the variation. The second PC is the direction through the data, orthogonal to the first PC that explains the next highest proportion of variation. The procedure splits the cluster which has least variation explained by its first PC (i.e. is least internally consistent), by calculating the first 2 PCs for the cluster and then assigning variables to one of two new clusters dependent on whether they are more highly correlated with the first PC or the second PC.

The procedure starts with all the variables in a single cluster and splits this. The procedure was completed when all clusters have at least 70% of their internal variation explained by their first PC. Table 1 shows the cluster labels and groupings of items with their respective Cronbach's alpha values.

The questionnaire items are in notated form in Table 1, the full versions are in the Appendix. Note that we have retained the original valence and wording of questionnaire items making up each cluster, rather than reversing negative descriptions into positive alternatives. So for example we retain the cluster item valence by describing the first cluster as 'not very informative', rather than reversing the scale to create one that represents 'informative'.

Perception of Solution Advisor and Solution Selector

Note that this analysis is based on the clustered responses, not the items as individual scores. We consider the clusters a more robust measure of

Table 1. Item cluster labels

Cluster and Label		Items	Cronbach's alpha
1	Not very informative	Irrelevant to my exercise barrier, unhelpful, would not recommend to my friends, uncaring, would not use again, not very informative	0.901
2	Credible	Provided solution in professional manner, enjoyable to use, advice seemed genuine, supportive, reassuring advice, gentle attitude, overall very satisfied, liked the way information laid out, better than expected	0.947
3	Impersonal	Prefer to talk to a human, too impersonal	0.697
4	Frustrating	Inconsiderate, unsettled after using, did not feel in control, frustrating to use, not easy to engage with, did not like appearance	0.878
5	Not easy to use	Easy to learn how to use, not easy to understand, required a lot of concentration	0.718
6	Persuasive	Trustworthy, reliable, sincere, motivating to exercise more, would change the quality of my life, persuasive, will try the advice recommended	0.928
7	Forceful	Forceful attitude	only 1 question

perceived differences as they are dependent on an averaged function of multiple items related to an underlying concept. Although there is a danger, when running multiple statistical tests, of finding false positives, we felt confident in using a significance level of 0.05 due to the reduced number of comparisons when combining items into clustered measures. Averages are followed by the Standard Error [*se*] and where appropriate the tValue [t] and associated probability [p].

Order of Use

There was no significant difference in the ratings for any of the seven clusters by order of use, i.e. there was no evidence that the ratings a system received differed by whether it was seen first or second. Average ratings (across both systems) for the seven clusters were; not very informative (4.90, *se*=0.11), credible (3.11, *se*=0.09), impersonal (4.31, *se*=0.12), frustrating (5.15, *se*=0.09), not easy to use (4.33, *se*=0.05), persuasive (3.50, *se*=0.09) and forceful attitude (4.81, *se*=0.11).

Gender

Male and female ratings of the overall experience (combining responses for Solution Selector and Solution Advisor) were not significantly different, with exception that females found the interactions more impersonal (females: 4.56, *se*=0.12, males: 4.05, *se*=0.12; t = 2.86, p = 0.004) and less forceful (females: 4.62, *se*=0.12, males: 5.00, *se*=0.11; t = -2.21, p = 0.028).

Solution Advisor compared with Solution Selector

In support of H1 (that perceptions of the different systems will differ); the Solution Advisor was rated as being significantly less uninformative (SA 4.67, *se*=0.10; SS 5.13, *se*=0.10; t = -3.05, p = 0.003), more credible (SA 3.26, *se*=0.09; SS 2.96, *se*=0.09; t = 2.40, p= 0.017), less frustrating (SA 5.01, *se*=0.09; SS 5.28, *se*=0.09; t = -2.08, p = 0.038) and more persuasive (SA 3.64, *se*=0.09; SS 3.35, *se*=0.09; t= 2.27, p = 0.024) than the Solution Selector. Overall, this would indicate that the text based dialogue Solution Advisor was more positively rated than the simple pick list used by the Solution Selector.

There was no significant difference in ratings for ease of use, indicating that participants were not evaluating the interactions simply on usability. There was no evidence for the observed differences between the Solution Advisor and Solution

Selector being more influenced by male or female responses. The means for each cluster when analyzing males or females alone showed the same trend between ratings of the Solution Advisor and Solution Selector, albeit less significant due to the reduced number of responses.

Locus of Control

There was no significant difference in the way that participants with a different Locus of Control (Internal, Chance, Powerful Others) used the rating scales when evaluating the two systems.

In contrast to H2a (that Internals would rate the Solution Selector more positively) the Internals actually found the Solution Selector to be more uninformative (SS 5.13, *se*=0.17; SA 4.35, *se*=0.17; t= -3.15, p = 0.002), less credible (SS 2.91, *se*=0.15; SA 3.55, *se*=0.15; t = 2.98, p = 0.003), more frustrating (SS 5.46, *se*=0.16; SA 4.74, *se*=0.16; t= -3.27, p = 0.001), and less persuasive (SS 3.19, *se*=0.15; SA 3.89, *se*=0.15; t = 3.28, p = 0.001). H2b was not supported as there was no significant difference, on any of the seven clusters, between the Solution Advisor and Solution Selector ratings from Externals (neither Chance nor Powerful Others).

Externals might not have differentiated between the two systems because they were both mis-aligned with their belief that external forces guide their level of physical activity. An alternative explanation for Internals having rated the Solution Advisor more positively is that they gained a greater sense of control through the deeper level of elaboration required to enter their barrier in their own words and discuss it within the dialogue system. This effort might be seen as more worthwhile by Internals who already consider themselves to have the potential to control their own behaviour. Internals were also more likely to consider that they had control over their behaviour and so more likely to believe that they could act on the advice provided by the systems. Again, there was no significant difference between ratings by Internals and Externals on how easy they found the systems to use, indicating that we were not observing a simple difference due to usability.

Personality

In support of H3 the participants' ratings were dependent on their Personality. Overall, more extraverted participants rated both the systems as less uninformative (High E 5.07, *se*=0.11; Low E 4.73, *se*=0.11; t = 2.09, p = 0.037), and those with lower emotional stability found the systems less uninformative (Low S 4.70, *se*=0.11; High S 5.10, *se*=0.11; t = 2.42, p = 0.016), less impersonal (Low S 4.09, *se*=0.12; High S 4.52, *se*=0.13; t = 2.40, p = 0.017) and less frustrating (Low S 4.97, *se*=0.09; High S 5.32, *se*=0.10; t = 2.41, p = 0.016). This may indicate that those participants with higher emotional stability felt less need to be guided in controlling their behaviour, whereas those with lower emotional stability found it harder to control their behaviour and were more welcoming of a system that might help them.

Also, those with low (but not high) emotional stability significantly differentiated between the systems; rating the Solution Advisor as less uninformative (SA 4.46, *se*=0.15; SS 4.94, *se*=0.15; t = -2.24, p = 0.025) and less frustrating (SA 4.77, *se*=0.13; SS 5.17, *se*=0.14; t = 2.41, p = 0.016). The Solution Advisor was rated as less uninformative (SA 4.59, *se*=0.15; SS 5.22, *se*=0.15; t = -2.95, p = 0.003) and more persuasive (SA 3.70, *se*=0.13; SS 3.31, *se*=0.13; t = 2.11, p = 0.035) by those who were low on agreeableness. The Solution Advisor was also rated as less uninformative (SA 4.58, *se*=0.15; SS 5.19, *se*=0.15; t = -2.89, p = 0.004), more persuasive (SA 3.71, *se*=0.13; SS 3.31, *se*=0.13; t = 2.20, p = 0.028) and more credible (SA 3.39, *se*=0.13; SS 2.93, *se*=0.13; t = 2.51, p = 0.012) by those who were low on conscientiousness. Furthermore, the Solution Advisor was also rated as less uninformative (SA 4.53, *se*=0.16; SS 5.12, *se*=0.16; t = -2.59, p = 0.010), more persuasive (SA 3.76, *se*=0.14; SS 3.37,

se=0.14; t = 2.04, p = 0.042) and more credible (SA 3.39, *se*=0.14; SS 2.90, *se*=0.14; t = 2.54, p = 0.011) by those who were high on openness to experience. These differences indicated that the Solution Advisor may be more suited to those with lower emotional stability, low agreeableness, low conscientiousness and/or high openness.

Initial Level of Physical Activity

Participants reporting a lower level of physical activity rated their combined experience of both systems as less uninformative (Low 4.67, *se*=0.10; High 5.13, *se*=0.11; t = 3.03, p = 0.003), more credible (Low 3.37, *se*=0.09; High 2.85, *se*=0.09; t = -3.92, p = 0.001), less frustrating (Low 4.96, *se*=0.09; High 5.33, *se*=0.09; t = 2.73, p = 0.007) and more persuasive (Low 3.75, *se*=0.09; High 3.24, *se*=0.09; t = 3.85, p = 0.001). Indicating that either system would be perceived more positively by those who are not already undertaking high levels of physical activity. Presumably those already reporting higher levels of physical activity see less need for a system designed to help them overcome barriers to physical activity.

Also whereas those reporting a high level of physical activity did not significantly differentiate in their ratings of the two systems, those reporting a lower level of physical activity found the Solution Advisor to be less uninformative (SA 4.40, *se*=0.15; SS 4.94, *se*=0.15; t = -2.55, p = 0.011), more credible (SA 3.57, *se*=0.13; SS 3.18, *se*=0.13; t = 2.10, p = 0.036) and more persuasive (SA 3.95, *se*=0.13; SS 3.55, *se*=0.13; t = 2.12, p = 0.034). Indicating that the Solution Advisor is best suited to the needs of those currently low in their level of physical activity.

Correlation between Variables

There were some low level correlations between variables (Table 2), for example, the Internal score was significantly related to emotional stability and openness, but only at 0.16 ($p<0.05$) and 0.23 ($p<0.01$) respectively. The Chance measure was significantly negatively related to emotional stability, but again only at -0.16 ($p<0.05$). Those with higher conscientiousness scores were more likely to report higher levels of activity as these variables were correlated at 0.25 ($p<0.01$). Cohen (1992) recommended a set of terms as a guideline for interpreting correlation size from social science studies, namely; small (0.1), medium (0.3) and large (0.5). Following this guideline we can conclude that the relationships found in this study were small to medium.

There was no significant relationship between any of the Locus of Control scores and the METs measure of reported physical activity, indicating that the observed effects of these two variables on participant ratings of the systems were independent. There were significant correlations between the Personality dimensions but these are not of direct relevance to this study.

DISCUSSION

Cluster analysis of the 34 item evaluative questionnaire identified seven key areas underlying participant rating of the systems. These were; 'Not Very Informative', 'Credible', 'Impersonal', 'Frustrating', 'Not Easy to Use', 'Persuasive' and 'Forceful'.

Our seven clusters show some similarity to those reported by other researchers. For example Love (1997) identified five key areas (confirmed by Larsen, 2003) for evaluation of speech based systems, labelled as; Cognitive (confusion, concentration, flustered, stress), Fluency (frustration, complication, competency, in control, speed), Transparency (ease of use, voice clarity, prefer human), Quality (use again, reliable, efficient, needs improvement) and Engagement (friendly, liked voice, enjoyment, polite).

We included items in our questionnaire which led to clusters related to how Credible and Persuasive the systems were. Other research has also

Table 2. Pearson correlation coefficients

	Internal	Chance	Others	Extravert	Agreeabl	Conscien	Stability	Open
LoC: Internal	**-0.15** ***0.04***							
LoC: Others	+0.08 *0.27*	**+0.22** ***<0.01***						
Extraversion	+0.03 *0.65*	-0.08 *0.28*	-0.13 *0.08*					
Agreeableness	**+0.14** ***0.05***	-0.13 *0.08*	-0.10 *0.19*	+0.13 *0.08*				
Conscientiousness	+0.13 *0.08*	-0.06 *0.39*	-0.08 *0.24*	**+0.22** ***<0.01***	**+0.29** ***<0.01***			
Emotional Stability	**+0.16** ***0.03***	**-0.16** ***0.03***	-0.11 *0.13*	**+0.22** ***<0.01***	**+0.15** ***0.04***	**+0.22** ***<0.01***		
Openness to Experience	**+0.23** ***<0.01***	-0.04 *0.57*	-0.12 *0.10*	**+0.30** ***<0.01***	+0.08 *0.29*	**+0.15** ***0.04***	**+0.27** ***<0.01***	
Total Activity (Sqrt of MET mins/week)	+0.10 *0.20*	-0.11 *0.15*	+0.10 *0.16*	-0.03 *0.69*	+0.10 *0.17*	**+0.25** ***<0.01***	+0.05 *0.48*	**+0.15** ***0.04***

Correlation and *significance level*

highlighted the importance of these factors, for example Fogg, Kameda, Boyd, Marshall, Sethi, Sockol and Trowbridge (2002) concluded that overall credibility comes from participant perception of the system's trustworthiness and expertise. From this perspective the more a user believes the information provided by a computer based system is credible, the more likely the system will be able to help them reach their goal. Further work is required to assess whether there is a set of areas that are universally relevant to the assessment of all systems and target populations. Our position is that whilst there is likely to be some commonality in the underlying factors used by participants to evaluate systems, researchers need to ensure specific items are included in order to test their experiment hypotheses.

Average ratings for the seven clusters indicated considerable room for improvement, for example the systems were clearly fairly frustrating to use; scoring higher than 5 on a seven point scale for this cluster. However, note that participant rating of the systems may have been influenced by the relatively artificial nature in which they were experienced, i.e. in isolation as part of an evaluation study, rather than as an integrative part of a larger system being used to define and implement a plan to increase physical activity. For this reason we focus here on the impact of individual differences between the participants on their ratings of the systems or the rating differential between the two systems, rather than the absolute ratings. Also note that this study compares only one example of each system type (dialogue and pick-list), each of which could be further improved or replaced with another example from their category. However, note that both systems used in this study have some pedigree, with the Solution Selector having been taken from a larger system with proven efficacy (Hurling et al. 2007) and the Solution Advisor dialogue previously evaluated via an automated optimisation procedure (Spitters, De Boni, Zavrel, Bonnema, 2007).

We found females rated the systems as more impersonal than did males, perhaps reflecting a general gender difference in evaluation of automated interactions, regardless of whether they are dialogue or pick-list in format. This might be due to a general difference in attitudes towards computers (Comber, Colley, Hargreaves and Dorn, 1997),

although we would have expected this to influence all ratings rather than just the two observed here. An alternative interpretation is that females have different expectation from an online discussion. Guiller and Durndella (2007) examined students' language use and interaction styles in text-based, computer-mediated discussion groups. They found significant gender differences with males more likely to use authoritative language and to respond negatively in interactions, than females. On the other hand, females were more likely to explicitly agree and support others and make more personal and emotional contributions, than males. If females expect to be able to engage in more personal exchanges and reach agreement then they may find automated systems more impersonal and forceful.

We found, in support of H1, that participant ratings significantly differed between the text based dialogue (Solution Advisor) and simple pick list (Solution Selector) systems, despite their being no difference in ratings of how easy to use they were. Overall the Solution Advisor was rated as being more informative, more credible, less frustrating and more persuasive than the Solution Selector.

There was no significant difference in ratings of the Solution Advisor and Solution Selector for ease of use or for perception of forcefulness, indicating that participants were not differentiating between the interactions simply on usability or overall style of interaction. This reassured us that we were evaluating the impact of the different information exchange styles (text based dialogue versus simple pick list) and not a gross difference in usability. To our knowledge this is the first reported comparison of a text based dialogue system with a simple pick list system, that have both been designed for exactly the same purpose. We can conclude that in this instance an automated text based dialogue system provides benefits over and above that of a simple pick list.

One explanation of the observed benefit is that, in this instance, the automated dialogue guides the user through the wide range of alternative choices, making the task less demanding for the user, in comparison with the Solution Selector where all options are presented simultaneously. Although some choice can lead to greater emotional and psychological satisfaction during a task (Taylor and Brown, 1988) it is also the case that too much choice can impair cognitive processes (Dhar, 1997). The Solution Advisor allows the user to retain some choice over whether or not to choose a solution whilst guarding them from the overwhelming total number of options.

In contrast to our expectations (H2), we found that Internals rated the Solution Advisor significantly more positively, while Externals rated the two systems similarly. From this study we can only speculate as to why Internals rated the Solution Advisor more positively. One explanation is that the type of task required by an automated dialogue system (e.g. entering their barrier in text rather than simply ticking options from a list) is more engaging for someone with an Internal Locus of Control, due to their greater enjoyment of mastering computer programs (Potosky and Bobko, 2001). Alternatively, the greater value placed on health by Internals (Burk and Kimiecik, 1994) may lead them to engage more in a dialogue about overcoming their barriers to physical activity. Further work is required to understand the mechanisms by which Locus of Control might influence user perception of systems designed to help identify and overcome health behaviour barriers, and the factors that lead to greater engagement in dialogue.

Similarly, although (in line with H3) we found links between the participant Personality and ratings of the two systems, it is not clear from this study what mechanisms are behind such associations. However, our finding that more extraverted and more emotionally stable participants rate the systems more positively is in line with Hamburger et al (2002), who found that introverted and neurotic (less emotionally stable) people tended to locate their 'real me' on the internet, whereas extraverts and non-neurotics tended to locate their 'real me' through traditional face-to-face social

interaction. The Solution Advisor and Solution Selector may not have been able to fully meet the social interaction expectations of introverts and those with lower emotional stability. The more positive ratings from extraverts may also be a reflection of their superior performance relative to introverts in tasks that require more attentional resources (Szymura and Necka, 1998) and tasks that impose high working memory demand (Eysenck, 1982).

Our study also suggests that the Solution Advisor is better able to meet the needs of those with lower emotional stability, presumably due to its attempts (albeit imperfect) to engage the user in a dialogue-like social interaction. This may be due to those with lower emotional stability selectively attending to threatening stimuli (e.g. a barrier to activity) and then having difficulty disengaging from that stimulus once attention is focused upon it (Derryberry and Reed, 1998). The Solution Selector presents a wide array of stimuli that may be considered potentially threatening by a participant with low emotional stability, leading them to rate the experience less positively than when presented with just one threatening stimuli at a time, couched within a social dialogue, as with the Solution Advisor.

The system was designed to help people increase their level of physical activity by overcoming perceived barriers. In line with our expectation (H4) we found that participant's initial level of physical activity did influence their ratings of the two systems. Those who reported a higher level of physical activity rated the systems less positively, presumably due a lower perceived need for such a service or the systems being unable to meet their higher expectations.

We have assumed, based on previous work (e.g. Hurling, Fairley, B.W., and Dias, M.B., 2006), that components which increase engagement will also increase the efficacy of a behaviour change system, as the more engaging a system the greater the opportunity for users to benefit from the change processes and advice it offers. Further research could evaluate the impact of a system with dialogue components on actual behaviour change, in comparison to one based on simple pick lists, given that we have now established a dialogue component can lead to improved user perception. Further work is also required to identify the key elements of dialogue that generate improved user perception, is this effect driven by social exchange, greater guidance of the user and/or simplification of the choices to be made?

CONCLUSION

In summary, we found that participants rated a text based dialogue (Solution Advisor) as being more informative, more credible, less frustrating and more persuasive than a simple pick list system (Solution Selector). Participants' ratings were dependent on their Personality, Locus of Control and reported level of physical activity. The Solution Advisor appeared to be more suited to those with lower emotional stability, low agreeableness, low conscientiousness and/or high openness, and to those not currently undertaking high levels of physical activity. Those with an internal locus of Control also found the Solution Advisor to be more informative, more credible, less frustrating and more persuasive, than the Solution Selector. The differences in perception were not due to ease of use, which was equally rated between the two systems. The questionnaire framework developed in this study could also be used to guide optimisation of the dialogue itself, for which there was clearly room for improvement.

This study demonstrated the benefits of including automated dialogue in a system designed to help people find solutions for their exercise barriers. In particular, the automated dialogue systems was most positively rated by those in greatest need of support, i.e. low conscientiousness, low emotional stability and low current level of physical activity. This work suggests that inclusion of dialogue-like elements into automated behaviour

change systems (such as that described by Hurling et al, 2007 or Tate et al, 2006) might help improve their long term efficacy, by increasing user engagement.

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APPENDIX

Questionnaire Items

This system was not very informative
I thought this system was enjoyable to use
This system provided a solution in a professional manner
I would prefer to talk to a human about my exercise barriers rather than use a system like this
The advice offered by this system seemed genuine
I found this system supportive
It was not easy to engage with this system
I did not like the appearance of this system
It was easy to learn how to use the system
I felt that this system was too impersonal
This system provided reassuring advice
Using this system required a lot of concentration
I felt this system had a gentle attitude
I thought this system was inconsiderate
Overall I was very satisfied with my experience of this system
I felt that this system was trustworthy
I felt unsettled after using this system
I liked the way information was laid out on the screens
The system's responses were irrelevant to my exercise barrier
I think that this system is a motivating influence to exercise more
I found this system unhelpful
I would not recommend using this system to my friends
Using this system for advice was better than I expected
This system was not easy to understand
Using this system would change the quality of my life
I thought this system was reliable
I did not feel in control of using this system
I thought that this system was frustrating to use
I thought this system was sincere
I felt that this system had a forceful attitude
I thought this system was uncaring
I would not like to use this system again
I found this system persuasive
I will try the advice that this system recommended

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Chapter 14
On User Experience Measurement Needs: Case Nokia

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ABSTRACT

Measurements related to user expectations, behaviors and experiences can provide useful data to many roles and teams in a company. Each role provides different views to the question "what should be measured, and why?" We conducted an empirical study on user experience (UX) measurement needs at different units and levels in one corporate (Nokia) and asked which kinds of UX measurements would be useful for different functions. We identified common UX measurement needs on 8 different themes.

INTRODUCTION

In all phases of product development, measurements play an important role as they enable systematic improvement of products. Often measurements are designed and conducted in ways that serve only limited audience and purposes. By studying corporate organizations as systems and expecting organizational units to share common interests, it is possible find better ways to conduct measurements and also to apply the measurement data more efficiently.

We can identify measurements that are made before, during or after the development, and measurements that are needed across disciplines and functions. In the development of consumer products the data from users and customers is needed when creating the products, and also to provide actionable feedback about the developed products.

Usability measurements investigate whether the designs are easy and efficient to use for the

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target user group. As usability has evolved to user experience (UX), we are also interested to know how users *feel* about using the product. This feeling is affected not only by usability (how I get tasks done), but also by the beauty of the product, brand image, and support services, for example. Therefore, while the customer for usability measurements is typically the R&D department, user experience information interests also people at, for example, sales point, support service, and customer care.

We wanted to understand how UX measurements would help the extended group of stakeholders and whether new measurement needs and requirements could be identified. In specific, our research questions were:

1. Which UX measurement needs are seen in different roles and organizations?
2. Which common UX measurement needs can be identified?

We conducted an email survey with the following company activities: research, concepting, product development, sales, customer care, and quality management. Based on the findings, we developed guidelines to help designing a UX measurement system that serves many organization units in a corporation.

In this article, we first describe earlier work on UX and related measurements. We then describe the study and main findings. We conclude our article with discussion and implications, including a set of guidelines and a process proposal.

RELATED RESEARCH

A large company should not be looked at as a single community of practice but as a federated set of multiple (and often competing) communities of practise and knowing (Klein & Hirschheim, 2008). Each community consists of the knowledge, concepts, observations, values, meanings, assumptions, beliefs, and so on that comprises a community's shared ''thought-world''. According to Klein & Hirschheim, the more communication and shared knowledge there is across communities, the better an organization can achieve its objectives and improve. They propose a new research priority to create better ''understanding of organizational stakeholders'' and to develop social boundary spanning ''knowledge creation and transformation networks''.

It is important for companies to keep old customers and recruit new ones, that explains why customer satisfaction has been measured for long with different kinds of measures and in different kinds of teams, communities and activities. From company viewpoint, user experience measurements are close to customer satisfaction and usability measurements, so we will shortly discuss what metrics are in use in these different fields.

Customer satisfaction models come from the field of commerce and many of them reach beyond product usage to all customer touch points. The touch points are interfaces where a customer encounters a company: products, advertisements, sales, care centers, Web sites, etc. (Peppard, 2000). A Net Promoter Score (Reichheld, 2003) is seen as an important measure for a company to find new customers, as it measures how many people would recommend the product to others. In the U.S., customer satisfaction is measured annually with American Customer Satisfaction Index, ACSI (Fornell et al. 1996). The metrics used in ACSI are overall satisfaction, expectancy disconfirmation, and perceived performance compared to ideal performance.

In human-computer interaction (HCI) field, measurements have traditionally been usability measures, such as efficiency, effectiveness, and satisfaction (ISO 13407); learnability, memorability, error prevention, and satisfaction (Nielsen, 1993); effectiveness, learnability, flexibility, and attitude (Shackel, 1991, p25); guessability, learnability, experienced user performance, system potential, and re-usability (Jordan, 1998).

Uldall-Espersen et al. (2008) studied the impact of improving the usability process in a real-life organization, and conclude that evaluation techniques need to be combined. It is important to have multiple evaluations and measurements over time, to allow firm design evolution and linkage to development.

When usability evolved to user experience, the measurements broadened from pragmatic (easy and efficient) to experiential (delighting). Jordan (2002) upgraded his list to functionality, usability, pleasure, and pride. Norman (2004) set the goal in engaging users in visceral, behavioral, and reflective level, and Nokia followed these lines with the Wow, Flow, Show model (Nokia, 2005). Although UX, by definition, is related to interacting with a product (ISO 2008), it is often seen as covering user's experience with the company and its services as well (Nielsen-Norman Group, online; UPA, online). As UX highlights the emotional aspects, also emotion measurements have been investigated. Most emotion evaluations concentrate in identifying the emotion a user has *while* interacting with a product, and both objective and subjective methods are used to collect this information (e.g. Hole, 2008; Desmet et al., 2001). UX evaluation can take place *after* interaction phase. For example, Hassenzahl (2003) has investigated the pragmatic and hedonic aspects of products from the perspective of product appraisal. This model helps to measure user experience after interaction, preferably after long-term use.

User's expectations play a big role (Mäkelä & Fulton Suri, 2001) when UX is measured. This shows in many field studies of ours where different groups use two different systems for one week each. We see a big difference in UX results between the groups who used the systems in different order; the first experience changed the expectations for the next system (Roto et al., 2006). Few UX measurements take expectations into account. Expectations are investigated on some other research fields, e.g. in the science of medicine when evaluating the perceived quality of life (Carr, 2001). Buttle (1995) discusses the role of expectations in service quality evaluation and the challenges of taking expectations as a criterion. These papers are relevant also in user experience evaluation and indicate that many different research fields deal with very similar questions as we have in user experience evaluation.

Gartner (2007b) reports UX measurements from the perspective of return on investment (ROI): what is the monetary benefit of spending money on user experience work. They study the relations of brand experience, company experience, and the implications to related revenues and costs. User experience is claimed to be a subset of brand experience. According to Gartner research (2007a), the success of UX can be measured in hard metrics and as intangible benefits:

- Increased revenue: More orders per customer; More repeat engagements; More products per order.
- Reduced cost: Fewer support calls; Fewer returns due to mistake or misperceptions; More efficient server use.
- Faster time to market due to accelerated development: Increased customer satisfaction; Improved brand image; Positive word of mouth.

As seen in this section, there are various viewpoints to UX measurement. We wanted to understand what kind of measures are the most useful in the different parts of Nokia, so we conducted a survey to find out the measurement needs. We presented the initial results in Ketola & Roto (2008), and this article builds on the final results.

THE EMPIRICAL STUDY AND RESULTS

The UX measurement needs cannot be identified by UX researchers only. People at different phases, roles and levels of development are the suitable

population from whom to ask their view on UX measurements needs. We do not know any established method on investigating the needs for user experience measurements. Therefore, we selected to conduct a phenomenographic survey (Marton & Booth, 1997) on the different measurement needs in their proper environment.

Phenomenography is a qualitative research methodology. It investigates the qualitatively different ways in which people experience something or think about something. Phenomenography's research object has the character of knowledge. The object of study is not the phenomenon per se, but the relationships between the actors and the phenomenon. (Marton & Booth, 1997; Wikipedia: Phenomenography, 2008).

We used Email survey for data collection (Meho, 2006). For practical reasons we invited 42 persons from different corporate functions which we believe have interest in UX measurements, to act as subjects in this study. We sent a short question (below) to selected engineers, specialists, managers, senior managers, directors and vice presidents). A total of 18 of them responded within one week.

Which User Experience information (measurable data gained from our target users directly or indirectly), is useful for your organization? How?

The question is intentionally open and can be interpreted in many ways. This way the study participants are not limited in describing their measurement needs, and can address any area they think is valid. Only one participant asked for further clarification for the question. In this section we will present and discuss the main findings. Most answers came from research, customer care and quality organizations. The most active group was customer care.

We analyzed the responses by using simple and straightforward content analysis. The free-text answers were first collected to a spreadsheet, matching the person, role and response. This grouping told us the key information needs for each discipline, answering our first research question (see section: Measurement needs for different groups) and the variations between roles within that discipline. Then, one researcher organized and grouped the answers as mindmap. The grouping was reviewed by the other researcher. This led to a consolidated grouping of topics across disciplines, answering our second research question (see section: Common needs for user measurements). Groupings were then translated to text format, communicating the discipline specific measurement needs and common needs.

We confirmed the results by giving the draft of results to the respondents to confirm that we interpreted and classified their responses correctly. All received feedback was positive, i.e. our interpretations were correct and the variations of the replies were properly included in the analysis.

Measurement Needs for Different Groups

In this section, we summarize the key needs of four groups that answered most actively.

Research

This group presents people who work with research management or hands-on research, before development takes place. Measurement needs in this group are seen in two main areas:

- How users perceive and use new technologies?
- Which are the most important UX or usability challenges in current products and services?

Development

This group presents people who manage and design concrete products and services, such as product managers or software designers. This group emphasizes the first use of products and services:

- Which functions are needed most?
- What are the first impressions (overall experience, first use) and level of satisfaction?

Care

This group presents people who manage and provide product support and maintenance services in online forums and in local support centers. In most cases they have direct connection to customers. This group has a very rich set of measurement needs. Major point of interest is out of box readiness with products and services:

- How easy it is to start using products and services?
- What is customer experience in support activities?

Quality

This group consists of quality managers and specialists, working with concrete products or in company wide quality development activities. Respondents in quality are particularly interested in developing the quality measurement practises, and understanding the users' perceptions about both products and support services:

- Which metrics should be applied for experienced product quality?
- Ease of upgrading from the old to a new product?
- What is the perceived performance of products and services?

Research unit was interested in the early phases of user-centred design (UCD) process, investigating the context of use, users, and the current tools. Development and Quality people were interested in the Setup and Usage phases of the Product Experience LifeCycle. Care was naturally interested in the Care & Support phases (not covered by UCD), and the Setup phase that is their major source for contacts. Many needs were specific to product features to be measured in the Usage phase, and but should be investigated also during the UCD process.

Common Needs for User Measurements

In this section we provide a consolidated grouping across all responses. The following groups are created based on common interest by at least two organizational functions.

Product Experience Lifecycle

Measurable information is needed not only when the user is interacting with the product, but also during pre-puchasing activities, when the device is taken into use and when there is an upgrade from old device to new device (Table 1).

Retention

Retention is a concept and also measurement describing the loyalty of the customers. It is assumed that good user experience correlates with retention. Retention information tells us how many customers continue with the brand, how

Table 1. Measurement areas in UX lifecycle

What should be measured?	Examples of measures
Pre-purchase	The impact of expected UX to purchase decisions
First use	Success of taking the product into use
Product upgrade	Success in transferring content from old device to the new device

Table 2. Measurement areas in retention

What should be measured?	Examples of measures
Expectations vs. reality	Has the device met your expectations?
Long term experience	Are you satisfied with the product quality (after 3 months of use)
Previous devices	Which devices you have had previously?
Engagement	Continuous excitement

many newcomers there are in customer base, and how many customers leave the brand (Table 2).

User Groups and Use of Features

The respondents from Research and Care organizations are interested to know which product features are used by different demographic groups (Table 3).

Where are the Experience Breakdowns?

All interviewees are interested in breakdowns and concrete user problems. A common challenge is to identify breakdowns and the need for improvements (Table 4).

User Experience in Customer Care and Maintenance

Organizations providing customer care and other support need to measure how users experience the given support. For example, was the provided support helpful (Table 5)?

Experiences with Accessibility

The consideration for mobile accessibility is emerging, and can be seen also in this study. For example, English is the primary language in technology communication, and often English language variants are provided first. There is a need to understand and measure how far this is enough for users in multiple countries, and what is the value of localized content in terms of user experience (Table 6).

Table 3. Measurement in the use of functions

What should be measured?	Examples of measures
Use of device functions	What functions are used, how often, why, how, when, where?
Differences in user groups	How different user groups access features?
Reliability of product planning	Comparison of target users vs. actual buyers?

Table 4. Measurement areas in breakdowns

What should be measured?	Examples of measures
UX Obstacles	Why and when the user experiences frustration?
Malfunction	Amount of “reboots” and severe technical problems experienced.
Usability problems	Top 10 usability problems experienced by the customers.

Table 5. Measurement areas in customer care

What should be measured?	Examples of measures
Customer experience in touch points	How does customer think & feel about the interaction in the touch points?
Accuracy of support information	Does inaccurate or insufficient (all features not covered, concepts or usage environment not addressed, or depth of information is insufficient) support information result in product returns?

Table 6. Measurement areas in accessibility

What should be measured?	Examples of measures
Effect of localization	How do users perceive content in their local language, what does it mean to them, how do they feel about it?
Graphics and icons	Ease of interpretation and recognition
Readability, display quality and font size	Readability. Especially important to older users and disabled people.
Industrial design	Ease of holding, pressing keys, opening slide/flip, switching on, attaching accessories, etc.

Perceived Performance

In product development, it is essential to know the performance targets, and how those targets are met in completed products (Table 7).

Experiences with New Technologies

There are several information needs mentioned by the people who present research teams. Researchers are especially interested in the reactions towards new proposed or realized solutions (Table 8).

DISCUSSION

In this section we shall first discuss our findings. Thereafter we pay attention to the limitations of this study. Finally we give practical and research recommendations.

We identified UX measurement needs that may be unique to certain disciplines but also needs that are common. This addresses the need to develop common UX measurements that can support various organizational functions and disciplines. We identified eight areas where UX measure-

Table 7. Measurement areas in device performance

What should be measured?	Examples of measures
Latencies	Perceived latencies in key tasks.
Performance	Perceived UX on device performance
Perceived complexity	Actual and perceived complexity of task accomplishments.

Table 8. Measurement areas with new technologies

What should be measured?	Examples of measures
Change in user behaviour	How are usage patterns changing when new technologies are introduced
Innovation feedback	New user ideas & innovations triggered by new technologies

ments are needed (Tables 1-8). Within each area we identified 2-4 specific or general topics that should be measured. As we had respondents also outside the product development, we got many measurements that are not directly related to detailed product features, as is often the case with traditional usability measurements.

Along the extension of usability towards holistic user experience, the view has evolved from UCD lifecycle (product development and user feedback) to understanding to Product Experience Life Cycle (PELC). PELC (Figure 1) is close to the model of customer touch points thinking in customer relationship management (CRM) field (e.g. Zablah et al., 2004), which investigates interfaces between a company and a consumer, such as products, sales, advertising, customer care, and web site. Since PELC sees the product from user's perspective, it ignores the R&D perspective. In UX work, we should consider both the UCD cycle to develop as good products as possible, and the Product Experience LifeCycle to take care that all product touch points and phases are serving the users well.

UX measurements proposed from theoretical groundings, such as human-computer interaction (HCI) and psychology, focus on the functional or aesthetic design of the product. The results suggest that UX measurement approach in SDM cannot be based on UCD only.

PELC and Measurement Needs

User experience measures and needs come not only from HCI specialists but from a larger group of collaborators, for example, from market research, consumer studies, and customer care. The UX measurement needs identified in this study can be mapped to the two product cycles, UCD and PELC. For example, when improving user experience in the point of sales, the audiences for the results are both the marketing department and the product development.

If the measurement needs identified in our study are mapped with PELC (Figure 2), we can see that the needs are related to all areas of PELC. Further:

- Several needs relate especially to the first use and the early experiences with the device (after set-up, before daily usage). This proposes that a special First and Early Use phase in PELC might be useful. We extend PELC with this phase.
- There are measurement needs related to the early phases of the use and also to the later phases of use. It might be useful to consider early and late usage as different phases of the product experience.
- Some needs are related to PELC as whole (e.g. continuous excitement, interaction in touch points). Although Care and Support

Figure 1. User-centred design (UCD) cycle and product experience lifecycle (PELC)

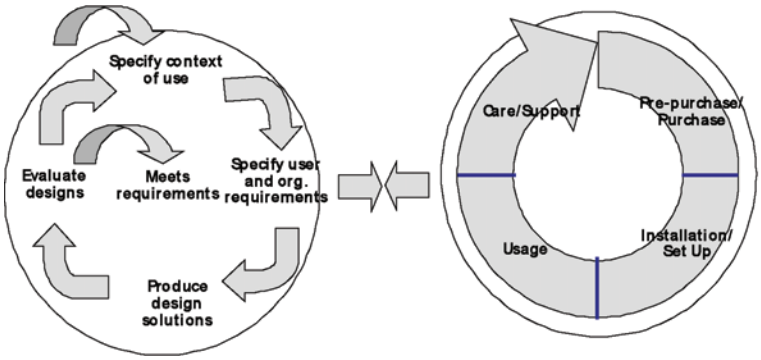
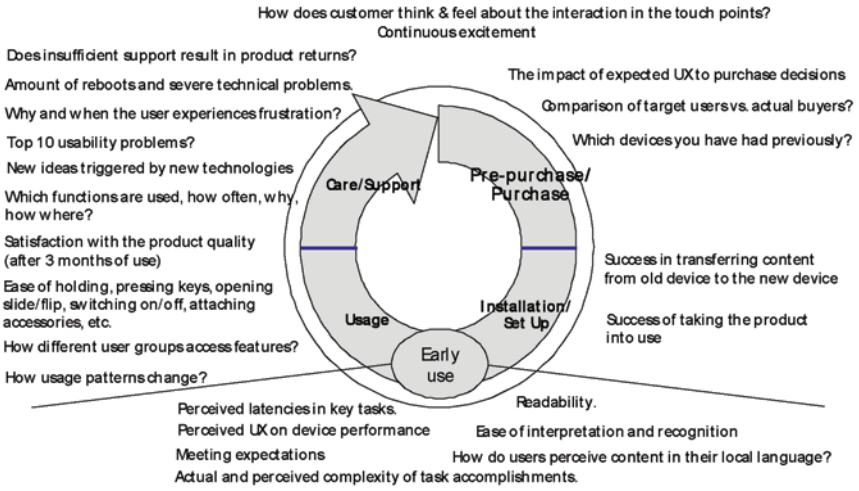


Figure 2. Measurement needs in product experience lifecycle



are presented as own phase in PELC, they are actually activities that can take place at any moment of product experience.

Limitations

The findings are not complete, exhaustive nor universal since the study was conducted in only one company and with a limited number of respondents. Primarily the results can be used as new data and inspiration for further measurement development and research activities.

Attention can be paid to the low response rate. In the phenomenographic study, however, the high response rate is not as important as the saturation level achieved. Alexandersson's survey (1994) on more than 500 phenomenographic studies concluded that the variation of a phenomenon reached saturation at around 20 research participants. The number of informants (18) is close to that figure, and we can argue that the saturation took place in this study.

Practical Implications

This study had some unintended positive side effects. Simply sending out the questionnaire triggered people to *start* thinking how UX measures might relate to their work or community. Participants also automatically started to connect this work to other measurement development activities in the company. We believe this as such is beneficial for advocating and developing UX work, and for improving knowledge creation and sharing in networks and communities.

Most of the UX measurement needs are familiar and already handled in existing theories and practices. However, this study provides new information revealing common needs for measurements. When new UX measurements are developed or existing measurements are improved, there should be sufficient cross-functional review to find out who else would benefit of the measures, and who else could be already measuring related topics or collecting similar data. The same finding can be extended to consider also cross-company perspective, such as for developing UX measures together with business partners, 'third parties' and developers.

One of the key criteria for UX evaluation is the need for lightweight solutions (Roto et al., 2008). All user measurements cost money and require resources. Hence the developed measurements should re-use existing practices, maximize the use

of results across firm functions, and minimize the effort in measurement and data sharing. However, there should also be possibility and readiness for heavyweight UX measurements when these are needed and justified.

From our learnings we can propose a general process for designing better UX measurements and related guidelines.

Design Process for Cross Functional UX Measurement

In cross-functional UX measurement, the phases requiring special attention are preparation and reporting. We propose the following process when a UX measurement with potentially multiple stakeholders is organized:

1. Cross functional stakeholder analysis: Identify the organizations, teams and people that
   a. might contribute to the UX measurement
   b. might use or need the results of the UX measurement
2. Review of related activities and earlier user research activities
   a. Has a similar measurement been conducted earlier (method, purpose, scope, etc.)?
   b. Has similar data been collected earlier?
   c. Are there other user or customer research activities that could be combined with the new measurement?
3. Design of measurement (= research plan)
   a. Tune the key research objectives to match with the most important needs of stakeholders.
4. UX measurement
   a. Involve stakeholders, invite, arrange ways to follow the measurement in person or remotely.
5. Analysis
   a. General results, findings of common interest
   b. Function/team/task specific analyses done together with the stakeholders.
6. Reporting
   a. Report and communicate the results
   b. Make sure results are accessible to all stakeholders

Guidelines for Identifying Common Measurement Needs

The development of UX measurements calls for activities that study organization's multiple levels and places of action. Burton & Gallivan (2007) developed guidelines for deeper understanding of system usage in organizations. In the following (Table 9) we apply these guidelines for identifying common UX measurement needs.

Implications to Research

As the discipline of user experience is still forming, it is beneficial for the field to be aware of

Table 9. Guidelines for studying and improving the usage of UX measurements

#	Guideline	Application to UX measurements
1	Function of Usage	Identify common UX metrics that are meaningful for multiple organization units.
2	Structure of Usage	Study how people who conduct UX or customer measurements are related to each other.
3	Form of collective use	Study how people collectively share and use UX or customer information.
4	Context of Usage	Study how the contextual factors affect to use of UX measurement data.
5	Impacts of usage	Study what are the practical impacts of UX measurements in development.
6	Improvement	Study how the collective use and development of UX measurements could be improved.

the kinds of UX metrics needed in industry. It is also healthy to start UX metrics work from the needs of the audience that will use the results. This hopefully helps UX researchers to establish the boundaries for UX measurements and even for UX as a discipline.

We believe that improvements in UX measurement methods create value for users and thereby for the companies. We need to continue exploring the evolving role of UX and the changing nature of its contribution to organizational value creation. Unless we can identify how and where UX is contributing to company value creation, we cannot measure it; unless we can measure it, we cannot demonstrate the value of user research.

Traditional boundaries of a company are blurring. Companies have strategic relationships with other companies that range from loose outsourcing to seamless integration in which products and information flow smoothly. When different companies influence to the user experiences through products and services that work together, it is unclear who generates value and how the system UX could be measured. The next generation of UX measurement studies should study the creation and measurements of UX that is dependent on many different products from multiple companies. Collaborative UX creation represents the idea that (a) UX value is increasingly being created and realized through actions of multiple parties, (b) value stems from robust collaborative relationships among companies (and teams), and (c) structures and incentives for parties to partake in and share emergent value are in place.

The data from our survey is in line with the evolution of measurements that is visible in previous research from such disciplines as HCI and marketing. It is no more enough to investigate product features, or how to get consumers to buy a product, but it is important to think about the whole Product Experience LifeCycle with the different touch points between a company and a consumer.

The research results originated from Nokia, and need to be compared to other types of companies. We warmly welcome further studies on this topic, hopefully pointing out the differences in the UX measurement needs in different types of companies and discussing the means to measure the various types of aspects of user experience.

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Section 3

The Case of Design in Technology, Concept and Learning

Chapter 15
A Motive Analysis as a First Step in Designing Technology for the use of Intuition in Criminal Investigation

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ABSTRACT

Investigators occasionally rely on intuitive feelings during crime solving, but have no technological tool targeting directly on mediating this investigation factor. Technology that encourages the sharing and alerting of hunches therefore seemed to be needed. A motive analysis of interviews with criminal investigators was performed as part of an investigation aiming at adding hunches to the criminal investigators' visualization tools (the project management system to keep track of the investigation). Purpose of the study was to explore how a motive analysis (by revealing the criminal investigators' motives and attitudes) could contribute in the first phase of the design. The assumption that designing for intuition could be useful, was confirmed by all of the informants. The study gave valuable input to how motive analysis could be used to identify suitable requirements, by resulting in a proposed technological concept supporting the use of intuitive feelings in criminal investigation.

INTRODUCTION

It is claimed that criminal investigators occasionally experience sudden intuitive feelings – so called hunches (Thune et al. (1993). They get strong feelings of rightness or wrongness without being consciously aware of why. Sometimes hunches have no importance for solving a crime case. Other hunches may lead to important evidence

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findings. The former head of the department for tactical investigation in the Norwegian police fought for the investigators' acceptance of using intuition in the investigation process. He believed that the investigation process was being directed by too many rules and regulations, on the cost of the investigator's own creativity (Brügger Bjånesøy (2005). An important part of the investigation process is lost, he claimed, if every step in the criminal investigators' move is regulated. Therefore he arranged a course in intuition that investigators should attend. His goal was that criminal investigators should start developing and using their intuition as a tool during the investigation process, a topic that for periods has been a controversy in Norwegian press. Technological tools supporting this potentially important use of intuition in criminal investigation, seems to be non-existing. It therefore seemed to be a need for designing for intuition, aiming at offering computerized functionality which encourages the sharing and alerting of hunches.

In other professions, intuition seems to play a role as a diagnostic tool, for instance in business, medicine, software debugging, teaching etc. Diagnosing includes both the ability to notice trouble and to take the proper action (Mesman, 2007). Henden examined how 105 Norwegian top leaders relate to intuition (Henden (2004). His study indicates that in strategic thinking, more emphasis is put on intuition than on analysis, particularly on areas that relate to exploring new terrain and technology.

Facilitating the use of intuition through technology is of interest for criminal investigators individually and the police as a whole. A better understanding of the investigators' relationship to intuition and hunches can contribute to a deeper knowledge of the criminal investigation process. It could help in designing for technological artifacts that could capture and formalize these private feelings (and reasons for certain actions). Design of such artifacts could contribute to that the investigators' sudden intuitive feelings become part of the organization's publicly available, shareable knowledge base for taking a certain line of investigation.

To study the use of intuition in criminal investigation, this apparently important, but officially overlooked aspect of the criminal investigators' work, it was of highest importance to identify the correct requirements. Many large system development projects have failed, and a vast amount of money has been spent because of unsuitable requirements (Dix et. al. 2004, Rogers et. al. 2007, the author's previous experience). Regular methods for requirement gathering (for instance task analysis, questionnaires etc.) seemed to be too superficial when studying user's relation to intuition. There was a need to go 'deeper under the investigators' skin', in order to uncover their underlying motives related to intuition. We were interested in investigating if a motive analysis could contribute in the first phase of designing technology for intuition, because it presumably would go deep into the users' (investigators') understanding of their own practices. It was therefore conducted a motive analysis with input from eight criminal investigators' reflections upon the use of hunches and intuitive feelings in criminal investigation. The hypothesis was that revealing the criminal investigators' motives, and thereby attitudes, while studying ways of speaking in their statements about intuition, would give a valuable contribution in designing technology for intuition.

Through the motive analysis of the investigators' statements about intuition, several implications for a new computerized system was suggested, for instance the demand for mobility and suddenty. Based on these suggestions, a technological concept for using intuition in criminal investigation is proposed. The proposed technological concept visualizes the main features a new 'intuition system' should have in order to reflect the requirements that emerged from this study. Different technological realizations of the concept are introduced; from mobile equipment for entering and alerting about intuitive feelings,

to placing intuition markers in an augmented reality system.

A SUDDEN INTUITIVE FEELING

This study was inspired from some of the theories of what intuition or hunch is as a cognitive phenomenon. A brief introduction to some of these theories is given in this section.

Intuition in Psychology

Intuition is within psychology described and treated as an unconscious and automatic process that can be classified as one of the members of the family of 'fringe consciousness' (FC) experiences. Mangan (2003) puts it this way:

'Intuition is simply a conspicuous, if heretofore puzzling, example of fringe feelings doing cognitive work in the absence of a sensory content.'

The concept of FC was brought back to life by Mangan in 1993 (Mangan, 1993a, 1993b) after first being introduced by James (1990). From Mangan's work FC may be referred to as *'conscious feelings which reflect non-conscious context information, and which therefore play a functional role in metacognitive monitoring and behavioral control*' (Mangan, 1993a, 1993b, 2001, 2003, Norman, 2006). Typical examples of FC where research has been performed is "tip-of-tongue" (ToT) (Brown, 1991), "feeling of knowing" (FoK) (Metcalf, 2000) and "feeling of familiarity" (FoF) (Whittlesea & Williams, 2000, 2001a, 2001b). While TOT gives a strong feeling of potential *recall*, FoK is concerned with the likelihood of *recognizing* for instance an object when presented together with other objects. The FoF is regarded as evidence for the subjective feeling of having been exposed for a stimulus earlier (Norman, 2006).

There are several theories concerning the underlying structures and mechanisms involved in non-conscious reasoning. One theory is that an associative neural network is activated (Mangan, 1993b), and instantiated as a parallel distributed processing architecture (McClelland & Rummelhart, 1986). Another way of viewing this is that FC is a monitor for the associative network retrieving context information and evaluating the relevance of it. A third theory uses the Interactive Cognitive Subsystem model to understand FC (May, 2002).

Many suggestions have been made about what the functionality of fringe consciousness is, and there seem to be some discrepancy in the theory. The main function of FC is, according to Mangan, to represent large amounts of context information in a condensed format which do not exceed the limited capacity of consciousness, the "*summary-function*" (Mangan, 2001). Galin suggest similarly that 'a summary is needed because the whole map is too big for the limited capacity of the system (Galin, 1993). The conscious signal (the sudden intuitive feeling or the hunch) is therefore necessary to inform the individual of relevant context information. A feeling of knowing, for example, informs the individual that relevant context information is available. The *retrieval-function* and the *monitoring-function* are also theories of the FC's functionality. In the monitoring-function theory, it is argued that fringe feelings reflect ongoing cognitive activity. The retrieval-function theory reflects another view on FC functionality; to make non-conscious information accessible to conscious awareness (Mangan, 1993b, 2001, 2003). For the individuals, fringe feelings are often given as a 'felt meaning', for instance the feeling of rightness or wrongness. Individual sensitivity to fringe feelings have been paid little attention to in the literature, except for research related to pathological conditions like Tourettes and obsessive compulsory disorder (Leckman, Walker, Goodman, Pauls & Cohen, 1994).

Concepts within psychology that relate to fringe consciousness are, according to Norman,

meta cognition, attention, emotion and intuition. The focus will from now on be on the latter, intuition.

While intuition in everyday speech often indicates an element of supernatural abilities, most dictionary definitions mainly characterize intuition as a specific kind of thought process, characterized by its sudden appearance of insight, seemingly without conscious reasoning. Oxford English Dictionary (1989) gives an example of such definition of intuition: *"The immediate apprehension of an object by the mind without the intervention of any reasoning process"*. In Wikipedia, the definition goes in the same direction, by including both the immediate aspect and the non-conscious element: *"ability to sense or know immediately without reasoning"* (Wikipedia, intuition). Both definitions state the two attributes that seems to characterize intuition as a FC experience: Speed and unconsciousness. The latter definition connects intuition with the perception of information. When the information is perceived without conscious reasoning, the owner is not aware of having the knowledge. While this knowledge is tacit, the result is that the owner experiences the feeling as intuition. Bowers' definition of intuition is: "*a preliminary perception of coherence (pattern, meaning, structure) that is at first not consciously represented, but which nevertheless guides thought and inquiry toward a hunch or a hypothesis about the nature of the coherence in question*" (Bowers et al., 1990). This definition differs, according to Norman, from fringe feelings by the extent to which it is characterized by conscious feelings.

Some systematic investigations of intuition have been performed (Petimengin-Peugeot, 1999, Bowers, Regehar, Balthazard & Parker, 1990, Lieberman, 2000) but the topic of intuition seems largely neglected in psychological research (Norman, 2006).

A hunch is the result of using intuition, and can be defined as '*an intuitive feeling or a premonition*' (Answer.com, intuition), '*A strong, intuitive impression that something will happen*' (Dictionary.net, intuition) or as '*A strong intuitive feeling concerning especially a future event or result*' (Merriam-Webster, intuition). Common for all the located definitions of hunch is that they are explained by intuition. It might therefore be argued that a hunch is the result of using intuition in a concrete situation.

Intuition and Philosophy

Henden argues that intuition is considered more rational in philosophy than in cognitive psychology (Henden, 2004, p 47). From the works of all the philosophers he studied (e.g. Plato, Spinoza, Kant, Bergson and Buddhism) he found no exceptions from the view that the intuitive state of mind is considered superior to the discursive. All the philosophers, Henden argues, define intuition as rational and intellectual while discursive thought is seen as relative, incomplete and fragmented. Bergson regards intuition as some sort of long-term memory, in the way that it manages to hold on to the manifold of the preceding, and to see one enduring picture (Kolstad, 1994). In Bergson's view, this differs from discursive thinking, where one thing is perceived after another without holding on to the preceding. However, with criminal investigators, the hunches become – through discourse or other action – part of the realm of relative, incomplete and fragmented. This is another reason for why the research on hunches in this (practical) connection should be done carefully in order to capture the situated nature of the use of hunches. Also and, consequently, design for hunches should be performed in a way that appreciates the whole material and discursive situation in which they occur.

Intuitive User Interfaces

A main goal in user interface design is to create intuitive user interfaces, a topic broadly covered within human computer interaction (HCI) theories,

and in activity theory. Users' limited resources of attention should be directed towards problem solving instead of striving with a difficult user interface (Jensen, 2006; Anderson, 2004; Rogers, Sharp and Price, 2007 etc.). In other words using the user interface should be an *automated process* to which the users do not have to pay valuable attention. Automatic processes allow people to perform complicated actions without paying attention to it, for instance driving a car, riding a bike etc. These are actions that are being automated after a period of practicing (Anderson, Price etc). In activity theory actions that are performed without consciousness are talked about as being *operationalized* (Leont'ev, 1978). These operational or automated experiences are either a result of training (skill) or instincts (preborn).

CRIMINAL INVESTIGATION, TECHNOLOGY AND INTUITION

The use of technology in criminal investigation has historically become more and more sophisticated in police forces around the world. Much of the technology has focused on identifying criminals through biometric data (fingerprints, palm and foot print, blood and other bodily fluids, hair, ear print, bit marks etc.), found at the crime scene. Fingerprints have been used for more than 100 years, and are still commonly used. Pictures have also been used extensively in identification work, though sophisticated tool for face recognition etc. has been introduced quite recently. Ballistics techniques are used to identify weapons as well as voice identification techniques are used to identify criminals. In many cases criminals are identified by DNA, found at the crime scene, criminals that earlier might not have been caught. Lie detectors are still in use, but not always accepted by the court system. Other tools help in reconstructing a crime scene, for instance by animating a car accident, or analyzing the angle of a bullet direction. (Newburn, 2007). Lately complex tool for tactical investigation have been introduced, aiming at supporting the investigator's traditional brown paper technique, where persons and incidents are added to time/place matrices, for instance Analyst Notebook (Analyst Notebook, 2008). Another group of technology is used for gathering a person's activity, including phone call registration, geographical position (video surveillance), bank transactions, traffic sensors etc. This last group of technology generates a vast amount of data, that often is very complex to handle for the investigators, and too large to be introduced to the court (Mena, 2003).

The implementation of intuition in systems for criminal investigation seems to be non-existing. Criminal investigators often make personal notes about hunches, but do mostly not formally share them with others. The finding closest to facilitating documentation of intuition in criminal investigation is in the criminal analysis system Analyst Notebook. In this system, it is possible to grade the certainty of information, from uncertain to confirmed. The word 'Hunch' or 'Intuition' is however not used.

MOTIVE ANALYSIS

Why a Motive Analysis?

So why was an apparently complicated method like motive analysis selected for requirement gathering while designing technology for intuition? Many large system development projects have failed, and a vast amount of money has been spent because of unsuitable requirements (Dix et. al. 2004, Rogers et. al. 2007). The author's personal experience from systems design revealed the importance of identifying the suitable requirements, while current methods (for instance task analysis) in many cases seems to be too superficial. These factors indicates that a need for a new method has emerged; a method which go deeper into users mental models. Motive analysis seemed to be

of interest in this respect because it seeks to go behind the users words, by analyzing their way of speaking, presuming that language possibly can reveal a person's motives and attitudes through how they formulate their perspectives.

A motive analysis was performed as a tool in seeking to understand how the criminal investigators are positioning themselves in giving explanations for their actions. We were interested in studying how the investigators view and create the world by taking different explanatory positions when talking about intuition. Do they place responsibility on others; to the society, people or technology? Do they have goal-driven explanations? Or do they say that things just happened? Also, the motive analysis can concentrate on hunches and intuition in relation to the various documents, phone calls, people and places that are encountered in the work (for instance, are hunches talked about in connection with mediational means such as tips, actors such as witnesses or scenes such as the crime scene). The mediated actions (in which 'hunch' or 'intuition' plays a role) that are explored focus on the investigator's decision to go to a certain direction during the investigation process. This includes how they relate themselves as actors to hunches/intuition and where they put the focus in the description of hunches/intuition. So this study is not concerned with how the use of intuition 'really happens', but in the motives the investigators construct while discussing intuition.

The Interviews

Eight depth interviews were performed in order to explore how criminal investigators talk about intuition and hunches. Most of the fully transcribed interviews lasted for about one hour, the shortest was 33 minutes and the longest was 86 minutes. Informal interviews were chosen in order to as far as possible avoid leading the informants in a specific direction. It was important to let the interviews flow depending on the informants' interests and angles. The goal was to encourage the informants to share their experiences and tell stories related to the topic. However, some open-ended questions were prepared to keep conversation at the right track: What is intuition? What role do hunches and intuition play in the investigation process? What role does experience play? What role does talent play? In the criminal investigation process, are hunches/sudden intuitive feelings documented, or does this knowledge remain silent? Does it make sense to document hunches, and if so; what would be the most useful way to document them? Did the criminal investigators remember any specific examples from their working career where intuition/hunches seemed to play an important role? In addition, some follow up questions were asked in order to get a further description of something, to get an interpretation of something or to get an insight in causes or intentions.

The informants were recruited partly consciously and partly through 'the snowball principle'. The strategy was to represent mainly experienced criminal investigators, but some younger and not so experienced investigators for a second opinion. It was also a goal that investigators of both sexes should be represented.

Motive Analysis: The Method

The motive analysis builds on Kenneth Burke's 'Grammar of Motives' (Burke, 1969). Burke investigates motives by viewing human performance and communication as drama (Kjeldsen, 2006), and explores implications of "What is involved, when we say what people are doing and why they are doing it?" (Burke, 1969). Burke views the use of language and communication as actions if they have a purpose and are not just movements (a movement can happen without a purpose). And an action is recognized, according to Burke, as all possible activity performed by symbol-using human. In contrary stands non-symbolic operations like growth, digestion, tide water etc. which are not defined as actions. Words are verbal symbols, and are sources to revealing the speakers' attitudes and

motivation. Kjeldsen formulates it as "*when we explain the world for each other, we also formulate motives for action*". Burke proposes five points of view where any action can be talked about from: the scene, the mediating means ('agency'), the social actor ('agent'), the mediated action ('act') and the purpose. These five elements form what is called the "pentad". Each of the elements in the pentad, Burke claims, can be used by the social actor as an explanatory position or a discursive motivation for an action. When a combination of these elements is used, Burke calls it a *ratio*, e.g. an actor/scene/action ratio.

'Dramatism' is used synonymously to motive analysis, because Burke believes that it may be useful to view human activity as a drama (Burke in Foss, Foss and Trapp, 2004; Kjeldsen, 2003). To uncover human motivation dramatism is developed, by using the concepts act, agent, scene and agency. A drama must have an *action*. And in order to have an action, someone must act - the *actor* (agent). The actors need somewhere to act, the *scene*. The actors need some *mediating means* to be able to act on the scene. The mediating means can only be called a means if the actors have a goal or a *purpose* for the action. These five elements form Burke's pentad of dramatism.

The most well known example of a motive analysis is David A. Ling's pentadic analysis of Senator Edward Kennedy's speech to the people of Messachusetts July 25th 1969 (Ling, 1966). Kennedy left a car accident scene where his secretary, Mary Jo Kopechne, was killed. In his defense speech, he focuses on the scene *"*of a narrow, unlighted bridge over cold, dark, rushing water that left him nearly drowned and not thinking straight". The scene is talked about as the most controlling and conclusive element in the drama. Thereby Kennedy puts other causes in the background, for instance that he personally had been careless, or driving under influence. Ling's analysis shows that the speech targeted on minimizing Kennedy's responsibility.

Within Burke's analysis there are the following grammatical possibilities:

1. **Scene:** The scene could be anything that frames the situation in which intuition occurred. It could be the current discourses in place, like laws and regulations and other public discourses, domestic language, police internal language etc. It could be the situation included the place where the investigator was at the moment. It could be histories, social life and social interactions that make people act. The criminal investigators might explain that they use intuition because of the scene, for instance by saying that something on the crime scene triggered the intuition. But scene can also be interpreted in a broader respect, for instance to other discourses that the criminal investigators are a part of. They could say that everyone uses intuition, and that this is encouraged by the police heads. When an action is interpreted in terms of the circumstances in which it is acted, we have a scenic explanation (Burke in Foss, Foss and Trapp, 2004).The scenic explanation is tending in the more deterministic direction, and is often used in sociological and political explanations. The human is seen as an element directed with stronger forces outside their own power.
2. **Agent:** Others might ascribe the motive to the social actors (themselves or other actors) by explaining their action to qualities of their own person. They might for instance say that they use intuition because they have a special talent for it. Or that "nobody believes in intuition, except me". By taking this explanatory position, the investigators' motives could arise from their own will, their own intentions or their own special characteristics. This indicates a strong believe in the individual's free will in contrary to a stronger deterministic view, as argued by the National Rifle Association in USA:

Criminals kill, not guns. The actor kills, not the means.

3. **Means:** The use of intuition could also be explained by mediating means. The investigators could for instance argue that they use intuition because of some tip they got. The tip was the mediating means that triggered the use of intuition. Or intuition could be explained as a means itself, by being a tool in solving crimes. By taking this explanatory position the agents 'blame' the means: "It was the wine that spoke…". The motive is removed from the individual itself and to some instrument outside themselves.
4. **Purpose:** The investigator could argue that they use intuition because they want to achieve a goal. If they, for instance, explain their actions by saying that using intuition saves time in performing a search at the crime scene, the action is explained by its purpose. This explanatory position views the human as a highly goal-directed individual, who act intentionally in order to achieve some teleological outcome. Kjeldsen points out that the concept 'purpose' must be separated from 'motive' (Kjeldsen, 2006). 'Purpose' refers to what the 'actor' wishes to achieve, while 'motive' in dramatism is the explanation to the person who communicates the statement.
5. **Act:** More seldom, Burke claims, is to explain the action by referring to the action itself, typically for humans could be involuntarily actions like reflexes. When taking this explanatory position, the action has no source, no purpose and no context. In this case the investigator could argue that the intuitive feelings suddenly just occur. The hunch appeared all by itself without being consciously triggered by the actor, the scene, the purpose or some mediating means.

The collected data from the interviewed criminal investigators form the input to this motive analysis. All statements have been investigated and gone through a brief categorization analysis, by grouping statements that can be interpreted in the same direction according to explanatory positions. The selected extracts focus on statements that the investigators found important in their relation to intuition in criminal investigation. A consequence is that the cases referred to mainly describe situations where the hunch is described as an unexplainable reason for the overall purpose of using intuition, namely *success*, and not vice versa. None of the investigators gave any good examples of situations where they followed a hunch which did *not* result in anything, and that maybe was a waste of time.

Some additional material is used as input to this motive analysis. To support some of the reflections in this article, a few statements from other sources supplement the statements in the interviews; statements that investigator 1 has given to news papers and in books.

Procedure and the Question of How to Reproduce/Generalize

The qualitative interviews were chosen to dive into the investigators' own discursive relation to intuitive feelings through the investigation process. As stated by Kvale: '*The qualitative research interview attempts to understand the world from the subjects' point of view*' (Kvale 1996).The goal was to see intuition through the criminal investigators' ways of speaking, and thereby try to expose their attitudes through the language. Other qualitative methods, for instance observation, did not seem to be a suitable method for this purpose, except for a later comparative study to see how their attitudes were exposed in real life. Quantitative methods did not seem to be suitable for this purpose either, because the

goal never was to get objective answers through statistical evidence, or to state some new truths.

The nature of qualitative interviews (and the analysis of them) will always depend on the researcher who performs them. Kvale uses the metaphor 'traveler' on the role of the interviewer, seeing the interviewer wandering in different landscapes having conversations with different people in different countries (Kvale, 1996). Interviewers meet different experiences and maybe focus on different extracts in the interviews, or interpret the extracts differently. The discussion in this investigation should therefore be taken for what it is; a traveler's report of experiences after having conversations with criminal investigators. However, the use of the motive analysis method limits the subjectivity of the work, by guiding the researcher in examining the statements, providing a set of interpretation glasses: Every statement of the interviews should be examined to see how the investigator talked about intuition. The researcher should ask the following questions when examining each statement: Did the subject talk about intuition as a scene, as an agent, a means, a purpose or as an act? The researcher should go through each statement in all of the interviews using this procedure. This methodological procedure could be reproduced by any researcher who uses motive analysis as a tool. It can be argued that if different researchers went through this procedure on the same set of data it would lead the interpretation in the same direction.

Reproduction or generalization of the findings is not the primary goal of the study. Using the motive analysis as a tool in analyzing the interviews does not change this fact, but introduces an element of methodological reproducibility which can guide similar future studies. It might therefore be argued that this examination is not purely subjective, but have methodological elements that can be reproduced. The guiding questions in the interviews in the data gathering phase strengthen this view.

RESULTS FROM THE MOTIVE ANALYSIS: WHAT EXPLANATORY POSITIONS DID THE CRIMINAL INVESTIGATORS TAKE?

The Mediating Means/Actor Ratio

When taking the explanatory position of the mediating means/actor ratio, intuition is seen as a tool supporting the investigator in solving a crime. In this perspective not only the intuition (the mediating means) is important but also the investigator's (actors) way of using the tool. Intuition is seen as an important tool that mediates different actions performed during the investigation to an extent that corresponds with how well the investigators develop it. The actor (investigator) is given a responsibility of the usefulness of the tool (intuition), by being viewed as in control of how it is developed. Extract 1 illustrates this:

So, intuition as a tool in crime investigation it is… very relevant. Without any doubt. And it is used a lot, consciously and sub-consciously. I am conscious about it. And I have used it without consciousness. Up to when I realized that this is an important tool, and then I started to make it conscious. And then I can develop it more as a tool... And very good to be conscious about this, and that it is put on the agenda. Because it is a tool, unfortunately because of all of the technology and large amounts of information and methodology, manuscripts, quality insurance systems, deviation registration, you name it. Evaluations. Which cause intuition to my opinion to be more and more distant. Which I believe is a very big loss for criminal investigators and of course for anyone else who uses it in their profession. (Investigator 1)

Investigator 1 also reveals a pure mediating means perspective, by considering intuition as a tool whether it is used consciously or unconsciously. But the investigator's (actor) value of

intuition depends on a personal choice between developing it or not. Investigator 1 states that he started developing his intuition after first had been using it unconsciously. At some point he realized that intuition could be an important tool, and starts to develop it and treat it as one. In that perspective he goes back in time and tries to explain his own historical body relevant to intuition, splitting it into phases. He not only talks about intuition as a mediating means, but is also *grading its value* by the level of consciousness of the investigator. He uses himself as an example, telling his own story of how his relationship to intuition developed from being a sub-conscious tool to be a more concrete tool

The Actor/Action/Scene Ratio

The actor/action/scene ratio perspective moves the focus away from the mediating tool in favor of the actors themselves, triggered by a certain action and/or scene. Intuition may be talked about as a specific kind of knowledge that a person possesses, and that the investigator (the actor) has a more important role. A more actor related perspective is expressed in extract 2:

That is part of the definition of intuition; to know without knowing that you know. That is – you know something without knowing why you know it, but still you know it! (Investigator 1).

The way investigator 1 talks about intuition corresponds to the psychological view of intuition (as described earlier in this article), as unconscious knowledge and knowledge that you do not know the reason for having, as an unconscious part of the social actor, a non-verbal part of the brain, and that intuition is what happens when one is able to communicate with it.

The perspective is shifted to an even stronger focus on the actor's role when the subjects talk about the ability as a skill that could be trained, similar to what is called autogenously training on the sports arena. Intuition is explained and talked about from the social actor's point of view, giving them a responsibility for practicing and trusting it. A social actor can use intuition in different ways, and have the choice to train it. Extract 3 exemplifies a strong actor focus:

And the more you do this, the more you practice this ability. And the more you trust it to really exist, and give you correct 'hunches', the more it will turn into a tool. (Investigator 1).

In this case he talks about the social actor as being anyone, by using the general term 'you'. By generalizing in this way, the investigator seems to take a kind of a 'hunch coach' position', advising others as to how they should relate to intuition. He indicates that he believes intuition can be practiced and developed into a personal ability, and that anyone can develop this ability. Also, by using the formulation 'you', he removes the focus from his own person. By impersonalizing, he states that the use of intuition in criminal investigation is not something that is particularly connected to himself, and thereby harmless for his integrity.

The actor perspective is strengthened further when the element of 'talent' is related to intuition. Talent is normally a highly individual phenomenon which is strictly connected to and belonged of a specific person, and is often one of the explanations to success stories. In an interview (extract 4) investigator 1 expresses how talent can play a role in using the intuition:

Intuition can be developed. Intuition is totally conclusive, and is highly underestimated. A musician without the ability to create and improvise might become a good violinist in the Norwegian Broadcast Orchestra, but hardly a good composer. (Investigator 1)

By using this musician-metaphor investigator 1 gives association to *talent*, as great composers often are considered as being born natural ge-

niuses. Indirectly, investigator 1 seems to explain the difference between a good detective and an extraordinary detective with the intuition element. In Extract 5, investigator 1 views himself as the social actor, who seems to have some talent, or have trained himself in using intuition (extract 5):

I seldom miss. This may seem a bit bragging, but... It might not be correct to say it like that, but if I should make myself conscious, and evaluate afterwards, then it is very seldom that I miss the most important, namely to follow the right track. (Investigator 1).

In Extract 1-4, investigator 1 has either used himself as a general example or the general term 'you' to illustrate his point. He continues by talking about qualities that seem to be special is his own way of using intuition, and thereby exposing himself for critics. That he 'seldom misses' may be viewed as a self defending argumentation. Since the use of intuition to his opinion seems so effective and useful in the respect of achieving the preferred goal, a continuing use of intuition can be justified. In other words, the way he has developed his way of using intuition gives him a special competence in the process of solving a crime. Investigator 1's explanatory position may here be characterized as an agent-act ratio. As Burke states: "An agent-act ratio would reflect correspondence between a man's character and the character of his behavior" (Burke in Foss, Foss and Trapp, 2004). The agent is investigator 1 himself, being the actor using intuition, and the act is in this case 'to follow the right track'.

By introducing the scene in the explanatory position, intuition is related to a concrete situation or part of the environment. While taking this perspective, situations, environment, and other elements outside the actors themselves are given roles in the use of intuition. Having a purpose for using intuition could be seen as an attempt to legitimate its use, by giving a reasonable explanation. Extract 5 introduces the scene (the track) combined with the purpose (to follow the right tracks), imaged by pictures from the nature. The investigators reveals an underlying purpose with using intuition, namely not to waste time and resources on unnecessary activities. Another technical investigator also explains intuition from the scene's point of view, extract 6:

It [the intuitive feeling] often occurs as a result of information you get, or visual information on the crime scene. (Investigator 2).

'*Information you get*' (the scene) refers to received tips or other information received from witnesses etc. related to the case. While arguing that gut feeling often is triggered as a result of received information, investigator 2's explanatory position can be interpreted to giving the scene (information, environment, observation etc.) a part of the responsibility for triggering the hunch.

Intuition as an Actor Itself

By talking about intuition as being an actor in it self (the actor perspective) responsibility is given to something outside their control. This explanatory position is often revealed by giving intuition (or hunch, gut feeling etc.) the subject's role in the sentence, a subject that can perform human activities like speaking etc. Investigator 3 exemplifies how his gut feeling was conclusive for where the search was started (extract 7):

... and then it might be a bit coincidental that the gut feeling tells you to start a search right there. I have the strongest belief on that particular area, but if it is intuition or builds on experience... (Investigator 3).

In larger geographic areas, it is not possible to examine in a detailed extent. In that case there will be an issue of prioritizing where to do a search. This is also a fight against the clock, since evidences could be ruined over time. It may be of

vital interest for the investigation to decide what area the search should start in. In this decision process, the hunches may be conclusive. Investigator 3 questions whether these hunches are based on intuition or experience, and he talks about his decision as being mediated by some means outside himself. The investigator positions himself as not being fully responsible for his decision – another actor, the intuition, is made subject for the decision and given full responsibility. Intuition as an actor thereby form his point of view in his argumentation, and from the perspective of how he talks about intuition, it's a scene. This may be seen as an actor /scene/ action perspective, because the scene (the search area) triggered the actor (the gut feeling) to act ('tell' him where to start the search).

Another case in which investigators talk about intuition as being used as an actor is when they need to prioritize which tip to follow up. Tactical investigators do in many cases receive extremely many tips from the audience. It is not possible to follow up all these tips, as investigators are restricted by limited resources and time. Therefore, it is of vital interest which tips are prioritized. As for technical investigators, evidences may be ruined if not followed up at the right moment. A tactical criminal investigator (Investigator 4) puts it this way (extract 8):

In one specific case we got a tip that I reacted to, because I felt that the tip said something to me, …… Maybe it was because it [the tip] was so special, so unlikely possible. And the tip could very easily have been put away, as a… Because we always get a lot of tips in cases with this kind of media focus. So we get all kind of strange tips. And very many of them we just put away.(Investigator 4).

Investigator 4 talks about how he took an interest in a tip that would normally not have been followed up. The tip is subject in the sentence (actor), having the ability to act (speak). The tip seemed extremely unlikely to be true, and it seemed like a bad prioritization to use resources on following up this tip. However, there was something, not explainable, that caught the investigator's attention. He did not know what it was, but the hunch was so strong that he took an interest in it anyway, it caught his attention. All these things (tips, scenes, people) are present for the criminal investigator as potential triggers to choose what to do next, but before that they have to orient their attention to a specific tip/scene/piece of discourse (by a witness) etc.

The result was, in this case, that following up this tip led to the solution of the case.

In the investigator 3's case (…"*the gut feeling tells you where to start a search*"…(Extract 7)), the gut feeling is made an independent actor, that actually did speak and advice. This could be seen as a way to separate him self from the decision made, with the potential result that if the search showed no results, the gut feeling was to blame, not his own rational reasoning. The statement seemed to be a way to underline the fact that the investigator did not use rational reasoning to decide where to start the search. Another actor (the gut feeling) told him where to start the search, and therefore he did not have to give any rational reason for choosing this particular starting point. If he explained why he started the search at that particular place as his own decision (for instance: "I believed that the search should be started…"), he could also be obliged to give a rational explanation for *why* he believed so. By referring to the gut feeling as an actor on its own, the explanation responsibility is removed from the investigator as a rational individual.

In investigator 4's case *(…"The tip said something to me…"* (Extract 8)), the *tip* is talked about as an actor that actually spoke. He did not formulate it to that 'he himself interpreted the tip this specific way'. By giving the tip human abilities (to speak), the tip is made an actor that can speak, and thereby seems to be able to act of free will, and, even more importantly, with unquestionable authority. The investigators' own interpretation that takes place in any case, is put

in the background, while focus is placed on the tip. The shift of focus relieves the investigator from the demand of explication; it wasn't the investigator who interpreted the tip, it was the tip that spoke to him. The way he talks about the tip, makes the tip seem more objective as if it could not been misunderstood. Two interesting views seem to emerge from these statements. First, the 'immediate' nature of 'intuition' is put into words by talking about 'the tip talking'. It seems obvious that it's the 'intuition' (the ability to perceive stuff unconsciously) that 'makes the tip talk', but for the investigator it is the tip itself. Secondly, its 'interpretation' *in this specific case*, namely of *what does this tip 'say'* is talked about as unproblematic, even though indeterminate –"*said something to me*". This illustrates how the 'immediate' or 'self-evident' nature of the 'hunch' is emphasized, by expressing the reaction to the tip.

Using Intuition Because of a Purpose

Some of the informants indicate different ways in which intuition can be a mediating tool, positioning their explanation of intuition by its purpose. They justify their use of intuition by focusing on the purpose, which they consider to be important in criminal investigation. The most mentioned purpose is a tool for decision support. Several of the criminal investigators view intuition as a useful mediating means when it comes to prioritizing. As for other occupations, criminal investigation may be restricted by limited resources and time. The interviews indicate that hunches, or sudden intuitive feelings, often play an important mediating part of the decision making in the criminal investigation. This is particularly evident when it comes to which tip to follow up, where to start a search etc. One experienced investigator, argues that intuition or gut feeling can be a factor in prioritizing the resources (extract 9):

...this I trust is right, or this I trust is wrong. So then I put it away. I cannot spend resources on in it, so I just have to leave it. You can do that. And then the gut feeling, or the intuition is a factor in deciding how you spend your resources... (Investigator 5).

Extract 9 gives more evidence as for the 'immediacy' or 'unquestionability' of these hunches (or, that they are talked about as helping sort out trajectories of action).

Investigator 1 also lets the purpose be the explanatory position when talking about intuition (extract 10):

...To choose the right track... If I miss there, I burn the clients' money or the resources I have got. On nothing. And there I mean, same as other people I have been talking to, that intuition really is an important tool for me. (Investigator 1).

Investigator 1 argues that using a well developed intuition can help him save money and resources. Since he is working in private sector, money and other resources may seem more limited than when he worked for the police. The purpose seems to be investigator 1's discursive motivation here, by expressing the goal to limit the clients' money and other resources. If the intuition give the right hunches, the whole investigation process could be more efficient. By pointing out this purpose, he also strengthens the position of intuition as a mediating tool.

DISCUSSION

The Criminal Investigators' Perspectives on Intuition from the Motive Analysis

According to the analysis above, the criminal investigators give themselves different roles while talking about intuition. They talk about intuition from different explanatory positions, giving themselves more or less responsibility of what

happens when an intuitive feeling occurs. Some of the investigators talk about intuition as an actor in itself, and thereby relieve themselves from the responsibility of giving a rational explanation. The gut feeling told them where to start the search, it was not the result of a conscious reasoning process. If the search showed no results, the gut feeling was to blame, not the intellectual capacity of the criminal investigator. Investigator 1 talked about intuition from different explanatory positions; as a mediating means, as an actor in itself and by referring to its' purpose. By explaining intuition from its purpose, an effort to justify the use of intuition is made. If the purpose makes sense, that would be an argument in favor of using intuition.

Since most of the criminal investigators have relatively similar backgrounds, and work in the same environment, there has to be some additional reason for the different approaches they take while talking about intuition. One reason could be found in the investigators own personalities, for instance how much responsibility the investigators are willing to take for their own decisions. This could be illustrated for instance by the investigators who talked about intuition as an actor itself ("*the gut feeling tells you were to start a search..."(Extract 7), "the tip said something to me…" (Extract 8))*. By talking about the gut feeling and tip as independent actors, the focus and thereby the responsibility for the decision seems to be moved away from the investigators own person. The technical investigator who started the search where the gut feeling told him to (investigator 3), had the option of taking several other explanatory positions that would give himself more focus and more responsibility. One alternative to move responsibility closer to him self, was to formulate *ownership* to the decision by saying "*my* gut feeling", instead of "*the* gut feeling". In this alternative the gut feeling is still an independent actor, but it is owned by him self. The ownership would have been even stronger if the formulation was for instance *"suddenly I felt where I should start the search"*. This formulation sounds maybe a bit unprofessional, by basing a decision on private feelings. The full responsibility would be put on him self, no other actors are involved and he has no other arguments than what he felt. In that case investigator 3 is taking the explanatory position of an actor/action/scene ratio, with him self being the actor. The actor/action/scene ratio would be even stronger if investigator 3 had formulated his statement for instance: "*Because of how the area appeared, and my previous knowledge and experience in conducting searches, I immediately knew where to start the search*". In this case he would have taken the full responsibility for his decision, and even tried to explain why. By formulating the statement this way, investigator 3 would have appeared more self confident, but he would also put himself in a position where he would be more exposed for critical remarks.

In the same way the tactical investigator who followed the tip that *said something to him (investigator 4),* moves the focus and responsibility away from his own person. In this case, following up the tip led to a solution of the criminal case. Following up other tips may be a waste of time and resources. By giving the tip human abilities (to talk), the tip is made an actor of its own and therefore given the responsibility. In case of a wrong leading tip, it would be the tip that said something wrong. Investigator 4 could have taken other explanatory positions that would relate the decision of following up the tip more closely to him self. He could for instance have taken the actor/scene/action ratio, by saying: *"the way I interpreted the tip…"*.In that case it would be investigator 4's own interpretation that was conclusive for following up the tip. If the tip led nowhere, he would be in a position to be blamed. He could also formulate the statement in a more arguing way: *"Because of my long experience with this kind of tip; I knew immediately that this tip must be followed up"*. In this case he would position himself as an actor, arguing that his intuitive feelings could be right because of his experience. Again, this statement would make the investigator

4 appear self confident, but he would to a larger extent be exposed for critics.

The actor's explanatory position may also be a sign of modesty – to put less focus on their own special talent for criminal investigation. Instead of crediting themselves with the 'victories' of successful intuition histories, investigator 3 and investigator 4 credit other actors ('the tip', 'the gut feeling'). They are just doing the job, to solve the crime case. And if the tip says something, or the gut feeling says something, they have to listen. This argumentation somehow seems to be fitting into the traditional Norwegian culture, where on might argue that bragging is considered to be a negative thing. Statements like where investigator 1 argues that his intuition mostly is right (*"I seldom miss. This may seem a bit bragging, but… "(Extract 5))* seems to be quite rare in Norwegian settings. Even investigator 1 tries to avoid giving the impression of being a person who thinks too well of himself, and brags about it.

Motive Analysis and Requirements

The different explanatory positions the investigators took could give valuable input in designing for intuition in computer based systems for criminal investigation. The way criminal investigators view intuition could indicate how intuition should be visualized and presented in their systems. For example, should the 'hunch' be depicted differently if it has to do with tips (or witness statements) or scenes? Or is it the case that all hunches (whether to do with the scene, other people, or traces, or tips, or...) should be represented as an *attention* that makes certain action spaces (where to look/ go next) more palpable than others?

The first phase in designing user interfaces is normally to perform a requirement analysis in order to achieve the best usability possible of the new system (Rogers, Sharp and Preece (2007); Dix, Finlay, Beale (2004), Mayhem (1999) etc). This requirement phase includes several activities, like analyzing user profiles and -tasks, and identifying platform capabilities and constraints. When analyzing user profiles, one of the goals is to identify specific characteristics of the actual user population. One of the techniques in order to gain insight in the users' world is depth interviews. These interviews should be analyzed to extract the system requirements and the usability goals. How the analysis should be performed is paid little attention in human computer interaction theory.

This study is an attempt to use a motive analysis while analyzing material gathered in the requirement phase. The motive analysis is used as a tool to reveal the investigators own thoughts, by focusing on how they talk about intuition. The result of the analysis is to identify indications that can point to a certain way of designing. The motive analysis seeks to reveal the mental models of the investigators, and could therefore give valuable input in the process of designing for intuition.

Usability factors in systems for criminal investigators will be improved if the system reflects the users' mental models (Rogers, Sharp and Preece (2007)). If intuition is introduced in a way that corresponds to the way users think of it, an improvement is made by making the systems more self-explanatory, and thereby easier to use. The experience in this study shows that motive analysis seems to go deeper into uncovering how criminal investigators view intuition, and thereby deeper into the requirements. It may be argued that requirements identified through a motive analysis will match the criminal investigators mental models better than other requirement analysis methods, for instance a task analysis.

The motive analysis in this study shows a general acceptance of the importance of designing for intuition. All of the investigators in the study recognize the concept of intuition, and confirm that they use intuition one way or another during the investigation process. The first assumption; that designing for intuition could be useful, therefore seems to be confirmed by all of the investigators. All the investigators were asked directly what they thought about documenting intuitive feelings or

hunches. All of them indicated that it could be a good idea to document these hunches, so that they could be shared among the investigators. This is vital for the continuing study, because it indicates that implementing intuition in systems for criminal investigation seems to be useful.

Perspectives, Requirements and Implications for Design

Imagine criminal investigators that are constantly alerted and updated on their collegues' hunches. Imagine that investigators are able to save information about the intuitive feelings they experience directly at the crime scene, and that the geographical position where the hunch occurred is accompanying it. Imagine criminal investigators who can ask a system for a reasonable explanation for an experienced hunch. Imagine criminal investigators that are able to make usage of their own and others' hunches in the process of solving a crime. On this stage, such scenarios are speculations, because it is not possible to evaluate the usefulness of a technological intuition tool before it has been tried out in real life. However, the implications below as to how an intuition system could be designed have emerged according to the previous conducted motive analysis.

The Scene Perspective

While arguing that intuition is triggered by the scene, the investigators indicate that there is a need to document their hunches not only in their office, but for instance at the crime scene, during a witness interview etc. The design should be ubiquitous, in the sense that the system is available whenever a hunch occurs.

From the scene perspective, the *immediate* nature of intuition is reflected. An intuitive feeling is something that can be triggered in different situations during the crime investigation process, always appearing suddenly. This indicates the requirement that the tool should be accessible from different geographical positions, and therefore function under different weather conditions. Implications for the technological concept is that the intuition tool should be running on a mobile device and that it should be waterproof, see Table 1. The scene of a crime could be anywhere, and happen any time, therefore it should be built to work under for instance strong heat or coldness, at locations that are muddy, sandy etc. Another implication of the scene perspective for technology is that the intuition tool should have some kind of positioning feature. The geographical position should be saved at the spot the hunch occurred, and the alert of hunches should happen where they were saved.

The Agent Perspective

The investigators who take the *mediating means/ actor ratio* as an explanatory position view intuition as a tool, but that their own role also is important. The corresponding user would probably accept functionality for saving and browsing etc. of intuitive feelings, because of its mediating role in the criminal investigation process. They would value their own contribution, by using the system in their own way, not trusting the technology blindly. In order to meet the conceptual model for these users, the system should be designed in a way where it could mediate different working activities and routines. These investigators seem to have strong opinions about hunches and their use in criminal investigation, and therefore they seem to have a strong and individual relation to their work. It is important that the system is open and flexible, not forcing the investigator to use it in one specific way, matching one particular type of work routines. It is important to facilitate independent and initiative taking users by letting them in charge of the system. In practical an object oriented (modeled around objects) user interface design would be preferred over a task driven (wizard, based on transactions) approach. An additional feature could be that the system

Table 1. Over view of the relation between perspectives, requirements and implications for technology

Perspective in motive analysis	Requirement	Implication for technology
Scene (Intuition could be triggered by a scene)	The tool should be accessible at different geographical locations	Mobile device AR technology etc.
	The tool should function in all weather types	Water proof Not sensitive to warm or cold temperatures.
	The tool should function in different geographical areas	Not sensitive to sand, mud etc.
	The geographical position should be saved at the spot the hunch occurred, and the alert of hunches should happen at the geographical spot they were saved.	A geographical positioning feature (GPS, RFID etc.)
Agent (The actor has a major role in using intuition)	The tool should be designed for different types of users	Flexible user interface
	The tool should be designed for independent users	Object driven user interface
	The tool should be designed for users who need guidance	Task driven user interface (wizard)
Means (Intuition is a mediating means)	The tool should mediate the sharing of hunches	It should be possible to save information about an intuitive feeling
	The tool should mediate the alerting of hunches	The tool should alert of previous saved intuitive feeling through sound, light, 3D objects or other.
	Based on information about the crime scene and other knowledge, the system should suggest alternative reasons for a hunch to occur.	It should be possible to save information about the crime scene, and to receive suggested reasons.
Purpose (Intuition is used for a purpose)	User interface should be efficient	Main functionality should be fronted in the user interface Minimalistic user interface without unnecessary elements

follows the investigators development of their intuition, by for instance offering more and more advanced functionality.

On the contrary, investigators who explain intuition as being an *actor* itself might be more comfortable with a more wizard-like system, where the users are led through all necessary steps in a task. These users talk about intuition as having almost human abilities like speaking, and they talk about intuition as being an actor in it self. Therefore it might be expected that these investigators as users would require more initiative from the system, for instance like in a task-driven user interface.

Since the criminal investigators in this study view their own use of intuition differently from each other, the technological concept should be targeting at fitting all users. The system should be designed as flexible as possible in order to meet the different users' mental models. However, it seems like most of the mentioned design implications can be combined, for instance by having a mobile system where hunches can be added both in a task driven and an object driven way and relating the hunches to specific tasks

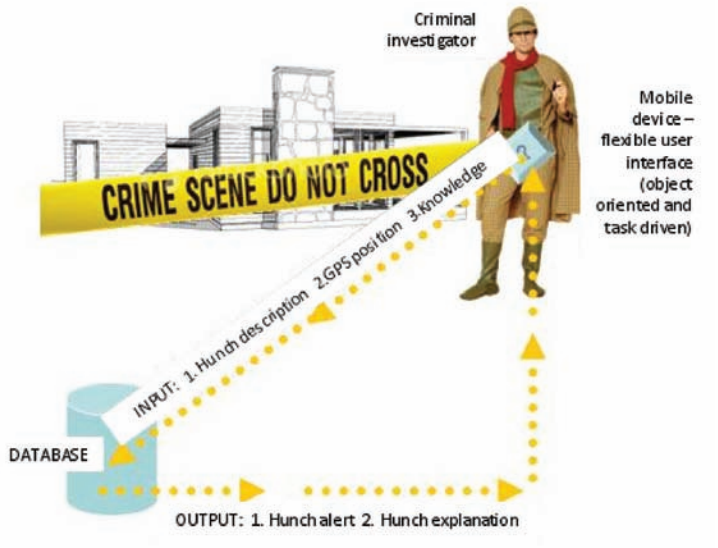
The Means Perspective

While analyzing the gathered data, further design implications are also identified by the fact that some of the investigators' view intuition as a tool, a mediating means. Intuitive feelings, or hunches, could therefore be documented in the system as a helping tool for the investigators. The investigation process is complicated, and the system should offer the functionality of mediating keeping track of all information that could be relevant for a case. Since intuitive feelings or hunches are judged to be an important factor in crime investigation, they should be documented in the system too. To accomplish this seemingly important factor, intuitive feelings could be shared between investigators and maybe lead to concrete evidences, for instance by checking out tips, performing searches etc. Intuitive feelings or hunches would in that respect be treated as other uncertain information that could be of interest in the case. If one investigator got access to other investigators' intuitive feelings, the individual private ability would be made a social phenomenon, which maybe would lead to new hunches.

This motive analysis gives implications for design of new technology for entering hunches into systems for criminal investigation, both when it comes to the concept of the system, and the concrete user interface. The psychological view that intuition is a summary function and the Bergsonian philosophical view that intuition is a long term memory function implies the need for dealing with large amounts of data. Both views argue that intuition supports decision making with basis in information that is too complex for the human to handle consciously. However, the number of hunches, which are documented during a specific case, might not be so extreme. It is important to note that it is only the hunches that are documented, and not all the unconscious knowledge and the processing that caused the intuitive feelings. This silent knowledge, based on criminal investigators' experience, remains private for each investigator. The results of using this silent knowledge are more easily shared than the knowledge itself, which may have been gathered through years of experience as criminal investigator. But a system designed for intuition could also be conceptualized as a memory device, a system that helps the investigators remembering what has been found out. This would give many implications when it comes to dealing with large amounts of data in order to support decision making. While humans' short term memory capacity is limited, the computer is able to handle a large amount of data while making decisions, and therefore be able to support the investigators' intuition. A memory device could transform an intuitive decision to a rational explanation. Such a device could go the opposite way; from the hunch to the knowledge that lay behind. An investigator could "feed" the memory device with a hunch, expecting a rational explanation in return from the machine. A scenario could be the criminal investigator who experiences a sudden intuitive feeling at a crime scene. She enters a description of the hunch into the intuition system, and also several different observations at the crime scene. In return she gets a suggested explanation for the hunch, and also several proposals as to which steps that should be taken and which direction the investigation should take.

These implications for the knowledge base is reflected in Figure 1, which shows a concept for new technology for facilitating the use of hunches in criminal investigation. Input to the database is the investigators' descriptions of their intuitive feelings (hunches), and also observations made at the crime scene and other knowledge. Output is alerts that inform about other investigators' hunches at that certain geographical position. Another output can be suggestions to explanations of new hunches based on knowledge in the database.

Figure 1. A technological concept for facilitating the use of hunches in criminal investigation



The Purpose Perspective

Some of the investigators explained intuition from its *purpose,* for instance saving money and saving time. For design of technology, this explanatory position imply that the ability to add or browse a hunch should be positioned close to the tasks that otherwise mediates the decision making in the system, for instance where to start a search, what tip to follow up etc. The users should be facilitated in performing their tasks easily without being able to struggle with the system. Main functionality should be fronting the user interface, encouraging the users to make the most out of the system. Also the user interface should be minimalistic, avoiding disturbing elements competing for the criminal investigator's attention.

Other Implications

Another design implication that may be implied from this study, gives input to the way intuition should be visualized or depicted. The attentive nature of intuitive feelings or hunches also appears in this study. A pre-assumption of the value of intuitive feelings or hunches is that *attention* is paid to them. If intuitive feelings or hunches should be presented through a symbol, it should reflect these two elements; immediateness and attention

The analysis suggested that attention and immediacy are two elements that could characterize intuition. The two elements seem to have implication for the design of the system, and for the user interface design in particular. The user interface objects that represent intuitive feelings should indicate both extra awareness, and that the extra awareness is due to a sudden intuitive feeling from an investigator. One of the main goals for collecting and saving intuitive feelings is that they should be shared between the investigators. The hunches therefore need to be visualized (or otherwise exposed) in a way that attracts the investigators' attention. The hunches must be distinguished from other data in the system, like for instance uncertain information, witness statements etc. The immediacy should also be represented as a part of the intuition depiction by creating a symbol for intuition that gives association to speed. The immediateness is reflected in Figure 1 by facilitating the entering of hunches through

a mobile device. The investigators do not have to go back to their office to enter information about a hunch; the hunch could be entered at the spot where it occurred. The device should automatically save the GPS position in relation to where the intuitive feeling occurred. Attention is supported in Figure 1, by alerting criminal investigators of existing hunches that previously have been entered at current geographical position..

Using Technology for Intuition

By implementing functionality for entering intuitive feelings into systems for criminal investigation, investigators are given the option of sharing their hunches with other investigators. A scenario could be as follows: On a crime scene, an investigator gets a strong intuitive feeling that there is something strange with the way the furniture is positioned. The investigator cannot give a rational explanation for why this positioning is strange, but her hunch is that this is of importance for the case. On the crime scene, the investigator describes her hunch, and enters it into the shared database in the computer based system for criminal investigation. A few days after another criminal investigator is alerted of this hunch when standing on the same geographical position. The alert makes the second investigator extra aware and paying extra attention to the furniture's positioning. A new hunch occurs, the second investigator realizes what significance the positioning of the furniture has, and thereby contributes to solving the case.

The above scenario illustrates the main point in designing technology for intuition – namely to let the intuitive feelings leave the private sphere, in order to be a social phenomenon shared by fellow investigators. Sharing hunches could bring extra awareness to situations/tip/statements etc. in the investigation process that otherwise might have been ignored.

New technology could be introduced in designing for intuition – for instance augmented reality technology (AR). Criminal investigators could be encouraged to place visual markers at spots of particular interest (intuition triggered) at the crime scene. When seen through a head mounted display (HMD) with a camera attached, the visual intuition markers could give information (visual, auditable, as text etc.) about a hunch. The following scenario illustrates the use of AR mediated intuition technology. An investigator entering a crime scene quite late in the process, several days after the crime had been committed. Other investigators already have been at the site, placing their own intuition markers at spots of interest. The 'new' investigator put on the HMD, and when looking at the visual markers, information about the hunches is superimposed mixed with the normal reality. The investigator received information about other investigators' hunches directly at the site, not having to go back to the office. AR technology also offers a unique possibility to superimpose removed objects (for instance a corpse, blood etc.) mixed with the physical environment at a crime scene.

Even though the option for sharing hunches had existed, there is no guarantee that it will be used. Some investigators would probably reject documenting their intuitive feelings for different reasons. It could be argued that only solid, objective information should be shared, for the sake of the legal security of the citizens. However, *uncertain* information, which is already documented in the criminal investigation systems, can be compared to intuitive feelings. Both are types of information that should be checked out in order to transform into certain (confirmed) information. Uncertain information or intuitive feelings will never be of the character to be presented as evidence in court, only if it leads to objective findings. Other investigators might also reject documenting their intuitive feelings, because of their private character. The criminal investigators' personality, their training and the environmental acceptance for documenting intuitive feelings could be conclusive for the number of documented hunches. As argued earlier, the criminal investi-

gators' feeling of modesty, and unwillingness to brag, might be one of the factors that can relate to the how willing they are to share their intuitive feelings. The modesty-factor should therefore be taken into account when designing for intuition.

CONCLUSION

In this study, a motive analysis was performed in order to investigate this new technique in the first phase of designing technology facilitating the use of intuition in criminal investigation. The purpose was to go deeper into the criminal investigators' mental models, in order to identify suitable requirements for technology for intuition. The study gave valuable input to how motive analysis could be used, by resulting in a proposed concept for intuitive feelings in computer based systems for criminal investigation.

Eight criminal investigators were interviewed to see which explanatory position they took while reflecting of the role sudden intuitive feelings have in the investigation process. The interviews showed that the relationship to intuition seemed to differ from investigator to investigator. Some of the investigators talk about intuition as an actor itself, and others talk about intuition as a mediating means that contribute in the criminal investigation process. Intuition is also talked about as a part of the actor, themselves. Several of the investigators combined explanatory positions, the actor/action/scene ratio. Some investigators talked about intuition while referring to its purpose; to support decision making during the crime investigation. It is discussed whether the criminal investigator's own personality is conclusive for what explanatory position they take. Willingness to take responsibility for their own decisions is suggested as one reason. Another explanation that lays in the investigators' own personality could be *modesty*, the unwillingness to focusing too much at taking credit for their work.

It is argued that though the criminal investigators take different perspectives while talking about intuition, the analysis gives valuable input to a technological concept for an investigation system that facilitates the use of intuition. The motive analysis seemed to be a suitable technique in the first design phase, by going deep into uncovering and identifying requirements to systems for criminal investigation. The motive analysis confirms the basic assumption behind this study; that criminal investigators believe it would make sense to document and share intuitive feelings. The motive analysis also gives valuable input when it comes to a future depiction or symbol of intuitive feelings. According to the criminal investigators view, a visualization of intuitive feeling should represent the two elements *immediateness* and *attention*. The study also seems to imply that when designing for intuition, both a task-driven and an object-oriented user interface design approach should be taken.

A technological concept for a new computerized system that reflects the requirements emerged from the motive analysis is proposed. Input to the system is description of hunches (intuitive feelings) with GPS position and related knowledge in general. Output is alerts of previous hunches and also suggestions of explanations for a hunch. The ability to enter and being alerted of, the hunches at the spot they occur (through a mobile device) reflect the requirement of immediateness and attention. Augmented reality seems to be a suitable technology to implementing an intuition system, because of its flexibility, and ability to trigger and superimpose information directly at the crime scene.

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Chapter 16
Designing Ubiquitous Content for Daily Lifestyle

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ABSTRACT

This article presents a design theory for an emerging genre in digital content called Ubiquitous Contents. To design entertaining experience, the article introduces the design concept of the Experience Chain. Examples are shown to illustrate how people, artifacts, and environment can be seamlessly connected to design emotional and entertaining experiences through the interaction.

INTRODUCTION

"Content" is often viewed as an artistic expression delivered to the audience on mass media. Typical genres of existing contents include movies, animation, comics, games and music. However, contents cover a much wider area, including those that rely on personal media instead of mass media. In this 21st century world where information technologies like Internet and Ambient Intelligence develop as infrastructures of society, contents that utilize such technologies are sought after.

Ubiquitous contents are contents for living people, those which bond closely with daily life. They are contents experienced through interaction between people, artifacts and the environment, all existing in the real world connected by networks. Ubiquitous contents are emerging genre of contents, which become realized through the embedding of Ambient Intelligence, in particular ubiquitous technology with sensors and actuators.

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This article presents the design theory for Ubiquitous Contents with emotional and entertaining experiences.

RELATED WORKS

Weiser opened the door of the research activities to make computers invisible and embed them into everyday life (Weiser, 1991). Vasilakos and Pedrycz (2006) describe that people will be surrounded by networks of embedded smart artifacts in the ambient intelligence environment. In order to create this ambient intelligent environment, it is important to give equal importance on product design and interaction design in addition to the ubiquitous technology research because end users see value in the "looks and feel" of the artifacts. At MIT Media Lab, researches on tangible interfaces and ambient displays stimulated the community to integrate computing technology with the aesthetic aspect of design (Ishii, Mazalek, & Lee, 1997).

"Music Bottle" proposed an interesting mixture of product design, tangible interaction design, and pervasive computing that completely hided the technology (Ishii, Mazalek, & Lee, Gottles as a Minimal Interface to Access Digital Information, 2001). Each musical instrument is controlled by the bottle. When the bottle is placed on the table and the bottle cap is removed, this interaction triggers the instrument to start playing. By placing multiple bottles, the ensemble can be performed. The tangible interaction is a natural interface between people and the computing system that allows smart artifacts to be used in the everyday environment.

Numerous research projects from the international community were published on the topic of smart artifacts and environment (Aarts, 2003; Streitz, Rocker, Trante, van Alphen, Stenzel, & Magerkurth, 2005). "Mediacups" is a coffee cup that knows if the cup is filled or empty (Beigl, Gellersen, & Schmidt, 2001). This type of artifacts is called smart artifacts. In "Hello.Wall", the wall acts as an ambient display, but it is smart to understand if a particular person is within the range to provide personal information (Prante, et al., 2003). "ComWalls" are a set of illuminating wall devices that are connected by the network (Tokuhisa & Inakage, 2006). They act as ambient displays that allow tangible interactions with the users.

It is important to theorize smart artifacts and environments in the context of experience design and interaction design. Dourish (2001) emphasizes the importance of physical action and interaction, McCullough (2004) extended the theory to the relationship of people, place and pervasive computing. Shredroff (2001) claims the importance of experience and discusses the elements to create a memorable experience.

DESIGN THEORY FOR UBIQUITOUS CONTENTS

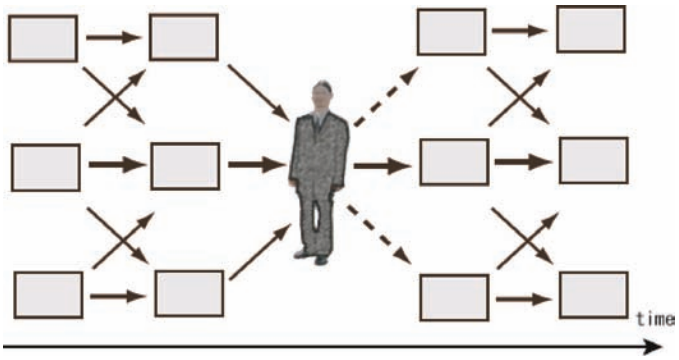
The Experience Chain

In our daily life, we accumulate experiences through interaction with artifacts surrounding us, environment that we immerse in, and communication with people and living bodies such as pets and plants. All of the activities contribute to building one's experience. As the result, we actuate the experience as some kind of expression through embodiment. This actuation acts as an input component for other person's experience.

The complex chain reaction is called the experience chain (Figure 1). Blocks are aligned as a time sequence from left to right. Each block in this figure is an artifact, the environment surrounding the user, or contents such as movies and games. Arrows, connecting the blocks, show how the blocks mutually influence to create this chain of experience. It can be viewed as input stimulation for sensors and output stimulation for actuators.

This model implies that people may be considered as a design component with inputs and

Figure 1. The experience chain



outputs, very similar to smart artifacts and dynamic environments with sensors and actuators. Typical output from people includes gestures, spoken words as well as decision making of the next action. For example, if the person just finished watching a Japanese movie, this person may decide to eat sushi for dinner. The dotted arrows depicts that only one decision is made at one time, so in this example, this person had a choice of 3 blocks (read a book related to the movie, go to shopping, or eat Sushi for dinner) and decided on the middle block, to eat Sushi.

Key Factors

The key factors to design a successful experience chain are storytelling, embodiment, and sensuality. Storytelling is proven to be important in many content genres such as movies and games as well as theme parks. In ubiquitous contents, the story may be interpreted as reasoning or a scenario. In addition, it is important to incorporate the affective element and the communicative element in the story.

Embodiment plays a central role because it creates the interaction. As Dourish claims [10], interaction design is an important method to design the link between people, artifacts, and environment.

Sensuality is crucial because we no longer restrict the content in auditory and visual domain. The more we can design utilizing our five senses with integrity, the stronger the experience will be.

UBIQUITOUS CONTENTS

Suirin

"Suirin" is an interactive furniture that is made possible with two of the ancient Japanese artifacts called "ukidama" and "furin", and the space realized by those two, which is expanded by a digital filter.(Figure 2) "Suirin" gives a user a therapeutic experience of augmented reality with its unique "sound scenery" by stimulating four senses: hearing, vision, smell and touch.

"Suirin" provides healings with touch (water), hearing (sound), vision (light), and smell (fog).

Figure 2. "Suirin"

The interface of SUIRIN is water. The generated sound changes according to the way of touching the water. As to the various ways of touching water, the generated sound changes. "Suirin" brings comfort by the smooth interface, the water. The sound that occurs inside the container goes through the process of filtering and audio-synthesis, then changes into sound of insect's chirping like crickets. This aims to provide calmness by chirping sound. "Suirin" gradually changes the color of light from blue to green, depending on the generated sound in the container. Blue offers coolness and green offers calmness to the users. The fog is generated from the container inside of chassis. Fog piles up in the container and provides mysterious space combining with the lights. In addition, users receive negative ions by blowing the fog in the container and taking a shower of fog. This soothing and therapeutic environment is designed around the storytelling concept that in a hot summer day a stressful busy person would search for Zen-like quiet and stress-free atmosphere where this person can contemplate and cool off.

"Suirin" is effectively designed to be a component in the experience chain with key factors of sensuality, embodiment and storytelling included in the content design. It also fits naturally in the home environment, embedded in the daily life.

Tabby

"Tabby" is a lamp that is designed to create a sense of imaginary life that is grown through intimate interactions between human and the lamp.(Figure 3) "Tabby" is not controlled by traditional switches but it responses to users' empathetic behavior.

The lamp has three important features. One is soft textured lamp shade, the second is breath motion mechanism controlled by air flow and the third is an interaction system of light patterns related to human's behavior. "Tabby" has animal-like soft body covered by fake fur. This fabric

Figure 3. "Tabby"

appearance and texture of touch help the intimate relationship between human and the lamp. "Tabby" changes its form as if it is breathing. When the user touches the lamp-shade, the lamp starts to light up and breathe. The speed of breathing is dependent on the nearby sound/voice recognition. If "Tabby" is not touched for a certain amount of time, "Tabby" goes to sleep mode (lights off and movements off). The breathing motion is designed by air circulation in the lamp shade made by fabric. When the air blow starts, the shade is filled and when the air blow stops, the shade is deflated gently by its weight. The light is also turned on when it starts to breathe, and the heat of bulb inside the lampshade generates the warmth of the fabric skins that enhances the imagination of human.

"Tabby" is another example of Ambient Intelligence artifact that can be embedded in the daily life, to be included in the experience chain. In addition to the three key factors, sensuality, embodiment, and storytelling, "Tabby" offers context-aware environment by listening to the environment and reacting to its context.

Figure 4. "InScene"

InScene

"InScene" is a sensuous communication device which uses incenses.(Figure 4) It consists of ICKO, a cone-shaped small device that acts as an incense base, and KORO, a table device that acts as a sensuous communication player. First, a message is embedded in ICKO using a mobile phone. ICKO is then given to a friend as a special gift. When the friend lights the incense in ICKO and places it on the table KORO, the aroma starts to fill the room, the smoke is lighted, and the shooting stars are projected on the ceiling. By holding or waving a hand over the smoke, the sender's message can be viewed. After the incense dies out, the receiver can enjoy the lingering atmosphere of aroma.

"InScene" is designed around the scenario of a romantic couple, sharing personalized messages. This project proves that storytelling is an important component for a strong content design, and it is another example of Ambient Intelligence artifact that can be embedded in the daily life, to be included in the experience chain. In addition to the three key factors, sensuality, embodiment, and storytelling, "InScene" acts as a mediator between 2 people for non-verbal communication.

CONCLUSION

This article presented a design theory for an emerging field of digital content called Ubiquitous Contents, which utilize ubiquitous computing as an infrastructure. Examples are shown to illustrate how people, artifacts, and environment can be seamlessly connected to design emotional and entertaining experiences through the interaction. Future works will include complex inter-connectivity between various artifacts and the environment.

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Chapter 17
Asymmetrical Learning Create and Sustain Users' Drive to Innovate, When Involved in Information Systems Design

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ABSTRACT

We describe a case of development of an interface to online feedback on electricity consumption designed for private households. The development process was planned and executed in line with traditions of participatory design and Scandinavian systems design: inviting selected users to take the lead as much as possible by introducing a design space and design artifacts in their home environment, and gradually, in a sequence of three events unfolding over a month, drawing their attention to possible futures. Our reflection on this case makes us suggest a couple of central principles of user involvement and user engagement, in short 'the user drive'. We emphasize mutually asymmetrical partnership comprising knowing, artifacts, and dedicated space: users knowing the setting of use, designers knowing technological possibilities, the design artifacts which stages user imagination and serve as a boundary object of communication between designers and users, and the dedicated space of imagination, which in our case had the form of a time- and story-line running from observing own home to innovating present ways of knowing about electricity consumption.

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INTRODUCTION

Research in Human-Computer Interaction suggests that humans attribute a variety of meanings to human-artifact-relationships (Bødker & Bøgh Andersen, 2005), one of which being humans and artifacts as nodes in a system with the human actor conforming to the rules of the artifacts of the system, another being humans holding the artifact as a tool, which expands capabilities and agency. In this chapter we focus on the human-artifact relationship of the tool-type, and the *innovative* space around it. As case in point we present and discuss the outcome of an instance of user-driven innovation, where we as designer-researchers worked with eight families on developing interaction concepts for feedback about electricity consumption of private households. In order to identify, evoke and work with these families on innovation, we had to consider the relationship between designer and user: how do designers conceptualize users?

The 'user discourse' has, since the first steps to include users in the design process of computerized Information Systems in the 1970s, gradually changed: from "victims" needing support in the 1970s (Bansler, 1987) to "competent practitioners" in the 1980s (Greenbaum & Kyng, 1991), to "serious professionals" in the 1990s (Nardi, 1993), to a present valuable "source of inspiration" (Gaver, 2001) or "developers with a recipe" (Aaen, 2003). These various discourses can be regarded as an increase in user significance primarily from a business perspective, where users are regarded as an irreplaceable source of inspiration for innovation along with the market conditions set by "new economy" (Kelly, 1999). In reflections on "Design Research in 2006", Sanders (2006) describes this increasing interest in users as a result of failed innovation in the years 1999-2001: "innovation that was not relevant, not people-centered and ultimately not useful, e.g., the many failed products and services of the dot-com era" (Sanders, 2006). Consequently, a search has been set out for "truly people-centered innovation" (Sanders, 2006), and the concept user-driven innovation has gained increasing attention in systems design.

The term user-driven innovation is, however, not new. It was coined by C. Freeman, who in the 1960s used it as part of his theory of democratic production processes (Freeman, 1968). In the same period von Hippel presented the term "user dominated innovation" (von Hippel, 1976), making the same point as Freeman: users can play a valuable innovative role for product development. Von Hippel's ideas are today realized in production processes and tool-kits to support lead-users' "real freedom to innovate" (von Hippel, 2001).

Since the new millennium, the term user-driven innovation has entered the research field of Scandinavian systems design (e.g. Bødker, Kensing & Simonsen, 2008; Buur, 2008; Kanstrup & Christiansen, 2006, Lee 2007). In Denmark research grants have been earmarked for methodological development of user-driven innovation and have resulted in several research centers, research groups, projects and experiments carried out in collaboration between researchers, business partners and users. The Scandinavian systems design tradition and user-driven innovation as defined by Freeman share a focus on human-artifact relationships of the tool-type, where the aim is to design for skilled people. The assumption is that users are in fact already skilled in what they do, hold potential to design improvements, adapt inventions, and turn them into innovations. Our ambition here is, to inform practical design by elaborating on a discourse of learning as embedded in the asymmetrical relationships of interaction, when users and designers collaborate in design. As opposed to von Hippel's lead user-category we have worked with innovators who may not be future users themselves. Their qualification was their situatedness in the home and everyday practice of electricity consumption and household reflections – a practice too rich for designers to

understand on their own. Following a definition of innovation as 'implementation of invention in ongoing practice', helped us to engage with users in a partnership of complementary capacities and mutual learning in an innovative design space (Kanstrup & Christiansen, 2006). As it is, we are not aware of research, which has gone in-depth with the implications of *mutually asymmetrical partnership* in a design context. with the communicative implications of staging such relationships as part in actual design practice. Hence, we begin with an account of the nature of the designer-user relationship in case of user-driven innovation of artifacts of the tool-type – a deepening of the understanding of what mutual learning means when working with user-driven innovation. We regard this *mutually asymmetrical partnership* as a fundamental for user-drive. A case of user-driven innovation of feedback on electricity consumption in private households exemplifies how and what we have found. The chapter concludes on the designer-user relationship in user-driven innovation and calls for further research.

THE DESIGNER-USER RELATIONSSHIP IS MUTUAL, BUT ASYMMETRICAL LEARNING

In order to enter the space in which users are ready to innovate tools, the designer must step back and support users in *their* drive to innovate. The Danish philosopher Søren Kierkegaard has given a quite accurate description of what this stepping back implies:

"This is the secret in the entire art of helping. Anyone who cannot do this is himself under a delusion if he thinks he is able to help someone else. I must understand more than he, but certainly first and foremost understand what he understands. If I do not understand that, then my greater understanding does not help him at all. ... all true helping begins with a humbling. ... to help is a willingness, for the time being, to put up with being in the wrong and not understanding what the other understands ..." (Kierkegaard, 1859).

Through our working with user-driven innovation we have learned that stepping back is vital. Without this understanding the user drive easily changes to driving users. The designers' gain of practicing the art of helping requires the creation of a design space, which will lead to development also for the designers. According to Vygotsky (1978) learning turns into development of new capabilities as the result of mutual engagement between a learner and a more capable peer. Vygotsky's theory of cognitive development suggests that learning leads to development through interaction between more and less capable peers, where the former has the chance to teach, and the latter to receive guidance in experimentation. This theory supports the idea that a give and take pattern motivates learning and development (Christiansen, 2008). Vygotsky emphasizes the reciprocity of the relationship. Vygotsky argues, that the more capable peer, by supporting and helping the learner, get an opportunity to externalize and verbalize and explain what he himself holds as tacit knowledge. It is at this explanatory stage, according to Vygotsky, that the development happens – for the more capable peer, notably, who, however, also in his explanation creates a scaffold and a safe zone around the learner's exploration.

USER-DRIVE FUNDAMENTALS

This perspective on the user-designer relationship as mutual but asymmetrical learning is not new, rather old, within Scandinavian systems design. In Bråten's theory on model power (Bråten, 1983; Bråten, 1974) the assumption is that understanding takes place on one's own premises or on the premises of others. "Model strong" participants are rich in their understandings, ideas and language on a certain subject area (e.g. systems design), and

"model week" participants are poor on relevant knowledge, ideas and language. According to Bråten relationships between the strong and the weak are characterized by the following principles:

1. If participant A is to be able to control x it is necessary that x is developed on the premises of A
2. If two participants, A and B, are to be able to communicate it is necessary that they have access to models on the subject area
3. Following this, a trade or conversation between a model strong A and a model week B means that the model week B will try to acquire the models of the model strong A
4. Following 1 and 3; the better the model week B succeeds in acquiring A's models, which are developed on the premises of A, the more B will be under A's control. (op. cit. 25)

The implication for user-driven innovation is that

1. Design spaces, processes, artifact, and design concepts for user-driven innovation must be developed on the premises of users
2. Users must be supported in learning about design (evoked) and designers must be supported in learning about users
3. The key focus for designers is to understand the model of users
4. The more designers understand the model of users the more user drive

USER-DRIVEN INNOVATION: PRINCIPLES

On this basis we have formulated the principles here:

- *An emphasis on making space a dedicated design space for users in the beginning of the design process*

In user-driven innovation emphasis is put on making space for users to participate and innovate early in design processes. Recalling Sanders (2006) and the classic waterfall model for systems design, the project management logic is that resources should not be spend going back-wards in design processes. Involving users as innovators (vs. as merely users in e.g. ethnographic studies) requires a space for users to participate in design processes.

- *An emphasis on evoking users innovative potential*

Like it is acknowledged that users need space in the design process it is acknowledged that users need a process and materials or tool-kits in order to get "real freedom to innovate" (von Hippel 2001). As worked out in Scandinavian co-operative design it is crucial that designers develop design artifacts, which can support users' design and innovation activities.

- *An emphasis on conceptualizing design based on user-innovations*

Designers who adopt the helping attitude serve as 'user innovation managers' in these processes, by motivating and keeping track of as well as collecting and analyzing user innovations. The outcome forms the basic building blocks in design concepts in terms of user perspectives, user needs, user ideas, and users' mixed feelings. This way design concepts become rooted in "the real world" (Papanek 1984).

We have developed and worked with through several research projects carried out since 2005 – one of these projects are presented below as

an illustration: the case of design of feedback on electricity consumption for private households based on user-driven innovation.

THE FEEDBACK-PROJECT: AN EXAMPLE OF USER-DRIVEN INNOVATION IN SYSTEMS DESIGN

Feedback motivated electricity saving in private households is a research project running from 2006-2007 involving universities (Aarhus Business School, Aalborg University, and the Danish Institute of local government studies) and business partners (software companies, hardware companies, and electricity suppliers). The explicit goal of the project is i) to develop and test out new concepts for communication from the electrical power industry to the end-users (feedback) and ii) to investigate whether on-line-feedback on electricity consumption results in energy saving. The project consists of three related sub-projects, one of which is the design of a user-interface for on-line feedback on electricity consumption. This part is based on user-driven innovation with eight families, in the spring of 2006 and managed by the authors. Prototypes are to be installed and tested in 120 Danish households in 2007 by other project partners.

User-driven innovation was selected as an approach out of the understanding that skilled users of future feedback technology in households holds both potentials for designing tools that fit their household-electricity-context and rights to influence technology to be designed and used by them if possibly aiming for sale and implementation in their private sphere.

Eight families participating in the user-driven innovation process was selected in a screening process (Kanstrup & Christiansen 2006).

Making Space for Innovators in the Feedback-Project: An Iterative Process

In the FEEDBACK-project the conceptual design space did unfold in a design spiral, presented in overview in Table 1. The table presents the flow of activities and show how we have worked with emphasizing who is on stage when in the process. The table shows how the user-space and the designers-space shifts in loops in a design spiral. Important is that the user-designer relationship is reflected throughout the design spiral as part of all interaction between innovators and designers, and of all planning by designers supporting a mutual but asymmetrical learning in the process. Being clear on location, roles, mediating artefacts, and outcomes supported us in keeping focus with our ideals of relationships the design space of a user-driven innovation process.

Evoking Users Innovative Potential in the Feedback-Project

In case of the FEEDBACK-project we were concerned about the inconspicuous, mundane nature of our design target, and how to facilitate our innovators coming-as-a-stranger to their everyday life with electricity consumption. So, apart from relying on artefact-driven evocations, we trusted gaming and competition. As described earlier, the innovators' expertise and advantage lies in knowing about everyday life with the product target, but here lies also a potential blindness. And since they are supposed to represent vast majority with respect to attitude towards technology adoption, they may not by any means see themselves as designers. On top of this, families are busy. Although they received a small treat in the end, our questionnaire showed, that the innovators in the FEEDBACK-project were basically motivated by contributing to the good course of research, and environmentally concerned behavior.

Table 1. The feedback-projects conceptual design space based on user driven innovation

Locations	Participants	Mediating setting and artefacts	Intended outcome
Lab = designers' turf	Designers	Problem-setting, where artefacts in use to be supplied /redesigned are in focus, and we try to learn from similar projects	A game to make innovators 'open up' and focus on electricity consumption, method for selection of innovators, plan for contact etc.
Field = innovators' turf	Designers and innovators	Innovators playing design games and taking and commenting on photos of where they want to know what about electricity consumption using a Polaroid camera, followed by negotiations and narratives saved on video	Videodata Polaroid photos
Lab	Designers	Exploration of videodata and notebook data, Polaroid photos, profiles and prototypes created	A family typology of four, comprising preferences, attitudes and habits Concept-prototypes/mock ups and a plan for who is going to have what; probing kits
Field	Innovators	The innovators try out the thought provoking prototypes in use, and reflect in probing kit	Innovators' notes from installation visits and from returned probing kit
Lab	Innovators and designers	Common ground, where innovators take the lead in reporting their experiences, and design their own best solution	Videodata and innovators' prototypes
Lab	Designers	Design of an interface concept inspired from analysis of workshop data	Conceptual design of interface for on-line feedback on electricity consumption

In the evoking of innovators in the FEEDBACK-project we focused primarily on a) the use of artifacts and b) the creating of safe but challenging situations. Starting with the latter much time has been used informing the families, via letters, e-mail, telephone conversations, websites, etc. about the purpose of the project, their role in the project, the expected outcome of the project, timeframe, and the amount of hours estimated for their participation. Every setting began with designers informing, and no materials were handed to the families without both verbal and written instructions. We wanted the families to feel safe when taking the unfamiliar role of innovators. We worked hard on making sure, that they always knew, what they were going to participate in, for how long, with who, where, etc. Entering their private homes we made an effort to respect the privacy of the family home by creating a public space at the dinner table – the place where most families meet guests.

At the same time we worked on making the design-settings challenging for the families. For this purpose we used artifacts especially to trick their memory and imagination – to evoke them as innovators.

In order to tune-in on the subject – electricity consumption – we created a card-game called "EnergyPower". It was a game with 52 cards with different pictures of electrical appliances (toasters, lamps, TVs, computers, etc.) and among these 5 trumps being pictures of things, which used no electricity at all (candles, oil lamps, etc.). The cards were distributed among the family members. All the participants, one at a time, would throw a card on the table, and the one with the least power consuming appliance (the most "EnergyPower") would take the points. Playing "EnergyPower" required the families to reflect on what they ac-

Figure 1. Examples of Polaroid-photos with written questions

tually knew about electricity use both in general and in relation to concrete appliances at the cards and in their own household. Within 15 minutes or so they were tuned-in on the subject and wanted to learn more.

After the card game the families were given a Polaroid-camera and asked to take 10 photographs of places in their home, where they would like more information about their electricity consumption. Most families split up in two teams taking 5 pol-photos each. After this photo-tour the family members returned to the dinner table. They took turns presenting photographs and jutting down one sentence explaining what information they were seeking or thinking of when taking the photographs. The exercise was challenging in that it forced the families to reflect on their habits and needs, but also to come up with ideas for information about electricity consumption. (Figure 1)

On the basis of analysis of the above materials we designed five mock-ups, based on five identified concepts for feedback on electricity consumption.

- *The concept of 'on-off'* for reminding. This was put to form in a display with 10 appliances and a notification on whether they were on (red) or off (green).
- *The concept of 'speed'* for observing. This was put into form in a speedometer (inspiration from cars) displaying the current speed of electricity consumption in the household.
- *The concept of 'quantity'* for observing. This was put into form in the design of a) a scheme displaying the amount of washing during a week supplied with a note on the cost of different types of washings and b)

a book displaying the use of play station or pc during a week (designed especially for the kids).

- *The concept of 'log'*. This was carried out via use of the local electricity company's existing website giving users access to logging registrations from their meters.
- *The concept of 'status'*. This was carried out via use of a) the Danish Electricity Funds website giving users access to register their appliances and get a norm-status on these and b) power meters which the households could use to measure the consumption of appliances.

Each family received 2-4 mock-ups, distributed to best match what they had themselves presented as needs and wishes during our initial visit and experimented for one week. A person (the father, the mother, the one who returned first to the house every day, etc.) was appointed be responsible for changing 'screens' in the mock-ups, testing if they were still in their place, etc. In order to trick reflection we developed a probe kit for every family. Main part of the probes consisted of postcards with questions that the family members were to answer and send to us on specific weekdays. The point being to keep them focused. Some family members reflected a lot and wrote long descriptions of their habits and experiences. Some family members, especially the kids, used to post-cards as sign of participation, made drawings or just wrote "Hallo".

With these experiences fresh in mind the families were eager to contribute with their own ideas. At a workshop they first evaluated the above mock-ups and second worked in groups on design of their own mock-ups for feedback. At the workshops we made an effort to make them feel 'at home', but also to make them feel challenged. Their design spirit was evoked when we asked them to present positive and negative critique of the concept-prototypes they had lived with for a week. We mixed the teams to maximize common interest and diversity of experience with prototypes. This first part of the workshop, where they shared and discussed experiences, made people feel eager to contribute to the next part, where they made prototypes themselves. Two-four families were working together at the workshops. Three prototypes were developed, quite different from our initial ideas when starting the project in January 2006 both in relation to the choice of media/hardware and in relation to the information and user-interface design. (Figure 2)

Figure 2. Innovators in a design-workshop making a mock-up of an information system for electricity consumption in private households

The innovators produced three mock-ups:

1. A mock-up designed for a monitor to be placed in the hallway or on Text TV showing i) what is on and what is off, ii) consumption related to a national norm for the type of household and iii) consumption related to the households own norm previous years. It was emphasized that the design should be "VERY simple" (capitals in original), easy to place a central place in the household, functional emphasizing "it can be turned off". Combining the design with information on other central consumptions like water, heating and garbage for the household was pointed out as an advantage.

2. A mock-up designed for a mobile monitor to be placed where-ever in the house and displaying the consumption in a barometer with the colours red, yellow and green: the left side of the barometer displays the current status of the consumption this year and the right side of the barometer displays the consumption at the same time but last year, i.e. the left side of the barometer is to be compared with the right side. Competition was important to the innovators of this mock-up. The left side being compared constantly to the right side was argued as a constant competition for the household against the household. The fact that the monitor was mobile was argued as a possibility to bring it to the neighbor or friend to compete on current consumption.
3. A mock-up designed for a fridge-monitor presenting I) what is on and what is off in the household, II) the consumption of every room in the house and III) the total consumption and VI) the current impact displayed with an arrow pointing at green, yellow or red.

Conceptualizing Users Innovations

In the FEEDBACK-project user innovations coined three concepts as central on the basis of the above analytic results:

- *Speed*: visualizes the current invisible consumption. Several of the families, both adults and teenagers, remembered their joy of watching old meters spin fast or slow according to the consumption now replaced with digital numbers.
- *Remind*: visualizes an overview of the on/off status on central appliances in the household. The on/off status explain the speed when put next to each other.
- *Compare*: relates consumption to a norm or previous consumption or relates appliances to each other and thereby prompting changing and buying appliances and white goods. Comparing is a central basis for the families' acceptance or fight against the consumption of electricity in the household. Consequently, national guidelines and saving objectives are crucial for understanding whether a household consumption is high or low.

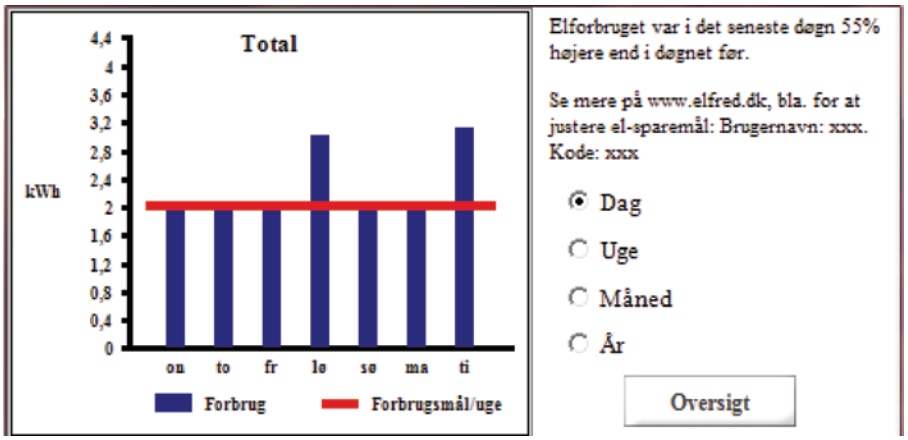
Several interaction designs have been based on these three concepts and some have recently been implemented to a medium screen solution to be placed at fix points in households at the choice of the individual family. The final outcome, illustrated with the primary screen dumps in Figure 3 and 4, was presented to the eight innovating families and is currently under installation in test houses in West Denmark. Measurements on the impact on electricity consumption will be conducted during the following test period.

CONCLUSION

We have presented the argument that user-driven innovation have to be a flow of mutual but asymmetrical learning, where the users take the lead in the beginning and the designers root their conceptual development in users' expressions. Hereby we deepen ideas to be found in participatory design and Scandinavian systems design. Consequently, we have found the defining characteristics of user-drive to be *the relationship between power over interaction and learning in interaction*. A case of design of feedback on electricity consumption for private households based on user-driven innovation serves to exemplify core principles of user involvement and user engagement. By referring to a phenomenological understanding of what it means to be in an innovative state of mind, we explain how letting users take the innovative lead has contributed a positive outcome, and how our approach to user-driven innovation can be regarded

Figure 3. Visualizing speed by a pellet drifting from side to side, comparing visualized in a bar displaying the total consumption since midnight compared to a norm and remembering visualized as a list of appliances to the right with colors indicating their on/off status

Figure 4. An example of the visualization of details of the total consumption



as a way to combine classic Scandinavian values of democracy with new economy calls for innovation in systems design, when designers take the conceptual lead in developing users' ideas. The chapter stresses the importance of designers taking a genuine interest in learning from users, put users first and follow users' professional knowledge, while also giving users the opportunity to learn about design.

The case of eight families contributing innovative design of feedback about electricity consumption in the home, demonstrates that users can design, and that designers can build on users work and make designs which have a change to work in the practice of end-users. The case of the FEEDBACK-project shows that families openly interested in re-arranging their environment and its technology, when supported by artifacts, and in a setting where they feel at home, safe, but challenged to play are valuable to the development of designs, which has a future in the everyday family life. The three core concepts *speed*, *remind*, *com-*

pare were derived from the user innovations and formed the basis for the user-interface designs, which became implemented.

Our conclusion is that user innovation grows from users having the opportunity to teach designers their competence, while also being offered the opportunity to learn about design.

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Section 4

Application of the Technologies in Specific Fields

Chapter 18
Internet-Enabled User Interfaces for Distance Learning

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ABSTRACT

The advent of Internet technologies since decades ago has propelled distance learning drastically. In this modern world, knowledge develops so fast that the amount of intellectual information that needs to be learnt before it becomes obsolete again is so huge. Distance learning through the use of Internet technologies has the advantage of being able to get across the information to the students remotely and effortlessly. The other advantage, which is the main focus of this paper, is that students are able to learn from their instructors on an entirely new media platform - the Internet-enabled and tangible user interface. This paper discusses how to use two main new media: multi-modal Internet technologies, namely remote physical interface and remote augmented reality technology in distance learning.

INTRODUCTION

In an attempt to provide increased educational opportunities to their present students and to attract new students who are working or have other constraints on their time or mobility, many colleges and universities (Hentea, Shea, & Pennington, 2003) are developing distance education programs. Distance education before the Internet age was painstakingly ineffective. First of all, there was the lack of interaction between the instructors and the students. Then there was the issue of delay

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in communications. Today the distance learning is supposed to provide a rich, ``almost classroom experience'' to distance students. It is a big challenge. Distance education offers freedom from space and time constraints, increased interactivity, improved delivery of multimedia, broadened curricula, and personalized learning (Hentea et al., 2003). Many tools have been developed to facilitate distance learning since its inception, such as traditional mails of printed material, videotape, CD-ROM, DVD, and the more recent web-based methods, which includes live video streaming, video conferencing and interactive graphical user interface.

The advantage of distance learning has been mentioned briefly. There are far more disadvantages that needs to be discussed here. We would discuss how our proposed Internet technologies could help overcome these shortcomings in later sections.

One of the major concerns is that students who are learning at a distance from the instructor and other fellow students may suffer from lack of interaction. Situated learning theory (Lave & Wenger, 1991) describes the process of learning as highly social, embedded in the lives of learners. Much of the theory of situated learning centers on the notion of communities of practice, dynamic groups that are present throughout our lives in which we participate in various ways. Such groups exist in schools, workplaces, social organization and families. With the pervasive of internet and those online social networks such as ``facebook'', social groups on internet become a new form of dynamic groups that people communicate using online chat, voice phone etc. technologies. However, usually students have little or no means of communicating with each other; even those who have the means of communicating with others in their class via online chats or email may not receive any encouragement to do so. Both students and instructors are affected if they do not have enough effective communication with each other. The instructor is unable to judge a student's progress and is unable to adapt the learning to successfully meet the needs of the learners. The students are more likely to feel confused or angered by assignments when they do not understand their significance. In addition, if communication between student and instructor is not timely, much of the value of feedback on assignments and tests is lost (Hentea et al., 2003). We need to consider how to encourage students to communicate with the instructor and other students when developing a distance learning system.

The other major concern of distance learning is that, often there is a loss of visual and physical experience. In other words, students sometimes could not visualize the physical objects or models as illustrated by the instructor. This shortfall is much real when it comes to subjects, which are best taught using physical artifacts. Instructors believe that visual enhancement helps students learn (Naps et al., 2003). Moreover, the feel of physical presence in front of the instructor or in the classroom also enhances the learning process.

So the current distance learning suffers from, but not limited to, lack of interaction, lack of active learning group, loss of visual experience and absence of physical presence. In this article we address the use of Internet-enabled tangible user interfaces, which encompasses augmented reality and remote physical interaction to handle these problems. A few enabling systems which we envisage will enhance the distance learning process which has been developed with the end users involved in the development process. We hope that practical tools using these enabling technologies can enhance the students' experience in remote learning. The tools, which will be described in later sections, are the 3D Live Technology (Nguyen et al., 2005), Mixed Reality Classroom-based Education Systems, and Internet Haptic System. The end users are involved in the development process of these tools and user studies are held to find out the usability and usefulness of using mixed reality technologies in educational area.

We will show how these systems are or can be used in distance education and the future works.

DEVELOPMENT SYSTEMS

3D Live Technology in Education

Introduction

The ability to overlay computer graphics onto the real world is commonly called Mixed Reality (MR). Unlike immersive Virtual Reality, MR interfaces allow users to see the real world at the same time as virtual imagery attached to real locations and objects. In an MR interface, the user views the world through a hand-held or head-mounted display (HMD) that is either see-through or overlays of graphics on video of the surrounding environment.

The most unique character of Mixed Reality Technology is that MR interface allows people to interact with real world in a tangible way. The 3D display and tangible interaction character enables this technology to be used in a wider range of application domains. According to Furness and Winn (Furness & Winn, 1997), virtual environments are unique in their usefulness to education due to their characteristics of autonomy, presence and interaction. There are three main reasons that make MR technology provide a totally different experience in education:

1. Support of seamless interaction between real and virtual environments.
2. The use of a tangible interface metaphor for object manipulation.
3. The ability to switch smoothly between reality and virtuality.

As extension of Virtual Reality (VR) technologies, VR and MR have characteristics that make them suitable for this new paradigm of learning such as experiential education and constructivism (Bricken & Byrne, 1993). As mentioned in the "Introduction'' section, Bricken and Byrne (Bricken & Byrne, 1993) also mentioned that social learning was one of the key learning theories. Multi-user virtual environments and augmented reality could help meet the need for communal learning (Dede, 2005). Collaboration is considered useful to the learning process because students have to articulate and debate their position, thereby leading to refection and constructed knowledge (Jackson & Fagan, 2000).

Roussou stated (Roussou, 2004) that interactivity is "generally seen as an intrinsic feature of educational practice in the sense of social communication, but also as an inherent property of any interactive multimedia or virtual reality environment that promise physical and sensor, in addition to mental, activity and response." Stuart (Stuart, 1996) looked at interactivity in two ways - the first, a generic view relating to the frequency of interaction, the range of choices when interacting with the system and the significance of those choices; the second, specific to virtual environments, defined as ``the tight coupling of head-tracked (and other) user input with multi-sensory display, so users perceive themselves as present in the environment''. As to the importance of interactivity, it was argued by (Roussou, 2004) that there was a strong relationship between interactivity, engagement and learning.

All these research indicate the great potential of using mixed reality in educational area, which motivate us for further research and are good reference of our work.

3D Live is the technology for capturing a person and, at the same time, displaying his/her 3D images in a mixed-reality environment in real time. The technology has been presented in (Prince, Cheok, & Farbiz, 2002) and (Nguyen et al., 2005) with its application in distant communication in mixed-reality spaces, where the user can see 3D images of his/her collaborators in mixed reality scenes when talking with them. We also applied the technology in Magic Land

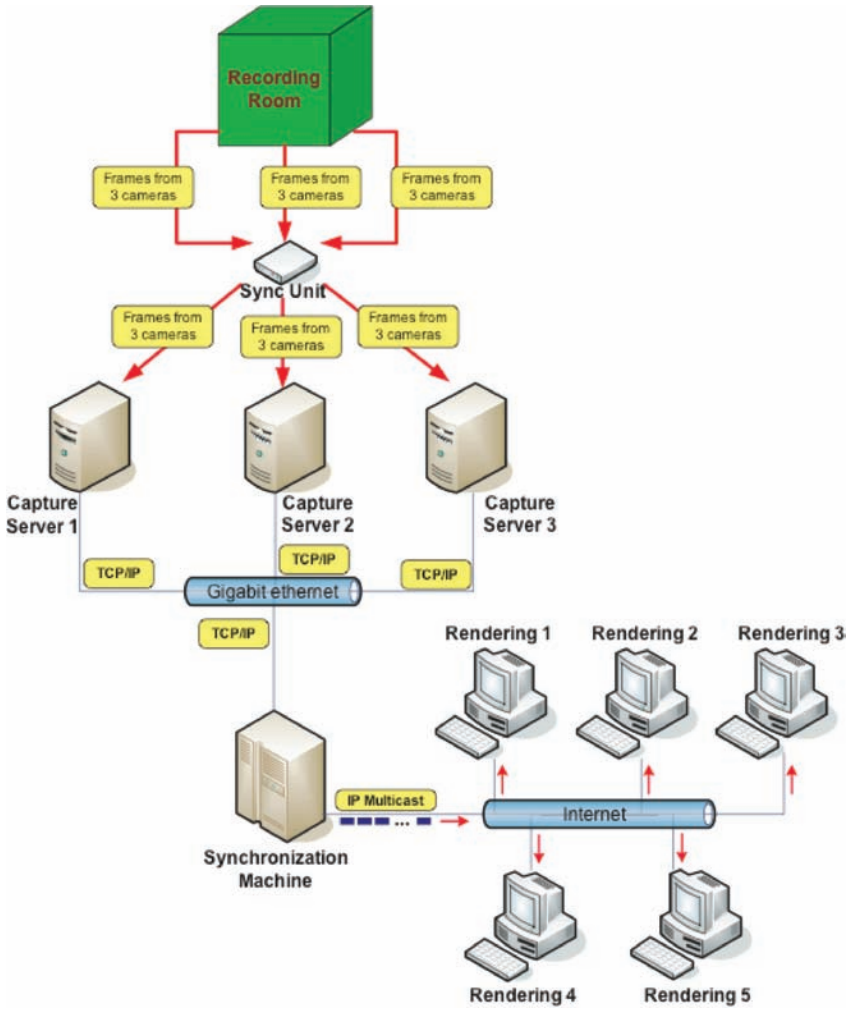
system, an interactive mixed reality game, where players can have themselves captured and then play with their own 3D captured avatars and other 3D virtual characters in mixed reality environment (Nguyen et al., 2005).

3D Live technology can "bring" instructors and students from different place together, which provide the face-to-face communication experience and encourage the communication among groups. The features of this technology can be applied effectively in education. In this section, we will explore the uses of 3D Live and Magic Land technology in remote education and training, including in areas such as cultural, dance, and sports training.

Overview of 3D Live Technology and Magic Land System

Details of the 3D Live and Magic Land systems can be found in (Prince et al., 2002), and (Nguyen et al., 2005). Figure 1 represents the overall system structure. Basically, we use nine Dragonfly FireWire cameras to capture the subject from nine viewpoints, including the top view. Those captured images from the cameras are then processed by

Figure 1. Hardware architecture



three Capture Server machines to eliminate the background scenes and retain the foreground silhouettes of the captured subject only. After that, the processed images are sent to the Synchronization machine, which then synchronizes the 9 streams of images so as to guarantee that each selected sets of 9 images from 9 cameras were captured at approximately the same time.

In the next step, those sets of 9 synchronized images are streamed through the Internet using IP multi-cast or RTP protocol to all the Rendering machines placed at different places. At the Rendering machine, the position of the virtual viewpoint is estimated when the user looks at the marker through an HMD with an attached camera.

Based on that estimated position and the 9 synchronized silhouettes of the subject received from the Synchronization machine, a novel view of the captured subject from this viewpoint is generated and superimposed onto the mixed reality scene. The novel image is generated such that the virtual camera views the subject from exactly the same angle and position as the head-mounted camera views the marker. And finally, this simulated view of the remote collaborator is then superimposed on the original image and displayed to the user. The result gives the strong impression that the model is a real three-dimensional part of the scene.

3D Live is mainly aiming for applications needs live, real time communication. The technology allows us to capture and render the 3D images of the subject at the same time. However, of course, it can also be used to record the 3D images and playback after that. This feature has been applied in Magic Land system, where users can play with their own 3D captured images, creating a new special kind of human self reflection that shown in 3D, can be sent through internet and recaptured and displayed almost in real time. In this system, users can tangibly pick up themselves or their collaborators and watch them in 3D form encountering other virtual objects. To allow users to manipulate their own 3D recorded image in MR environment, Magic Land does not fully exploit the "live" capturing feature of 3D Live, instead, utilizes the fast processing and rendering algorithm for fast record and playback feature. For different applications, live capture and view can be achieved.

Magic Land is a mixed reality application for art, story telling, and entertainment. The set-up mainly includes a large table with markers on top, the 3D Live recording system and several cups with marker on top. When looking at the table through the HMDs, users will see a virtual land on top of the table and virtual characters inside the cups. Users can have a capture of themselves inside the recording room for 20 seconds, and when the capture is finished, their 3D images will be rendered inside one of those cups. They can use their own hands to interact with the virtual characters, including their own 3D avatar, by moving the cups around the table, and the virtual characters will interact with each other when they are near to each other.

Magic Land introduces to user easy, tangible and intuitive approaches in dealing with mixed reality content. The main challenge of the project is to create a new medium for story telling that is different from book, CD etc. The outcome of the project is an infrastructure that gives users new opportunities to transport audiovisual information and encourage them of any discipline to deal with those new approaches.

Moreover, Magic Land is also an indoor mixed reality and tangible interaction game, which exploits physical tangible interaction, social interaction and also utilizes 3D graphics rendering to create an attractive imaginative virtual world. Moreover, the act of putting 3D images of real human beings in to that inventive world and making them new characters of the game story is unique in game context. Most importantly, Magic Land is a kind of "free play" game (Mandryk & M., 2001), in which players are free to use their imagination and creativity to design the game story and rules. Thus, in Magic Land, the game story and rules are not fixed but depends on players' imagination

Figure 2. Magic land installation

and decision, which is a good training for users to improve their creativity.

Figure 2 shows users using the Magic Land system together.

Applications of 3D Live and Magic Land in Remote Education

3D Live technology can provide the real-time capturing, transmitting and rendering the 3D images of the captured subject. Consequently, similar to 2D video-conferencing technology, 3D Live is suitable for use in any remote applications that need to display live captured images in real-time. However, the 2D images in video-conferencing cannot fully satisfy people's perception of sight, as human beings sense the world in 3D space. Moreover, 2D images cannot convey non-verbal cues such as body motion fully and completely. Another limitation of 2D video-conferencing is that users have to stay at one specific place, in front of their monitor.

3D Live overcomes the limitations of 2D video-conferencing by allowing people to see the 3D captured images at anywhere in physical space. Furthermore, with 3D Live, gestures, body motion and any 3D details of the captured subject are transmitted completely in full 3D, thus creating the full satisfaction of people's perception of sight. Consequently, 3D Live outperforms 2D video-conferencing in some live video applications where details of 3D captured objects or 3D complicated actions are important to the viewers.

It is very often in education that the learners need to observe their teacher's actions very carefully so as they can do exactly the same thing. It is necessary in normal classes like physics, chemistry or biology where teachers instruct their students doing some experiments. In these cases, not only the detailed views of 3D experiment tools and subjects but also the instructors' actions are very important for the students. This is because those students must follow the instructors' operations as closely as possible, the real world is 3D and 3D display can reduce chances for misunderstanding the operation, as opposed to a 2D display. Students have the option to choose the viewpoint, which they prefer. In areas where physical action is inherent such as sports, dance, or cultural education, it would be highly advantageous, in our opinion, to have a real time 3D image of the teacher. Previous research works from Yeh (Yeh, 2004) and Lester et al. (Lester, Zettlemoyer, Grégoire, & Bares, 1999) have found that 3D representations aid learners in understanding phenomena that pervade physical space. And 3D learning Environment motivates learners and contributes to learning effectiveness. Dede (Dede, Salzman, Loftin, & Sprague, 1999) found that 3D representations can help students develop more accurate and causal mental models than 2D representations in learning complex scientific concepts.

For that reason, 3D Live is very suitable to be applied in these contexts. The instructors with their experiment tools and subjects can be captured inside the recording room, and students at other places can observe the experiments fully in 3D, as if they were happening in front of them, anywhere in the world.

We have developed an application of 3D Live in dance training, where the full 3D body motion is the main important thing that the trainees need to learn. Figure 3 is an example of one of the

Figure 3. Live dancers rendered in physical space

scene that we captured. It can be seen in the figure that 3D Live technology allows users to see the captured subject in its real size, and it provides the flexibility to view the lessons at any places.

Obviously, 3D Live can be applied not only in dance training but also in sports training, where full body motion and player's actions are critical in the learning process. Figure 4 is an example of 3D Live application in Karate training. As one can see, it is very much advantageous for the trainees to see the Karate actions clearly and easily from any angle in full 3D. Using this technology, students anywhere in the world can learn and have a sense of presence with dance or sports masters in another country or even another continent. In our previous article we (Nguyen et al., 2005) have specified the sense of remote presence in social interaction and remote 3D collaboration. The 3D images displayed in a real environment can fully represent nonverbal communication such as gestures. Moreover, combine this technology with mixed reality technology, the remote collaborators become part of any real-world surroundings, potentially increasing the sense of social presence. In addition, a user study based on Magic Land project was given in (Nguyen et al., 2005). The results show that most of the participants think this technology will be useful for a remote 3D collaboration system.

The record and play back features of 3D Live also enable people to preserve the old cultural values from being missed or destroyed throughout the time. For example, the old traditional dances can be recorded, stored and displayed for younger generations in the future. Streaming over the Internet allows these 3D cultural icons to be viewed remotely from the teacher.

John Dewey's theory (Warde) of education shows that children soak up knowledge and retain it for use when they are spontaneously induced to look into matters of compelling interest to themselves. Both the 3D Live and Magic Land system engage the users in the systems in a compelling manner, and the game features in the design bring more fun into the learning process. All these features enable the systems to be efficiently applied in education. The game itself, which stimulates the players' imagination and creativity, is a good play-to-learn set-up for children. Moreover, the table top can be rendered with historical architectures and characters in history or architecture or design lessons. We have developed books using 3d Live which teach about Malaysian culture,

Figure 4. Live karate training

Figure 5. 3D Hamlet

and also Hamlet, as can be seen in Figure 5. Such a system is especially suitable for children, who are too active to sit at one place in front of a desktop for a long time, but like to run around, play and experience the lessons tangibly using their own hands.

MIXED REALITY CLASSROOM-BASED EDUCATION SYSTEMS

Related Works

Several applications for education have been developed. Liarokapis developed a system for engineering education (Liarokapis, Petridis, Lister, White, & M, 2002). It is developed using magnetic tracking device and ARToolkit freeware to design the visualization browser, attached with XML interface that allows teachers to input multimedia information into the database remotely. Following this project, a Web3D (Liarokapis et al., 2004) based educational tool is built that allows students to learn engineering related knowledge through a website in an Augmented Reality (AR) mode. It combined network and AR technologies together to achieve the remote education in the engineering field. This system is used to enhance students' learning and understanding of digital design. This approach leads to an improvement in the teaching and learning process (Jay & White, 2000). At the same time, Liarokapis (Liarokapis, Sylaiou, Basu, Mourkoussis, & White, 2004) developed an Interactive Visualization Interface for Virtual Museum. It provides a new media for visitors, especially disabled visitors to see and interact with virtual artifacts at the convenience of their own home. These two projects are good attempts to combine AR technology with network technology, and have achieved a certain aim for remote learning and remote art. Woods et al. (Woods et al., 2004) have set up several educational exhibits for science centers, museums and education centers such as BlackMagic Kiosk, Solar System and Story Book. Stanton D. et al (Stanton et al., 2001) collaborated with children and teachers together, designing a tangible interface for storytelling using gesture recognition and collaborative navigation technologies. Children can create their own stories using this system. Construct3D (Kaufmann, 2003) is a system used for mathematics and geometry education. Researchers from MIT proposed a new concept - Games to Teach and they have developed three prototypes for electromagnetic, environment and history educations. Shelton et al (Shelton & Hedley, 2002) developed a system to teach Earth-Sun relationships to undergraduate geography students. It is quite similar to our mixed reality solar system, but it focuses on earth and sun related knowledge such as equinox and solstice to give students an AR experience. Loscos, Shelton, Liarokapis et al. (Liarokapis et al., 2002;

Loscos et al., 2003; Shelton & Hedley, 2002) developed systems for arts-culture, geography and engineering education. FlatWorld created in USC can be used for education and training goals (Pair & Piepol, 2002).

All these AR education prototypes are trying to use the AR technologies in educational area and, the results were somewhat encouraging. But all these systems are used as assistants to enhance the traditional teaching method and are not actually used in classroom environment. Based on similar goals, we collaborated with teachers from a primary school in Singapore and developed the classroom based Solar System and Plants System, which we will now discuss.

System Overview

In our attempt to make the learning process more interesting and attractive and let students learn in a more intuitive manner, we developed two classroom-based MR teaching tools. First of all, to ensure that they are in accordance to the teaching syllabus, the contents are acquired from the teachers of the primary school.

Secondly, as a classroom-based system, it must be suitable for the classroom environment and at same time also suitable for self-learning and distance teaching. By projecting the display on a big screen, a teacher can use this system as a general teaching tool such as picture etc. For self-learning, texts and sounds are added in this system to help students understand the contents better. A quiz is included in this system to bring entertainment factors in the system and provide data for system evaluation. By connecting the system to the Internet, students can use the system at their own convenience at home and get help from teachers remotely if needed.

Thirdly, an important thing is to allow robustness for the personal user. Simplicity must be accomplished, as in everyday interaction with the environment; virtual objects can be easily picked up and moved without touching a conventional keyboard, mouse or joystick. By pressing buttons, different knowledge points can be chosen and displayed.

Finally, education through entertainment is another important aspect. Introducing Mixed Reality technology into the educational area can achieve this. It goes to the heart of our universal love of libraries, books, films, and museums. We love knowledge, and we love to learn in the most fun and entertaining way. We now describe actual systems using this concept.

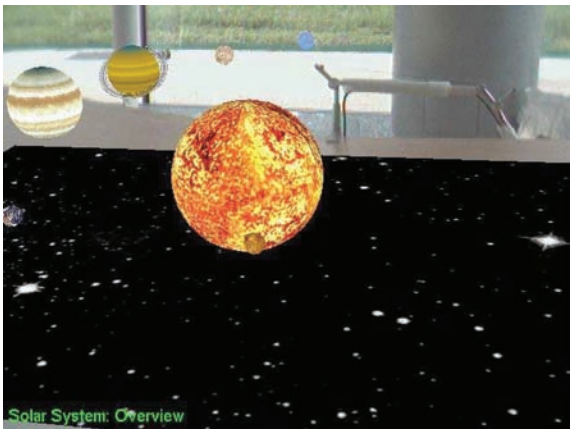
SYSTEM DESIGN

Mixed Reality Solar System

The Mixed Reality Solar System has a main operation table, where users (students) can sit around and look at the virtual solar system together. Users view the system through a head mounted display (HMD) with a small camera mounted on top. Several cups are used for the interactions between the users and the virtual objects. The teacher can be in a remote location and can view the various viewpoints of the students through a computer.

To view the virtual system on the table, the users need to put on the Head-Mounted-Display

Figure 6. System overview



(HMD), and aim at the board. They will see a virtual land on the base board as shown in Figure 6.

User interactions are designed for different knowledge points. For example, using the cups, user can pick up and move the virtual object to different planets as shown in Figure 7. Users can also pick up part of the Earth to observe its inner structure as shown in Figure 8.

A quiz is provided to help students to review the knowledge they learned and introduce more entertainment factors into the system. As shown in Figure 9, students need to use a cup to pick up the correct object and place it at the answer area (the square). A survey about this part is held after students try this system, the feedback from students shows that (example): "It makes us feel like we are really exploring the solar system and It is interesting because I get to see the result immediately." And students feel that (example): "The quiz component helps and allows me to learn some facts which my science teacher does not teach me in the classroom." From the feedback, we found that the quiz function really can help students review the knowledge and bring more fun factors to the learning process. Currently, only the Solar System is involved in the quiz part, students' Some feedback also pointed out this: "It is too easy and simple, it is not challenging enough for me." Based on the feedback and research needed, in the future, we will enhance the quiz as follows: Currently, no time limit and scores are given in the quiz. Students are allowed to try as many times as possible until they find the correct answer. For future work, we will add the time limit, error record and score in the quiz. Based on these data, we hope to discover if the system can help students comprehend knowledge easily and quickly.

It is also hoped that the system can help them identify their weak parts. For example, if the error rate of a knowledge point is much lower than others, this knowledge point should be more difficult than other points, or the system design for this part is not good. By analyzing these data, we

Figure 7. User interaction

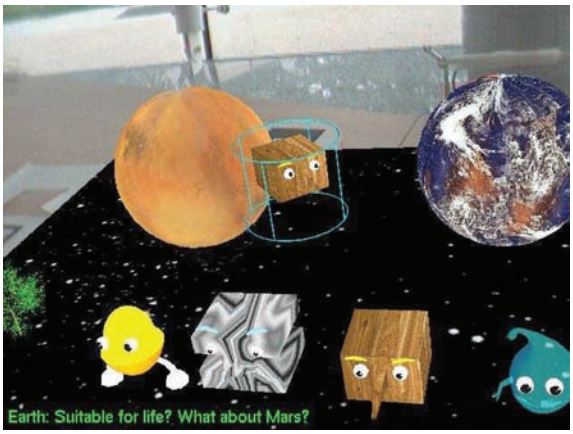


Figure 8. Pick up parts of the Earth

Figure 9. Quiz

can get useful information about the system and improve it further.

Plants System

This system includes four knowledge points about plant systems: Reproductive, Seeds Dispersal, Seeds Germination and Photosynthesis. According to the virtual conditions set by teachers/student, the corresponding natural process will be shown virtually and a virtual clock is used to show that all these natural processes happen in a certain time.

In the following, we will introduce the user interactions of different parts.

a. **Seed Germination:** users can set the water, light etc. conditions using virtual water, light bulb etc. When they finish the setting, press a button, the result will be shown. If the requirements for seed germination are met, the seed will germinate, users can see a bud growing up. (Figure 10).
b. **Seeds Dispersal:** in this section, four cups related to different disposal methods (wind, water, splitting and animal) are provided, user can choose any cup and move it to a tree to observe the different dispersal phenomena, Figure 11 shows the seed is dispersed by wind. User also can move the cup to a fruit to find its dispersal method.
c. **Photosynthesis:** User can alter the light and water conditions using different virtual objects and observe the effect in real time as shown in Figure 12. Students can observe the photosynthesis process when virtual light, water and carbon dioxide are provided.
d. **Reproduction:** plant reproduction related knowledge is involved in this part such as pollination and fertilization. Users can move a virtual bee to a flower to observe these processes as shown in Figure 13.

After using this system in the classroom, the majority of the students reflected that they like

Figure 10. Seed germination

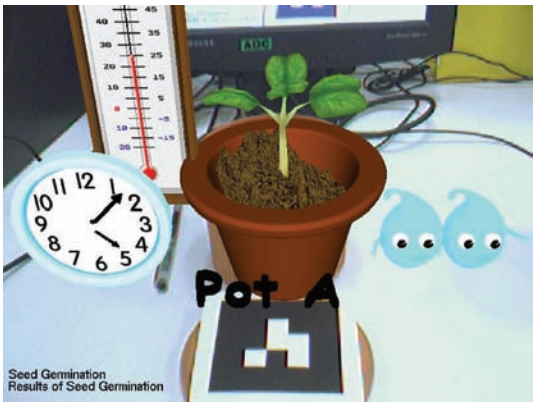


Figure 11. Seed dispersed by wind

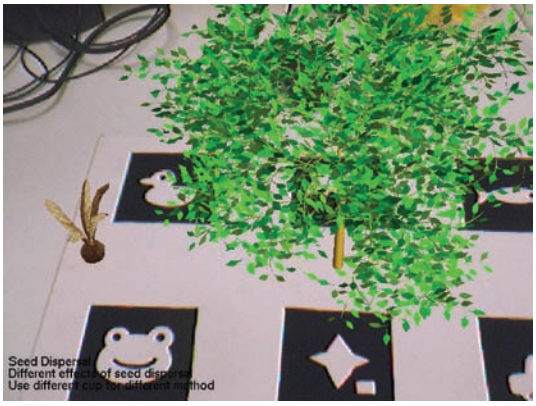
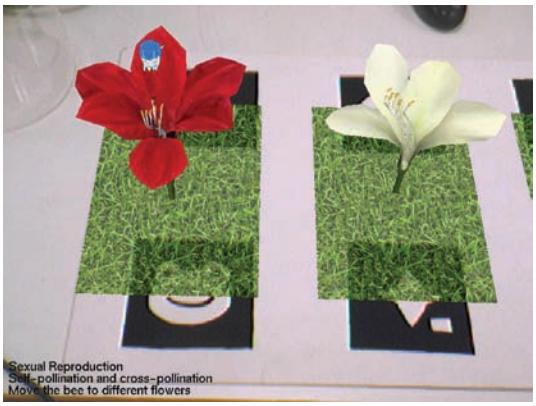


Figure 12. Photosynthesis

Figure 13. Pollination



the module on Seeds Dispersal and Seeds Germination. From their feedback: "I have a clearer picture about seeds dispersal after going through this module." "I can see how seeds germinate." "I can use the cute monkey and move it around to show how animal is used to disperse the seed." "It is fun and interesting to watch seeds germinate within seconds." "I love the hands-on experience." We can find that the hands-on experience and entertainment factors really help students in learning, those should be the main factors we will consider for future education related research and development.

In addition, the students feel that this system help them to learn plant related knowledge in an easy and interesting manner. This can be reflected from their own words: "It help me to remember the different types of seeds dispersal much easier." "Before I went to the MXR lab, I did not really understand the conditions how the seeds germinate, but after this experience, I have a bigger picture of how seeds germinate." "The graphics I see attracts my attention." etc.

Distance Education Using These Two Systems

The methodology of the mixed reality classroom provides the basis for distance education. By connecting to the Internet, these systems support distance education. There are two ways for distance education:

1. **Remote-teaching:** the teacher operates the system in one classroom and all his/her operations are sent to systems in other classrooms and students in those classrooms can see what the teacher does in real time.
2. **Self-learning with remote supporting:** students who use these systems to learn themselves and get help from teachers online. In this case, online chat is supported. Students can send their questions as messages to the teacher and at same time show their operations to teacher. In the same way, teachers can answer these questions by message or giving a demo.

User Study

Research Design

When new technologies evolve, there is a need to carry out user studies as early as possible, to identify and address usability and usefulness issues. To understand students' acceptance of the MR technology for learning, and the factors pertinent to influence their intention to use it, a study on our MR classroom was conducted, which took place in two stages: a pilot study of the Solar System was carried in a laboratory and a quantitative study of Plant System took place from 7-8 July 2006 at Excel Fest, an exhibition organized by the Ministry of Education, Singapore. Forty-four students at the exhibition were surveyed. The students were from various schools and enrolled in different levels.

The Pilot Study of the Solar System

A group of seven primary student volunteers comprising three boys and four girls around 11-12 years old are involved. They are divided into three small group (A, B and C) to reflect the real-life

scenario in a primary school setting where students were required to work and learn together using the MR teaching system.

The whole study involves four sessions: Demonstration, brief hand-on, task-oriented interaction and focus group session. In task-oriented interaction session different questions are given different groups for answer to guide their interaction with the system and they were required to complete a task. After finishing this session, the students were asked to fill a form to get their feedback. At last, a brief focus group was contacted discuss the participants' perceived usefulness and perceived ease of use of the Solar System.

FINDINGS AND ANALYSIS

Interaction Summaries

All three groups are managed to complete their task except that group A get some prompting from the researcher. A1 indicates that she had positive intention to use the system while A2's response was ambivalent due to the concern that it was "very difficult to capture image". Both B1 and B2 expressed their intention to use the system and perceived usefulness of the system and all three students in group C showed positive intention to use the system.

The system helped all students to understand the topic better. Group A answered "Maybe" as to weather the program was useful and make then more interested to learn about the topic. B1 thought that is was interesting and "help us understand science better." C1 said that the program was fun and interesting and could motivate them to learn science. C2 and C3 echoed similar sentiments, with both of them commenting that it was interesting and "made learning fun".

For the operation of the system, it is not easy to A2 and just "a bit difficult" to A2. Both, however, liked the system. Group B did not perceive the system as easy to use, but they enjoyed the system, with B1 using the word "fun". Group C gave positive answer to all questions on perceived usefulness and generally indicated they found the program easy to use. All of them enjoyed the program while C1 and C3 felt that the graphics and sound effects could be improved and C2 said that the 3D effects were nice.

Focus Group Feedback

Students Comment that they like the program because of the 3D models. For usage, they generally prefer independent exploration, which could indicate high self-efficacy and personal innovativeness. For usability, students had some difficult to position the camera properly, and issues were raised regarding the manipulation of the various devices, that is, the camera, the cylinder and the keys. Overall, it was seen that usability was a major issue for the students. However, they perceived the system is useful and could conceive of other topics that can use this system such as Math/Biology/Chemistry.

Analysis

From the comments made by the participants, we found that to improve the acceptance, the innovation factors explored might have to be compatibility with needs, values and past experiences, perceived enjoyment, perceived system quality and interactivity. Individual factors should include gender, personal innovativeness and self-efficacy and other factors such as environment also could be involved.

To get more evidenced findings, another bigger study is took place.

THE USER STUDY OF PLANT SYSTEM

Modified Theoretical Model and Hypotheses

In the context of education, Technology Acceptance Model (TAM) has been applied to educational technologies such as Web-based learning systems and digital libraries, in a higher education setting, and it has received considerable attention in the context of user acceptance of IT.

The questionnaire, using 5-point Likert-type questions, was designed according to the following factors: Interactivity, perceived enjoyment, interest and engagement, system quality, personal innovativeness, compatibility, gender, self-efficacy, attitude towards topic, social influence. And a research model, with five corresponding sets of hypotheses was developed using these factors. The factors and relationships were derived from literature on TAM, mixed reality, virtual environments and learning.

Five sets of hypotheses are:

- Set H1 Hypotheses: Experience-related
- Set H2 Hypotheses: System-related
- Set H3 Hypotheses: Individual-related
- Set H4 Hypotheses: Social influence-related
- Set H5 Hypotheses: Overall Perception

RESULTS AND ANALYSES

Students' Response

- General Response

Students' general response towards the Plant program was very positive. Almost all the students found the program useful, with 40.9% of those surveyed expressing agreement and 56.8% expressing strong agreement that the program was useful for learning about plants. The students were slightly less positive towards ease of use. 50% reported agreement and 31.8% strong agreement that the program was easy to use. The remaining students were either neutral (13.6%) or disagreed (4.5%) that it was easy to use. Thus, the mean score for ease of use was slightly lower at 4.09 compared with 4.52 for usefulness.

Regarding the intention to use the program, 86.3% wanted to have the program in their school (with 72.7% expressing strong agreement) while the remaining 13.6% were neutral. 90.9% said that they would use the program if it was available in their school.

- Experience-related Response

The students reported a positive experience. Almost all the students (97.7%) felt that the program was interesting, with 84.1% expressing strong agreement with this. A slightly lower 90.9% found it engaging. 95.4% felt that the program was interactive while 90.9% enjoyed using the program. 90.9% liked this science topic.

- System-related Response

The quality of the program, in terms of graphics quality and sensitivity of the program, was generally perceived to be good but the latter to a lesser extent. 90.9% of the students found the graphics attractive, while only 72.7% felt that the program was able to detect actions easily (sensitivity). 6.8% disagreed and 20.5% were neutral regarding the sensitivity of the program. Thus, the mean score for sensitivity was lower at 3.98 while that for attractiveness of the graphics was 4.43.

- Individual-related Response and Profiles

Mixed reality was largely compatible with their existing needs, values and experiences. 90.9% felt that multimedia CD-ROMs, websites or other learning technologies were useful for studies although a slightly lower 81.9% reported

that they used such technologies. 77.3% liked computer games, arcade games or console games.

Almost all of the students (97.8%) reported that they liked experimenting with new technology, showing that students' personal innovativeness towards technology is high. Nearly all of them (97.7%) were comfortable with using technology such as computers, showing high computer self-efficacy. Both genders were roughly equally represented, with 52.3% of the students surveyed being male and 47.7% female. Only 15.9% of the students found the subject difficult. The respondents ranged from Primary 1 to Secondary 3 students. 18.2% were in lower primary, 59.1% in upper primary and 22.8% in secondary school.

- Social Influence-related Response

The majority of the students perceived that their friends would be receptive towards the program. While 95.4% felt that their friends would find this system useful for learning, only 88.6% felt that their friends would want to use this system.

Hypothesis Testing

- Experience-related

The program was considered interactive, enjoyable, interesting and engaging, attitude towards the topic was found to predict interest and engagement, which reflected the notion of students taking interest in activities related to a topic that they like. Interest and engagement did not affect perceived usefulness or ease of use.

- System-related

System quality did not have any significant correlation with the level of interest and engagement, this possibly due to the brevity of the interaction and the novelty of the technology. However, it did have a significant and positive relationship with the perceived ease of use of the system.

- Individual-related

Personal innovativeness and compatibility were significantly and positively correlated, which could indicate that students with greater propensity towards trying out IT innovations will tend to have more positive attitudes and behaviors towards websites and technology-related games. Compatibility and self-efficacy were found to be significantly and positively correlated with the perceived usefulness of the system.

- Social Influence-related

Social influence had significant and positive relationship with the perceived usefulness of the system and it was also significantly and positively correlated with the intention to use the system.

- TAM related

The basic TAM constructs showed the appropriate correlations. The perceived usefulness was more important than perceived ease of use as a factor in determining intention to use. At the same time, perceived ease of use indirectly influenced intention to use through perceived usefulness.

From the result, we find that MR technology is very suitable for developing education related applications and most students are keen to use the new teaching tools. Also from the feedback, we find that the usability is very important for user-oriented applications. Improvement of the usability will be one of the important works for further development.

Tangible Internet Systems

Extensive research has been done in exploring the potential of the human body and applying this in human computer interaction. Humans interact with their environment using several methods via several communication channels. Even as we focus on performing a task with our hands, our periph-

eral vision and hearing are constantly absorbing information from the surrounding environment. All these methods of interaction suggest to us that human can learn much more by interacting in a multi modal way with their environment compared to traditional desktop computer based learning. Researchers have proposed that tangible user interfaces (TUI) can bridge the gap between cyberspace and the physical environment (Ishii & Ullmer, 1997). It is argued that by moving away from the current dominant model based on GUI to the TUI, we are actually drawing inspiration from classical ways of learning by using physical tools and instruments such as the abacus. Scientific measuring instruments of the past afford the users to use of their hands and eyes to coordinate and manipulate the instruments. This enabled them to work freely and creatively without limitation of a desktop-based GUI in everything they do.

Tangible interactive interface coupled with the vast reach of the Internet presents an interesting method for distance learning. In (Lee et al., 2006), we proposed that tangible interactive interface when used as a communication tool enhances the feeling of presence of the person one is communicating remotely with. Besides that, this multi-modal tangible interactive system allows users to intuitively manipulate and send 'bits' within their physical world as (Ishii & Ullmer, 1997) proposed. This enables users to bridge the gap between cyberspace and their physical environment. All these features can enhance the communication and interaction among teachers and students. We therefore propose that such a system allows learners to learn in a more conducive manner by making use not only of their bits (desktop based GUI) but also of their atoms (real physical environment).

Related Tangible Internet Systems for Distance Education

In (Treviranus, 1999), it was mentioned that Internet delivers curriculum which does not simulate the experience of touching and manipulating objects or environments. This restricts the number of subjects that can be effectively taught, and the types of students who can access the curriculum. With this in mind, a project that would develop software applications that make it possible to deliver curriculum that can be touched, manipulated and heard over the Internet was underway. Both the necessary software tools and exemplary curriculum modules would be developed, and would be based upon the 3D ISO standard VRML, and a Haptic API developed by a company called Haptics Technology Inc.

A "Haptics Pendulum" was developed (NIDE, 2001). The Haptics Pendulum device is a pen attached to a force feedback motor that simulates the swinging motion of a pendulum displayed on computer. The motion of the pendulum's bob was mapped to the end of a PenCat Pro arm (a 3-D Haptic pen) that enabled students to "feel" the velocity, range, and resting state of a pendulum.

One of the disadvantages of the above previous developed system is that they did not address much on the human-to-human interaction aspect. As mentioned, the tangible interaction was between human and a pendulum. We propose a system, which allows remote tangible interaction between students and instructors via the Internet.

Poultry Internet

In (Lee et al., 2006) a remote tangible human-pet interaction system is developed to enable humans to interact with their pets remotely, in real time manner, through the Internet. A pet jacket (as shown in Figure 14) is worn by a live chicken; and the jacket consists of several vibration actuators. These actuators reproduce a haptic feeling when the pet owner touches the pet remotely via a tangible doll interface. There is a doll interface, and inside the hollow body of the doll, touch-sensitive sensors and wireless transmitter are embedded. As the owner touches the outer shell of the doll, the touch signals are sensed by the

embedded circuitry and sent through the Internet to the fluffy haptic pet jacket shown in Figure 15. This pet jacket receives data wirelessly through an embedded Bluetooth module. Besides that, the doll is mounted on a mechanical positioning table, which moves the doll according to the movement of the pet. The purpose is to enhance the physical presence of the pet in the vicinity of the owner.

One of the main motivations for this research is that it has been shown that poultry have high levels of both cognition and feelings and as a result there has been a recent trend of promoting poultry welfare. There is also a tradition of keeping poultry as pets in some parts of the world (PTF). However in modern cities and societies it is often difficult to maintain contact with pets, particularly for office workers. Therefore the motivation of this work is to use mobile and Internet technology to improve the welfare of poultry by creating positive feelings towards them, and to allow humans to feel connected to poultry even if they cannot be physically present with them. It can also be used for people who are allergic to touching animals and thus cannot stroke them directly.

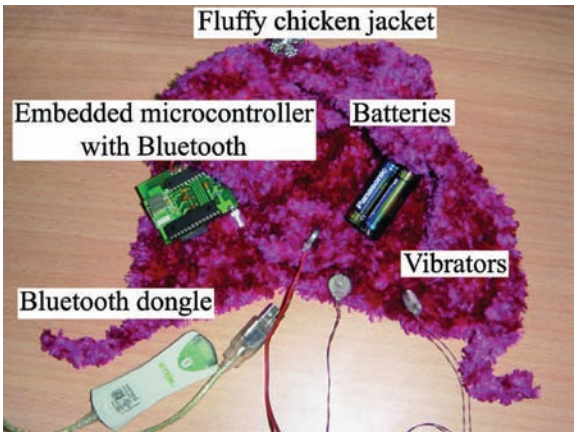
In addition to this, touch is very important to both animals and human beings. Many homes have companion animals usually dogs or cats and people enjoy stroking them. Animals often respond by closing their eyes and showing pleasure. In a study by Jones et al. (Jones, Larkins, & Hughes, 1996), it was shown that poultry farmers could have more productive hens if they installed video screens showing chickens being stroked. It was found that hens that are deprived of human contact are likely to be more anxious and prone to poor egg-laying. The above shows that the touch and stroking are very essential for humans and animals. There might be certain situation where touching pets is not possible, for instance when we are in the office, travelling or in the hospital; therefore remote touching would be helpful when our real presence is not achievable.

User Study

People who have participated in and tried out our system experienced the human-animal interactive symbiosis supplied by the system. They saw the doll move in real time according to the poultry movement. Furthermore, through the touch interface the participant stroked the doll and saw in real time that the touch is transmitted to the poultry.

Figure 14. The actual pet jacket worn by a live chicken in Poultry Internet

Figure 15. The fluffy haptic pet jacket



We have done a user study for our system. The interviewees were 31 students (18 male and 13 female) in the age group of 20 to 30 years old. They completed our questionnaire after having some experiences with our system. The users were asked to firstly interact with the poultry in the present conventional remote method interaction with pets, a live web cam and monitor. Then the users were asked to interact with the poultry using the physical doll interface. The users were not given any time limit of interacting with the system.

The result from the user study shows that most of the interviewees (84%) admitted that our system is better than current telecommunication systems for pets. A same number of users (84%) had a feeling of presence for the remote pet with our system. The survey shows that almost all users interviewed like to be able to touch and interact with their pets when they are out of home and their pets are alone (66%). Also most of them (68%) believed that the pet will have a pleasurable feeling and liked the remote touch using our system. Also the user study result shows that for most of the interviewees touching in more important to them rather than other kind of a kind of interaction like watching of their pets through a monitor. Our system allowed the users to compare using the proposed system with a normal web-cam system, as they could experience viewing the pet using a web cam and monitor only.

Huggy Pajama

A variant to this pet jacket system is the Huggy Pajama. Huggy Pajama is a novel wearable system aimed at promoting physical interaction in remote communication between distant users. The system consists of a hug reproducing jacket and a mobile novel hugging interface, which is able to sense the hug and transmit over the internet. The overall system diagram is shown in Figure 16. According to the Figure 16 we have an input device, which acts as a cute interface that allows the transmitting user to hug user on the other end and send mood expressions to them. On the right side of the figure, connected through the Internet, we have air actuating module and color cloth changing expressive interfaces to reproduce hug and connect the two users.

The system consists of 3 main parts namely the Input Sensing Device, Output Actuating Device (the jacket) and the color changing module.

The Input Device is a cute doll interface with touch sensors embedded in it. The doll has 12 sensors embedded in it (four in the front, four in the back and two each on each side) to accurately measure the touch pressure details of a hug. The components of the input device are shown in the Figure 17. The 12 embedded sensors consist of 12 QTC (Quantum Tunneling Composite) sheets that accurately measure the pressure. The linearly measured pressure is read and sent via Bluetooth

Figure 16. Huggy pajama system overview

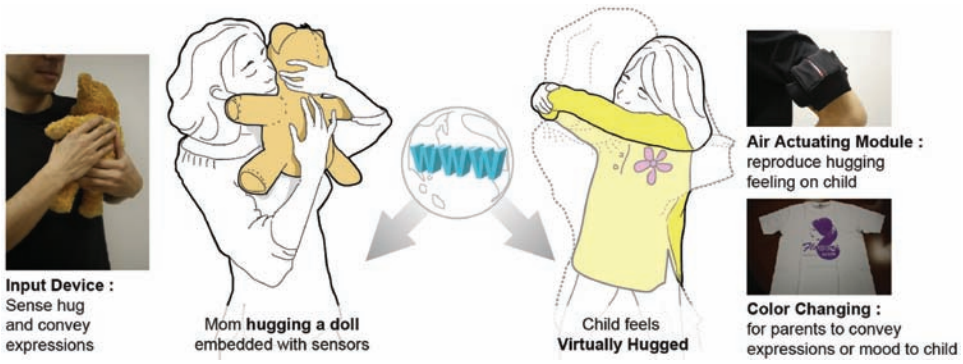
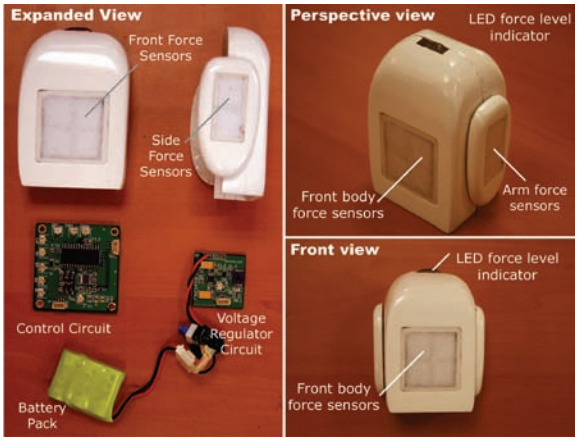


Figure 17. Input device components



to the internet. The system block diagram for the input device is indicated in Figure 18 and how it connects to the output device. The input device was designed in a cute and mobile manner such that the users can freely carry it around or probably attach it to their mobile phones while on the move.

The Output system mainly consists of jacket that is capable of reproducing the feeling of a hug. The jacket consists of 12 air actuating modules that are matched one to one against the 12 input sensors of the input device as shown in Figure 19. Two air pumps are used in each actuating module, one to pump air into the air pouch and one to pump air out of the air pouch to increase or decrease the pressure. The block diagram of the air actuator circuitry is shown in Figure 20. There air actuating modules are capable of accurately exerting a pressure that is related to the input pressure sensed by the QTC sensors on the input device through the use of a closed loop PI control system. Thus when the user uses to input device to transmit a hug the same sensation is recreated with the use of the output jacket with the air actuating modules. A sample of a single air actuating module is shown in Figure 21. We also developed an arm band version with a single air actuating module for the concept implementation and testing. Figure 22 shows the usage of this version. The LED's on the module indicate the current pressure level.

And we developed colour changing module to represent the hugging context to the remote place receiver and also express the sender's emotion and feelings to the receiver.

Figure 23 shows the colour changing T-Shirt that was our prototype colour changing module. We used Thermochromic Ink that is changed colours by controlling the temperature in this shirt. According to the levels of developer types in this ink, we made different colours changing effect through controlling temperatures of the ink

Figure 18. Input device system block diagram

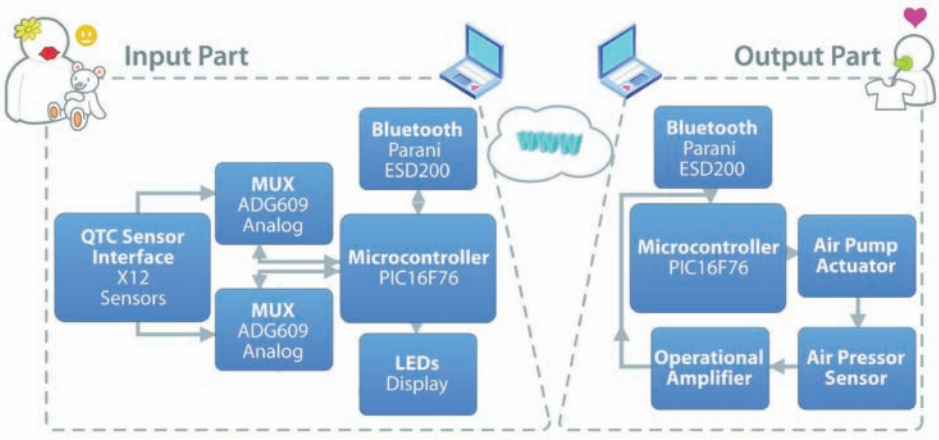
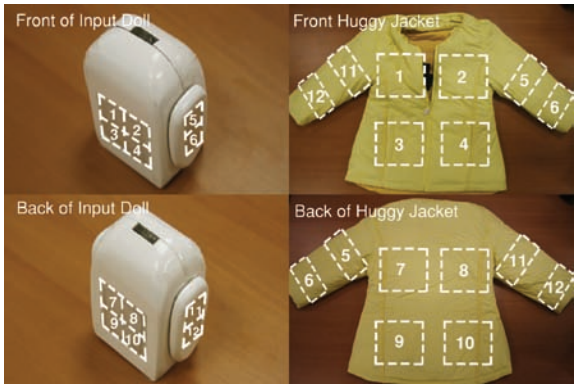


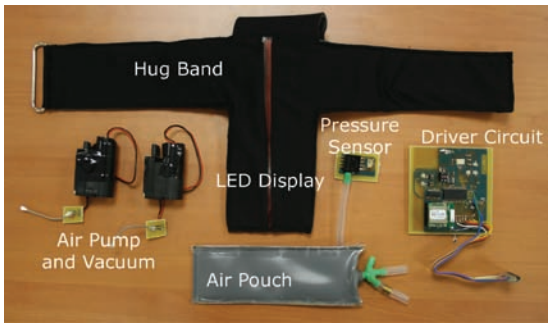
Figure 19. Mapping between input sensors and output air actuators



spot. (We used 2 types Thermochromic ink, and we made 3 different colours.)

As we can see in Figure 24 we made heating spots using the conductive yarn and also attached a temperature sensor to measure the temperature of heating spot. And we tested painting method as well as dyeing method. Figure 25 shows flower accessory type color changing tests. We attached these accessories on the blouse and Figure 26 shows the result.

Figure 21. Air actuating module components



The Huggy Pajama system was mainly aimed for the user of parents with their children. Parents who spend a busy work life may have to travel away from their children frequently and thus the Huggy Pajama system enables them to hug their children through the internet. Figure 27 shows the use of the Huggy Pajama prototype.

It can be seen that those previous remote haptic systems provide such a rich multimodal interaction for people over the Internet. It will be a good idea if this can be deployed in distance learning.

Figure 20. Block diagram of the air actuating module circuitry

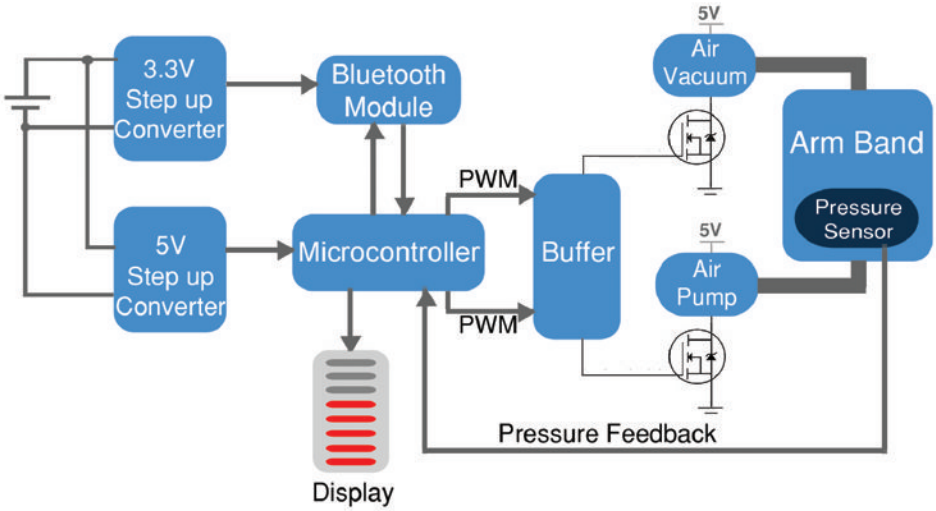


Figure 22. Arm band version usage

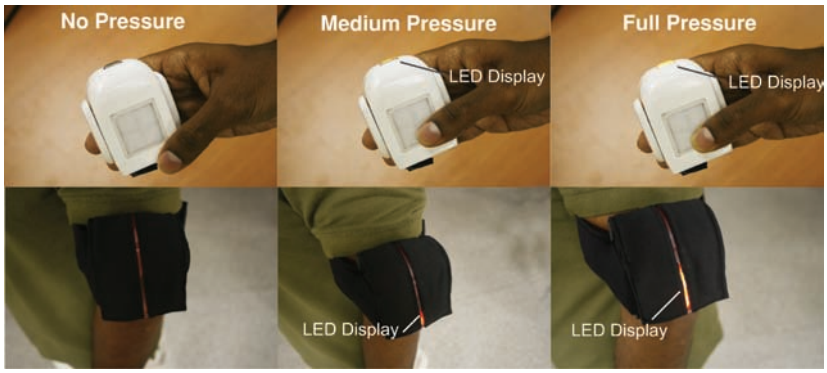


Figure 23. Colour changing t-shirt

Figure 24. Temperature sensor and conductive yarn

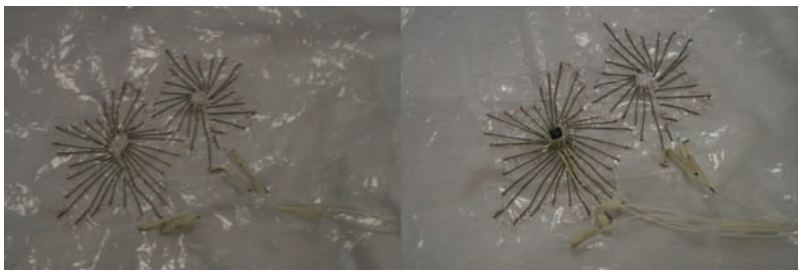


Figure 25. Colour changing flower accessory

Figure 26. Colour changing blouse

Figure 27. Complete Huggy pajama prototype system usage

Proposed Application of Tangible Internet Systems for Distance Education

As mentioned earlier the feeling of physical presence of the instructor can enhance the learning process, this is particularly true in physical education. For instance a table-tennis expert could teach a student how to play over the Internet, in real time. Both the instructor and the student would wear special haptic jacket, and thus remote action or movement synchronization can be achieved.

Another example is the teaching and learning of dance. The learner wears a haptic jacket similar the to poultry. Internet system and his/her movement replicated by a mechanical robot in front of the dance teacher. Both are interacting through the Internet. The teacher may correct the student's movements by touching the corresponding parts of the arms or legs. The student will feel these signals and be guided accordingly.

CONCLUSION AND FUTURE WORKS

In this article, we introduce related interactive media technologies and their usage in distance education and concern of the students' learning

process focus not just on specific subjects in classroom, but also on their preparation for learning and reviewing the knowledge at a distance. With the fast development of new technologies, adults need to learn new knowledge constantly. It is not so easy for everyone to go back school to learn new knowledge. Many new technologies are being introduced to distance education, but which technologies should be chosen is decided by the needs of students. Based on educational theories and previous research, the technologies we mentioned in previous sections have big potential in distance learning area. The prototypes and tools introduced have been or will be tested in real classrooms and over the Internet. We would like to combine these technologies to develop more distance education applications. For example, we can combine the above 3D live technology with mixed reality technology to let students see how the teachers are operating the solar system.

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Chapter 19
In-Vehicle Avatars to Elicit Social Response and Change Driving Behaviour

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ABSTRACT

Social and psychological theories have provided a plethora of evidence showing that the physical difficulty to express appropriate social interactions between drivers expresses itself in aggression, selfish driving and anti-social behaviour. Therefore there is a need to improve interactions between drivers and allow clearer collective decision making between them. Personal characteristics and the driving situations play strong roles in driver's aggression. Our approach is centered around the driving situation as opposed to focusing on personality characteristics. It examines aggression and manipulates contextual variables such as driver's eye contact exchanges. This paper presents a new unobtrusive in-vehicle system that aims at communicating drivers' intentions, elicit social responses and increasing mutual awareness. It uses eye gaze as a social cue to affect collective decision making with the view to contribute to safe driving. The authors used a driving simulator to design a case control experiment in which eye gaze movements are conveyed with an avatar. Participants were asked to drive through different types of intersections. An avatar representing the head of the other driver was displayed and driver behaviour was analysed. Significant eye gaze pattern difference where observed when an avatar was displayed. Drivers cautiously refer to the avatar when information is required on the intention of others (e.g. when they do not have the right of way). The majority of participants reported the perception of "being looked at". The number of glances and time spent gazing at the avatar did not indicate an unsafe distraction by standards of in-vehicle device ergonomic design. Avatars were visually consulted primarily in less demanding driving situations, which underlines their non-distractive nature.

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INTRODUCTION

Family trauma and tragedy associated with road crashes is phenomenal. Road crashes cost $17 Billion per year to Australia. Much of the emphasis in road safety in the last 50 years has been on modifying driver behaviour to reduce road crashes. Unfortunately, the effectiveness of these behavioural interventions in highly motorised countries has plateaued. Thus there is an urgent need to develop a novel type of intervention to reduce crashes.

The AAMI 2004 Crash index survey of licensed drivers across Australia reported that 93% of respondents (N=1880) had experienced some form of road rage or anti social behaviour. Furthermore, Australia had the highest percentage of drivers who had experienced attacks in the last 12 months among the Organisation for Economic Co-operation Development (OECD) countries (EOS, 2003). The Victorian Parliamentary Inquiry (Vic, 2005) identified sociological cues such as communication difficulties, anonymity of perpetrators/victims, power of the car, territoriality, physiological arousal, de-individualisation and dehumanisation as car-related factors contributing to driver aggression. Aggression is defined as any behaviour directed at causing physical or mental injury. We refer to non-extreme type of aggression (e.g faster speed, non cautious driving) as opposed to criminal and malicious behaviour.

Drivers use what they see in their environment to make appropriate decisions and control their actions. Knowing the intentions of other drivers is among the important environmental cues to be considered in order to avoid crashes. The intentions of the other drivers could be inferred from different cues such as vehicle speed, vehicle position, turning light indicators, gaze directions or simply horns. Crashes or aggression could occur when cues are misinterpreted or absent.

The vehicle's frame isolates the driver physically from interacting and being seen by other road users. A reduced visibility due to distance, windows and vehicles' metal frame prevents drivers from exchanging important cues required to share the road safely. The relative difficulty to exchange verbal or visual cues in a driving environment introduces ambiguity when one tries to perceive and infer the intentions of other drivers. A reduced visibility reduces the awareness of the "presence" of other drivers. Such constraints have social and psychological impacts. Presence is here loosely defined as the "degree to which a driver feels the proximity of another driver". A connotation of reduced social presence is its relation with disrespect of social norms (Derks et al, 2008). Social norms are explicit or unspoken rules about how we ought to behave. Driver's environment tends to be relatively void of social norms due to the inability to be clearly seen or directly accountable. The vehicle's frame socially isolates the driver and may provide a feeling of anonymity. The relative anonymity of driving environment manifests in two dimensions: (i) a driver does not know or cannot identify others drivers and (ii) drivers are less aware of the presence of others. Studies have shown that drivers are more likely to drive aggressively when they are anonymous and exposed to aggressive stimuli (Elllison-Potter et. al, 2001).

The design of technologies to mediate the subjective perception of presence is an active area of research. It has been widely studied in virtual environments. A virtual environment could change one's own attitudes to fulfil social norms (conformity theory (Asch, 1951)). It has been shown that the perceived level of presence in a virtual environment can be manipulated with visual, auditory or haptic cues (Nam et al., 2008).

Humans use eye gaze as an implicit rather than explicit, or necessary, communication media. The approach presented in this paper conveys eye gaze patterns as visual cue to change the driving behaviour. The use of eye gaze direction pattern as cues between drivers is not necessary, but an efficient and sufficient cue to assist drivers to make decisions in an ambiguous situation. For example,

a cautious driver often seeks eye contact with others on intersections in order to proceed safely. An established eye contact is a tacit recognition of the mutual awareness of the presence and the intention of each driver.

The virtual environment system presented in this paper will make use of existing in-vehicle technology such as ad hoc Vehicle to Vehicle (V2V) network and eye tracker technology to mediate the social power of mutual gazes between road users to reduce road violence, road hostility and selfish driving. This paper focuses on a pilot study examining the impacts of an avatar on driver's behaviour in a driving simulator. This pilot study is a model of our future research program to be validated on roads, but on a smaller scale. The pilot study focuses on those aspects of the full research program that are novel, untested, complex and innovative. This study examines two aspects of driver's behaviour, namely eye gaze pattern and vehicle speed in the presence of avatars on intersections. We conducted this study in a driving simulator as it is a quick, affordable and safe way to conduct research in the impact of future in-car technology. Furthermore, large in-vehicle head up displays able to display Visual Mixed/Augmented Reality information are also still unavailable on the market. Specifically there is no readily available technology able to acquire video stream, tracking/register external real objects from the driving environment and display them in real time on an in-vehicle head up display (Jung et al, 2008).

Our approach is simple, unconventional and radically different from traditional behavioural road safety interventions. It uses in-vehicle technology to mediate the social power of mutual gazes between road users to reduce road crashes. It generates the subjective experience of being observed and sharing the road, even when the driver is physically and psychologically isolated in a vehicle. This paper is an extension of Rakotonirainy et al, 2008; it details our design, statistical analysis and findings. The reminder of this paper is structured as follows. A literature review is presented followed by the statements of the aims and the hypothesis of this study. Results of the experiment are discussed followed by a conclusion and limitations of the study.

LITERATURE REVIEW

The social impact of eye contact on human behaviour has been largely documented in the literature. Eye contact is acknowledged as a major social cue to driving safely. Argyle(1969) has estimated that when two people converse, only 30% of the communication process is verbal, the other 70% is a result of indirect or nonverbal communication. Eye gaze direction plays a crucial role in the initiation and regulation of social encounters (Kendon, 1967). Being able to make eye contact is arguably one of the major foundations of social skills. Driving is a public and social behaviour where eye contact is a crucial cue enabling social awareness. Increasing social awareness with eye contacts could result in pro-social behaviour. Adopting a pro-social behaviour is commonly considered a good driving practice (Indemaur, 1998). The distance between drivers, the physical and psychological constraints imposed to perform the driving task safely, and vehicle design (metal frames, tinted windows) prevent drivers from exchanging clear and unambiguous social cues (Vic, 2005). All of the before-mentioned impediments hinder eye contact, isolates, provides a feeling of anonymity, and reduces drivers' social awareness. Zimbardo (1969) demonstrated that individuals in anonymous situations often lose respect for themselves as well as others (disinhibition effect). Therefore it can be argued that eye contact breaks driver's anonymity and regulates social interactions and expresses a sense of intimacy (Adams, Kleck, 2005, Argyle, 1969). Fullwood and Doherty (2006) also found that eye contact breaks anonymity, brings about self awareness and creates a feeling of immediacy and pro-

duces greater perception of closeness between individuals. Furthermore research on immediacy and arousal has shown that eye contact causes the receiver to reciprocate positively with intimacy (Patterson, 1976). Such findings show that eye contact could appease driver's aggression. Recent reviews (Vic, 2005; IBM, 2008) have shown that road rage is a product of weakened social and personal controls, which can act in concert with arousal-inducing environmental circumstances, such as traffic congestion, work pressures, or family strain. The inclination to undertake unsafe driving behaviour is exacerbated by the inability to perceive or express social cues when feeling anonymous. Inoffensive acts or gestures tend to be interpreted by angry drivers as aggressive and can escalate into road rage in an anonymous environment. It is widely acknowledged in the road safety community that being aware of being looked at has a tremendous effect on driver behaviour (Vic, 2005). Social cues are important means to assess the acceptability of our own behaviour. The immediacy of human contact and the relative certainty that we would immediately and directly be called to account prevents us from undertaking anti social behaviour. The "presence" of eye contact is the most efficient way to improve the feeling of self-awareness (Argyle, 1969). These research studies show that the absence of eye contact as a social cue contributes to road violence. Regardless of the notion of presence, a vehicle and its surrounding road space are perceived as a territory that the owner will mark and protect (Fraine, 2003). The invasion of such territory, without prior warning or agreement, by another road user is a factor contributing to aggressive behaviour (e.g He took my lane !!). A warning or a tacit agreement could be conveyed with eye contacts or turning indicators. Aggressive driving may occur when social norms for defending a primary territory (i.e., one's automobile physical space) become confused with less aggressive norms for defending a public territory (i.e., the road) (Szlemsko W.J et al, 2008). Recently, it has been shown that the driving environmental context (situation) has a significant role in elicitation of anger (Deffenbacher, 2008).

Knowing the intentions of other drivers is one of the informal road rules that drivers use to avoid crashes. A key aspect of safe driving behaviour is to signal your intent when you are sharing the road. A survey done by RACQ (RACQ,2006) has shown that drivers who indicate too late or fail to indicate their intentions is among the top 5 most annoying behaviour. This shows that the absence of cues signifying driver's intention could elicit aggressive behaviour. A precise estimate on the cost and magnitude of aggression in road safety is not available. However a figure from Australia has estimated that it is likely that driver aggression and related "selfish driving" contribute significantly to the approximately 11,000 rear-end crashes in the state of New South Wales (NSW) - Australia. It costed the NSW's community between $286 and $638 million per year. These behaviours are likely to also contribute to speeding, which is estimated to involve 40% of fatal crashes (Australian Institute of Criminology, May 2006- No 311). 26% of Australian drivers are "reckless and aggressive". 23% are "careless and easily distracted"(AAMI Crash index, August 2006). A recent survey by IBM on commuters pain survey showed that nearly half (45%) of the 4,091 respondents polled in 10 major US metropolitan areas say that traffic congestion increases their stress levels. Another 28% say it heightens their feelings of anger (IBM, 2008).

Although not perfect, eye contacts could be an implicit conduit to exchange information about drivers' intentions. It has been shown that eye contact is a good predictor of attentional focus (Adams, 2005). Social presence, the sense of being with another, may be the by-product of reading the intentions (minds) of others (Nowak, Biocca, 2001). Eye gaze is one of the most potent nonverbal signals humans possess (Yee et al, 2007). The best non-verbal way to communicate intentions with other road users is to attract their attention with eye contact (Green, 2001). This is a common safe

practice for cyclists and pedestrians. Eye contact could serve to show concern for the other driver. Hence, the absence of eye contact between road users may indicate a lack of awareness of the presence of other road users.

Technology has been used to enrich casual awareness of the activities and presence of remote individuals interacting in video conference with eye gaze. The positive social effects of using eye gaze in the design of human computer interfaces has been demonstrated at length in the Immersive Virtual Environment, Human Computer Interactions and Computer-Supported Cooperative Work literature (Yee et al, 2007; Fullwood, 2006; Garau, 2004). Mechanisms to improve awareness of social cues such as eye gaze are increasingly used in Collaborative Virtual Environments (CVE). Unfortunately findings from the context awareness research community and CVE have not been transferred into road safety to reduce the burden of crashes and injuries. Immersive Collaborative Virtual Environments (CVE) are simulations in which distributed users interact through digital media space. Unlike traditional video conference facilities, CVE track subtle non verbal social cues of interactants such as eye gaze and render them in real time onto avatars in order to improve social interactions. Eye contact is a primary aid to social interactions (Argyle, 1969; Kendon, 1967). Any theory or account of social behaviour that fails to include eye gaze could be suggested to lack a critical element. The social influence of avatars featuring eye gazes and head movements monitoring have been shown in desktop environments (Yee et al, 2007). Virtual agents have been shown to make a user pay more attention (Adams, 2005) and elicit emotions such as embarrassment or self–awareness (Slater and Usoh, 1994). The presence of a human or virtual human demonstrate classic social inhibition performance impairments effects compared to those performing alone (Adams, 2005; Zanbaka et al., 2007). Mediated eye contacts influence human behaviour. The use of avatars in online interactions influence behavioural pattern and perceptions (Nowak K.L et Rau, C ((2007)). It has been shown that augmenting virtual characters such as avatars with eye gaze exerts a stronger social influence on human interactants (Vinayagamoorthy et al, 2004; Yee et al, 2007). An avatar is a digital model representing a human whose behaviour is driven by humans in real-time. An example of avatar is depicted in Figure 5. Avatars evoke a sense of social presence especially if they are anthropomorphic (human like) (Noweask, 2001). The characteristics of the design of an avatar influence how it is perceived by users (Nowak and Rauh, 2008).

Advances in in-vehicle technology to track eye gaze, head movement and vehicle dynamics allow the mediation of eye gaze between drivers of remote vehicles who otherwise cannot establish eye contact. Driving is a complex task in which the relevance of perceptual information is intrinsically linked to the driving context. Driving context includes information about the environment, vehicle and the driver. Context awareness computing research have emerged a decade ago, out of ubiquitous and pervasive computing research communities. Context awareness is increasingly used in transport to improve drivers' awareness of the driving situation. Identifying what is the most relevant information in a given context is a challenging task in context modelling. For example, being aware of the eye gaze of other road users is very important at an unsignalised intersection; however it is not necessarily relevant when there are traffic lights. Intelligent Transport Systems (ITS) are increasingly used in vehicles to improve context awareness (e.g lane departure warning systems).

Aims

There has been little research into the role of social cues to improve driving behaviour. Existing theory on CVEs and avatars cannot be accommodated to a complex driving setting. Noticeable differences between the two types of situations, which have

a fundamental impact on the design of the supporting technology, are *(i)* the driver "roughly" sees the other real driver but cannot necessarily perceive detailed social or emotional cues. *(ii)* eye contact patterns are relative to the driving situation and *(iii)* the driver shouldn't stare at the details to avoid visual distraction. Overall, existing CVE approaches lack the support for concise description, manipulation and models for reasoning about driving contexts.

Our overall objective of this research programme is to *improve drivers' social awareness by breaking the "shielded space"* with the use of an avatar with eye gaze movements. The avatar is designed to *maximize a sense of social presence by reducing anonymity and increasing intimacy and immediacy*. The sense of social presence is operationalised objectively by observing and measuring changes in the driving behaviour.

Hypotheses

H_1: *The presence of avatar's gaze has social influences on drivers' behaviour. Thus it is predicted that gaze and vehicle speed patterns will change when an avatar is present.*

H_2: *Drivers refer to the provided icons/avatars when they require information on the intention of other road users. It is predicted that eye gaze duration and eye glances towards the avatar will increase.*

H_3: *The presence of avatar does not distract the driver. It is expected that the average glance duration on the avatar is below 1.6 seconds which is the maximum allowable according to the standard in-vehicle design guidelines.*

Eye gaze exchange could disambiguate decision making in conflictual driving situations such as un-signalled intersections. Exchange of eye gaze encompasses (i) awareness of the presence of other drivers and (ii) relative knowledge about the intentions of the other drivers. Therefore, eye gaze exchange could implicitly help to reduce the likelihood of attributing aggressive interpretation to an innocent or non-aggressive behaviour and prevent escalation into real hostile situation. We hypothesize that avatars foster the resolution of conflict situations and, in turn, eliminates misunderstandings that might influence decision-making. Misunderstandings could contribute to crashes or road violence such as verbal abuse.

EXPERIMENTAL DESIGN

This case control study identifies the driving behavioural changes resulting from the presence of an avatar providing gaze information by comparing the behaviour of participants in situations with (case: "looking avatar") and without (controls: 4 types) such an avatar during confliction situations.

The simulator scenarios were designed representing situations where conflicts could occur. Conflict situations are defined as instances of time in which two vehicles are bound to collide if they continue driving at their current speeds in their current directions of motion. Intersections create such conflict situations. The scenario consists of 4-way intersections where the crossing roads are perpendicular to each other and randomly feature crossing vehicles at constant speed when they have right of the way. Otherwise vehicles slow down in order to stop at the give-way line. To eliminate learning effects, the order in which a vehicle crosses the perpendicular road drove was randomized.

Eye gaze and head movements' patterns are the only social cues that we display on the simulator's windshield as an avatar. The avatar embodies driver's eye gaze and head movement. Although the realism of the avatar is critical to elicit an experience of presence or to have the sensory experience of "being looked at"; a "looking avatar" displayed on a windshield could generate a mere curiosity that could be confounded with the

expected behavioural social effects (H_1). Therefore 4 other scenarios were created to try to isolate the effect of eye gaze from other confounding factors. The 5 scenarios display different type of icons:

- "Looking avatar"
  - A 3D rotating avatar turning dynamically towards the participant is displayed on top of the vehicle during encounters. The avatar is displayed on the windscreen when the vehicle is in line of sight to minimise visual obstructions as represented in Figure 5.
- Other icons
  - "car" only: No icon is displayed on the top of the vehicle
  - "arrow": A 3D arrow is displayed on the top of the vehicle. The arrow was designed to be the same colour and same texture as the avatar and is shown in Figure 1. It matches the avatar in size, luminosity, degree of detail and movements in order to qualify as a control object for the detection of effects of humanoid appearance and (mutual) gaze. It i
  - Arrow "turning": A 3D arrow as above, but turning towards the participant is displayed on top of the vehicle Its rotation pattern is similar to the avatar's head movements.

Figure 1. Driving scenario with an icon (arrow)

  - "head": A 3D avatar identical to the "looking avatar" but looking constantly ahead and NOT at the participant.

Following one of the fundamental ideas of the underlying research project, avatars are only displayed above other vehicles in conflict situations, i.e. where collaborative decision-making is required. It is widely acknowledged that conflicts could occur on intersections. Hence, the likelihood of crashes on intersections is high. Intersection-related crashes constitute more than 50% of all crashes in urban areas and over 30%in rural areas (Kuciemba and Cirillo, 1992) where 27% of road crashes occur. Our scenario features vehicles appearing from the left/right side of the intersections. A road signs indicate if participants have the right of way. Driver's performance related to eye gaze, vehicle's speed, and acceleration/deceleration are recorded.

HARDWARE AND SOFTWARE SETUP

Driver performance were measured with the SiVIC (Simulateur Véhicules–Infrastructure–Capteurs) fixed based driver simulator software, developed at the Laboratoire sur les Interactions Véhicules–Infrastructure–Conducteurs (LIVIC) of the Institut National de Recherche sur les Transports et leur Sécurité (INRETS) (Gruyer et al 2006), France, and the FaceLab eyetracker. SiVIc and FaceLab logged data at 1Hz to 4Hz and 60Hz respectively.

The road scene is displayed with a projector. The vehicle is controlled with Logitech's MOMO steering wheel/pedals.. Acoustical inputs are provided by Logitech G5 (5.1) speakers. The simulator setup is shown in Figure 2.The participant's head is situated at a distance of approximately 150 cm from the screen, which has a width of 170 cm. Consequently, the field of view is limited to 30 degrees to either side, which coincides with the

range in which the FaceLab eye tracker can detect accurately the exact eye gaze directions.

Graphical components such as houses and avatars[1] were created as mesh objects using the open-source Blender software. The actual rendering of the simulated driving environment was performed by the SiVIC software, which therefore bases on the Massive G (MG) 3D simulation and game engine. MG is open-source (GNU License) and relies on the OpenGL and Simple DirectMedia Layer (SDL) libraries. Software were created to log and synchronise variables related to the environment, driver and road in an XML (eXtended Markup Language) database. Variables include acceleration, speed, lateral and longitudinal position, track curvature at the current position of the car, current 3D position of the icons and the crossing car in a camera-related coordinate frame, the object the avatar is gazing at, track index of the current position of the crossing car, speed of the crossing car, time of the encounter, the parameters of the current encounter (priority, side and type of icon), participant's eye gaze direction (relative to the scene and icons).

SIMULATOR SCENARIO

The residential roads have a width of 10 m in total. The roadway is composed of straight road modules featuring intersections separated by curves. The basic structure, shown in Figure 3, is repeated 32 times, providing for 96 intersections. However each basic structure is randomly augmented with trees, houses on road sides to avoid habituation.

The total distance is 13.4km. The duration of the experiment is kept below 20 minutes. Intersections were designed to have different type of priorities:

- The participant has right of way referred as "main priority" (50%): The participant has right of way, the crossing car stops to give way.
- The crossing vehicle has right of way, referred as "cross priority" (50%). The participant has to give way.

Vehicles approaching from right and left sides of these intersections are equal in numbers. Such a number of intersections allowed us to induce

Figure 2. Simulator setup

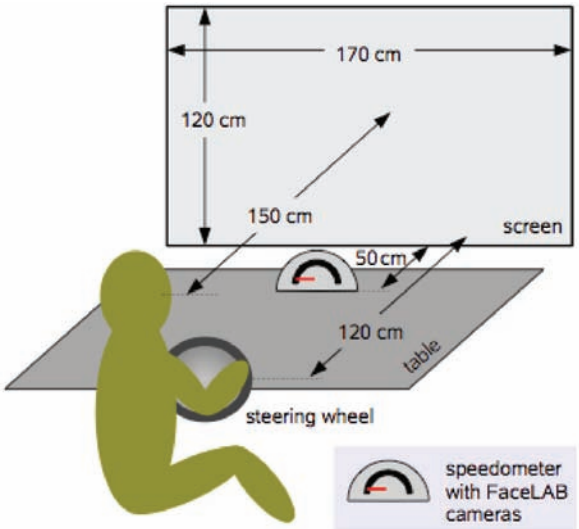
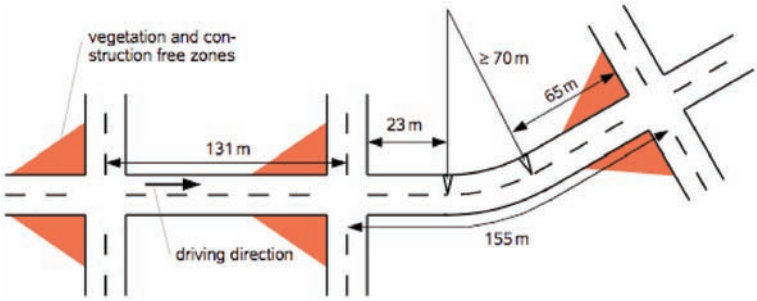


Figure 3. Road configuration

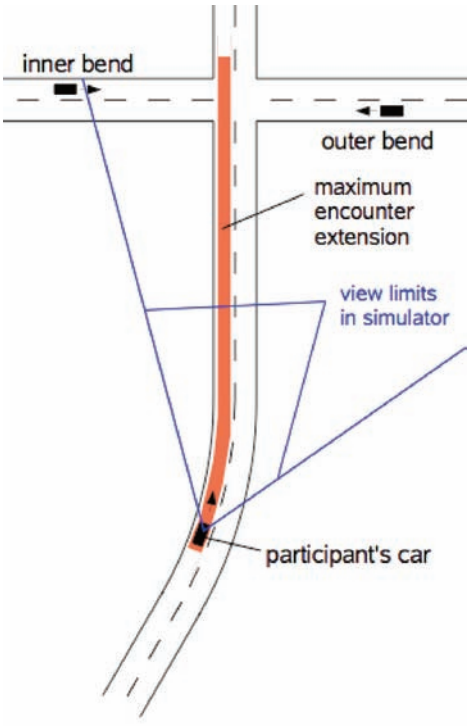


conflicts and observe consistent behaviour. Drivers are driving on the left side of the road.

Bends affect the participants' ability to detect cars and associated icons in the simulator. The notion of outer and inner bends is shown in Figure 4 and will be taken into account during the analysis.

Houses, vegetation and signs were placed on each side of the road to provide realistic features. Figure 5 shows such a driving environment.

Figure 4. Influence of bends on visibility



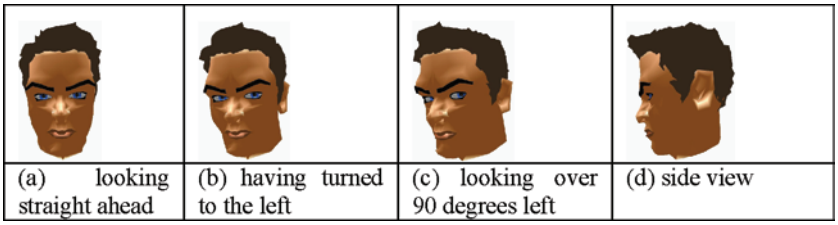
AVATAR'S APPEARANCE AND EYE GAZE

Avatar's appearance could be quite diverse however ours is anthropomorphic, but not photorealistic, and realistically imitates human visual behaviour. Figure 6. In order to convey social presence without attaching personality characteristics, we choose to have a non-photorealistic avatar. The non-photorealistic rendering describes an abstract representation of the content which emphasizes the information implicitly rather than making it visually plausible (Shin et al 2008).

We have conducted empirical observations on how drivers look at each other on intersections and we have modeled such behaviour on the avatar. We choose not to link up the avatar's behaviour with a real driver in real time as we wanted to expose exactly the same pattern of eye and head movements to all participants. Using a

Figure 5. Driving environment with avatar

Figure 6. Rotating avatar



(a) looking straight ahead	(b) having turned to the left	(c) looking over 90 degrees left	(d) side view

real human to generate the behaviour would have introduced variations in the avatar's eye and head movement patterns.

PARTICIPANTS

Since the present investigation is a pilot study and intended to shed a first light on the reaction of humans to avatars in a driving context, it does not impose stringent requirements on the selection of subjects. For instance, as no quantitative estimation of benefits is intended, the constitution of the sample does not need to represent the driving population, and the preliminary character of the study justifies a small number of subjects. 12 researchers/students (8 males, 4 females, mean age = 28 years) recruited from the Faculty of Health of the Queensland University of Technology participated in the study. Participants hold a driving license and have good eye sight.

PROCEDURE

Upon arrival, participants were briefed about the equipment to be used and the task. They were asked to drive normally and respect road rules. A researcher spent 7mn to calibrate the eyetracker on each participant. The researcher stayed in the room during the entire experiment. Participants had a 5-10 minutes practice where they encountered different type of situations (cars without avatars/with avatars not looking at them). The eyetracker were calibrated to each participant during the practice. The participants were asked to give general comments about the study at the end of the experiment.

RESULTS AND DISCUSSIONS

For analysis, the experiment is broken down to encounters. An encounter is defined as the period of time when the two vehicles approach an intersection. It starts when the crossing car is launched and ends when the participant has passed the intersection. Depending on the participant's speed, this corresponds to a zone of 55 m to 110 m in front of the intersection. All metrics including gaze, speed, and acceleration are computed on this interval and assigned to the encounter. In addition, each encounter is characterized by the type of displayed icon, the right of way situation and the side the crossing vehicle approaches from. Statistical analysis is performed to identify characteristics and differences between the encounters experienced by all participants, i.e. not on differences between individual participants. Since some intersections do not feature a crossing vehicle, each of the 12 participants has 80 encounters. Thus, we obtain a total of 960 encounters.

The gaze duration, i.e. the total time the subject's eyes gaze at the icon during an encounter, is the central metric in evaluating the impact of the display of icons on drivers' gaze behaviour. Due to limited eye tracker precision, we have to allow for an error margin and also count gaze at

the icon's adjacencies. In turn, gaze at the vehicle would partly be considered as gaze at the icon. In a first step, we therefore compute the duration of gaze at both the icon and the vehicle as the total time the gaze dwells inside the large window depicted in Figure 13a. Nevertheless, a metric for gaze at the icon itself would be better suited to describe the impact of avatars. We therefore introduce a second detection window without error margins as shown in Figure 13b. Since the gaze duration for the small window does not cover all gaze actually directed at the icon, it only allows for relative comparisons. The values cannot be interpreted absolutely. In addition, the small detection window is inappropriate for metrics strongly influenced by the correct detection of the gaze target at particular instants of time. Such metrics include detection time and the number of glances.

The statistical analysis has been performed using linear model based methods of the statistics package R. As far as relevant for the present analysis, these methods test the statistical significance of the influence of multiple factors using factorial ANOVA, provide predicted values including confidence intervals for the explained variable for all combinations of relevant factor levels, and perform pairwise significance tests between combinations of factor levels. In order to single out significant main and interaction effects of the design parameters on the explained variables, a first linear model has been fitted, taking main effects into consideration in the following sequence, along with all possible interactions of factors one through five:

1. Priority or right of way (cross, main)
2. Bend direction if before intersection (no, inner, outer)
3. Height of visual barrier in front of the intersection (high, low)
4. Side of vehicle's approach (left, right)
5. Type of displayed object (car only, arrow, head, turning arrow, looking avatar)
6. Phase of experiment (start, middle, end)

Non-significant effects have then iteratively been omitted, except for non-significant main effects of significant interactions, in order to obtain a model only containing statistically significant explanatory variables. A significance threshold of $\alpha = 0.05$ has been assumed.

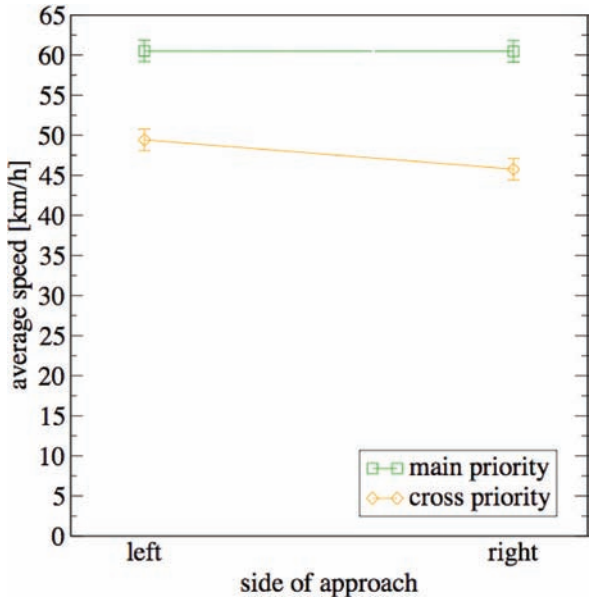
Average Speed Relative to Encounters

The participants' speed when approaching the intersections is an important metric in assessing the actual driving behaviour. Statistical tests showed that some encounter parameters such as priority have significant influence on the average speed, but not the icons. Figure 7 summarizes the cases where participants have or do not have the priority and a vehicle can appear from left or right. It shows that, for main priority, velocities are independent of the side and considerably higher than for cross priority, where a difference between sides of approach is observed. The effect of the right of way situation is simply explained by the need to decelerate when giving way in the cross priority case, whereas no behavioural adaptation is required when the participant has right of way. The difference of speed relative to priority indicates that the participants see and respect road signs. The speed difference relative to direction of the crossing vehicle when the participant has to give way may trace back to effects of the geometry of the driving scenario. In addition, a slight increase of average speeds has been observed during the experimental runs.

The ANOVA on the average speed yields significant main effects of priority ($F_{1,945}$=547,14, p<.001), side($F_{1,945}$=17.06, p<.001) and phase ($F_{1,945}$=4.29, p=.014), as well as an interaction effect between priority and side ($F_{1,945}$=10.61, p=0.0012). The resulting model allows explanation of a considerable fraction of 38.7% of the observed variation in the average speed.

The speed of the participants when presented with different icons did not show significant

Figure 7. Interaction diagram of side and priority for average speed



statistical difference. Such an observation could be interpreted as invalidating the H_1 hypothesis. However we will see later that it is not necessarily the case.

Gaze Duration

The gaze duration, i.e. the total time the subject's eyes dwell inside the (large) detection window during the encounter, is one of the central metrics in evaluating the impact of the display of icons on drivers' gaze behaviour. For statistical analysis, the gaze duration has been normalised by individual's means. Technically, normalisation has been performed as follows: If $t_{g,i,j}$ is the gaze duration of subject i (i = 1,..., N_s), N_s being the total number of subjects, at the j-th encounter out of N_e, then the gaze duration normalised per subject is

$$t_{g-normS,i,j} = \frac{t_{g,i,j}}{\overline{t_{g,i}}}; i = 1...N_s, j = 1...N_e$$

where $\overline{t_{g,i}}$ is the average gaze duration of all encounters with non-zero gaze for subject i:

$$\overline{t_{g,i}} = \frac{\sum_{j=1}^{N_e} t_{g,i,j}}{\sum_{j=1}^{N_e} sign(t_{g,i,j})}; i = 1,...N_s$$

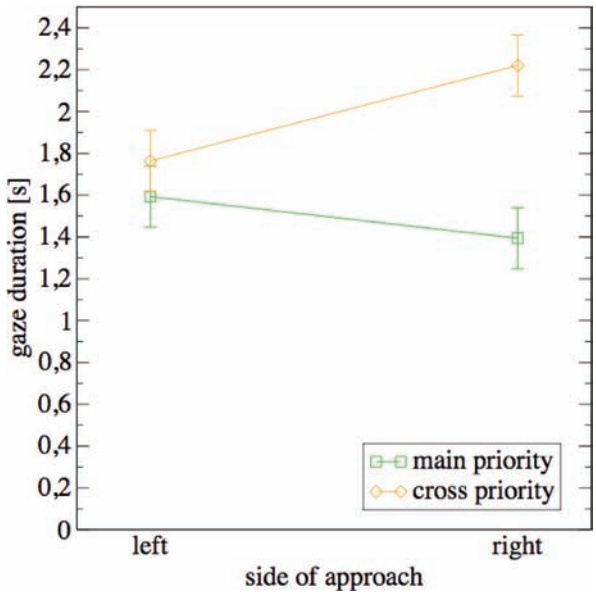
$sign(t_{g,i,j})$ being usable to count non-zero items because of $t_{g,i,j} \geq 0$.

This normalization which yields the largest share of variability explained by the resulting model is motivated by substantial differences between subjects, which might conceal effects of the investigated factors. Values have been denormalised for presentation.

The analysis of variance performed on the normalised metric found the main effects of priority ($F_{1,941}$=112.02, p<.001), bend ($F_{2,941}$=11.77, p<.001), side ($F_{1,941}$=7.60, p=0.0059), and type (of icon) ($F_{4,941}$=5.06, p=0.0005) to be statistically significant. 17.6% of the observed variation is explained by the resulting model.

The dependence of the gaze duration on the right of way situation and the side of approach is given by the interaction diagram in Figure 8. It exhibits a main effect of priority and shows that

Figure 8. Interaction diagram of side and priority for gaze duration



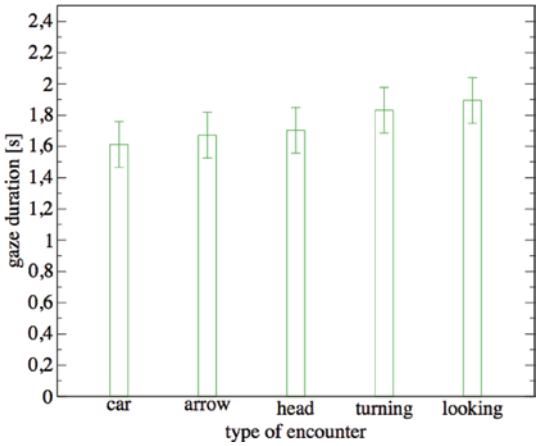
the cross condition provides longer gaze. This observation may be explained by the difference in encounter duration, as subjects pass the crossing vehicles at higher speeds in the main priority condition, leaving them less time to gaze at the crossing objects.

Considering the actual interaction, we see that, in the cross condition, gaze duration is substantially longer for vehicles approaching from the right. This may be explained by a combination of lower speeds of the participant's vehicle when they approach a crossing car on the closer lane, and the better visibility to the right due to the asymmetry of driving in the left lane, which allows for earlier detection of the crossing vehicle. A potential inclination of subjects to primarily check traffic on the lane they are about to enter first may amplify this effect. In case of main priority, an opposite effect of side is observed. It may partly be explained by the absence of a difference in encounter durations due to side in the main condition. Besides, drivers may pay less attention to objects further to the periphery of their field of view.

The gaze duration is the first metric to show some dependency on the type of icon displayed above crossing cars. Statistically significant differences are observed between the avatar "looking" at the participant and the static icons ("arrow" and the avatar not turning towards the subject called "head") as well as the "car" only. The "looking" avatar exhibits the longest gaze duration. This supports the H_1 hypothesis and H_2 partially. The differences between the "turning" arrow and the static "arrow" as well as the "car" without any displayed icon are statistically significant. Considering the numerical differences provided in Figure 9 we find approximately three different levels allowing for two explanatory factors.

Both the static avatar and the arrow receive somewhat more gaze than the baseline case of a vehicle without icon. This is expected from theory since an abrupt onset, i.e. the sudden appearance of an object, in particular in a prominent position within the field of view, is supposed to attract visual attention. The same applies to a foreign, novel object not expected in the scene. Both characteristics apply to the icons, so they are expected to attract additional gaze.

Figure 9. Dependency of gaze duration on the type of encounter (or icon)



The "turning" arrow and the "looking" head attract an additional share of gaze as compared to the static icons ("head" and "arrow"). This observation conforms to theory since a moving object is supposed to receive more visual attention. In particular for a dynamic task like driving, motion of objects is an important source of information, and visual resources are assigned accordingly. The fact that the effect of "turning" is statistically significant in contrast to the effect of appearance suggests that the former one is more reliable. Nonetheless, the sheer presence of an icon is not negligible, an object needing to be present in order to turn.

Number of Glances

The number of glances, i.e. the number of separate periods of time where the subject's gaze dwells inside the detection window featuring the vehicle and icon, has been included in the evaluation. An ANOVA yielded significant main effects for priority ($F_{1,945}$=178.79, p<.001) and bend ($F_{2,945}$=3.94), p=0.0199), along with an interaction of priority and side ($F_{1,945}$=30.11, p<0.001). The model additionally taking the main effect of side into account allows for an explanation of 18.2% of the observed variability. The type of the displayed icon has no significant effect on number of glances. Such finding supports the H_3 hypothesis as it indicates that the display of an avatar does not "disturb" the glance pattern.

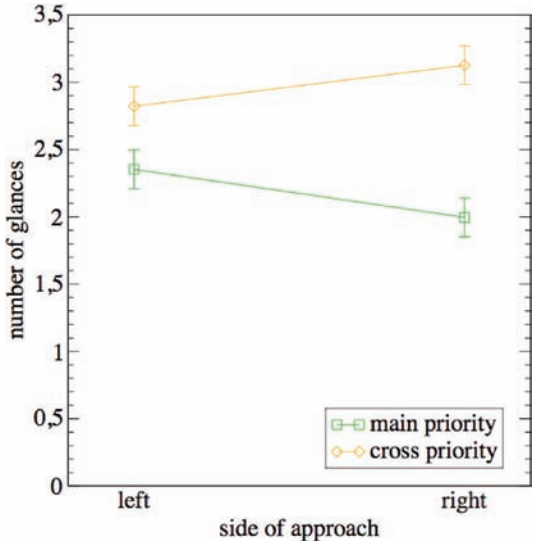
The diagram of priority and side in Figure 10 shows trends similar to the gaze duration, which may explain why glance durations are largely independent of these explanatory factors. One may state that in case of cross priority, more glances at the crossing vehicle are required to negotiate the correct speed to pass behind it, an effect particularly prominent when the car approaches from the right, i.e. when the distance to potential collision is the shortest.

Glance Duration

Glance duration is an important distraction metric. As such, its potential dependence on different icons or other parameters is of secondary importance, and it will be considered over all cases. In addition, the mean is not the only statistic of interest; devices attracting few, long glances may threaten traffic safety more than devices exhibiting slightly longer mean glance duration. Consequently, we are interested in the probability distribution of the glance duration, and in the percentage of glances exceeding some safety-critical threshold.

As an approximation of the probability distribution of the observed glance duration, the histogram

Figure 10. Interaction diagram of side and priority for the number of glances

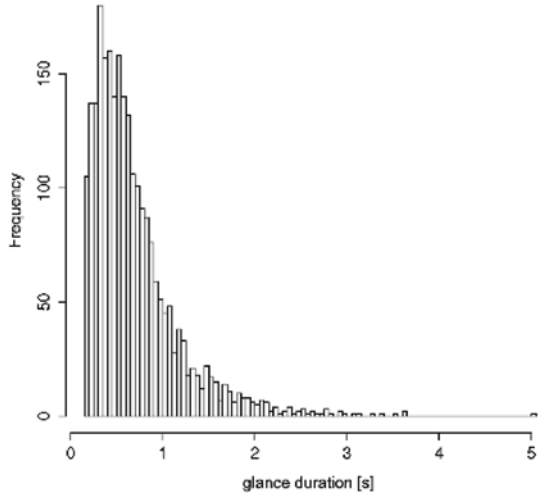


is plotted in Figure 11. It shows that the majority of all glances are shorter than one second, the average being of 691 ms, below the threshold of 1.6s formulated in the Battelle Guidelines for on-road use of in-vehicle devices. The maximum glance duration of 2s postulated by the BSI guidelines is only exceeded by 2.32% of all glances, and a negligible fraction of 0.325% falls above 3s. Therewith, we can still consider the avatar or control object safe for on-road use, since they do not form a classical in-vehicle device requiring the driver to avert their gaze from the road when operating it. An additional feature being projected onto the road environment, the requirements in terms of maximum glance duration can be relaxed, since drivers still perceive the traffic environment by means of peripheral view while looking at the icon. This supports the H_3 hypothesis.

GAZE DURATION FOR A SUBSET OF PARTICIPANTS

The results presented in previous sections were based on gaze metrics captured in large detection windows only. This section additionally uses a small window as illustrated in Figure 14-b. The gaze directed at the icon itself is of fundamental interest for this study aiming at the evaluation of the impact of the type of icons on drivers' gaze behaviour. Unfortunately, the metric expressing the amount of this gaze, the gaze duration inside the small window, is plagued by eye tracker errors, which additionally required the restriction of the set of participants. Some participants never gazed at an unlikely high number of icons according to the eye tracker data, suggesting very poor accuracy of the gaze signal. Figure 12 illustrates this effect, giving the percentage of encounters during which no gaze was detected inside the window for each participant and for both window sizes. In order to avoid distortion of the findings due to misses qualifying as measurement artefacts, a subset of subjects showing a relatively high tracking accuracy has been selected for the gaze duration analysis involving small windows. Lacking information on the actual tracking accuracy, an a posteriori definition based on the fraction of missed objects has been used. As a reasonable tradeoff between the number of tolerated misses and the number of subjects remaining in the subset, a threshold of 20% of maximally allowed misses

Figure 11. Histogram of glance durations



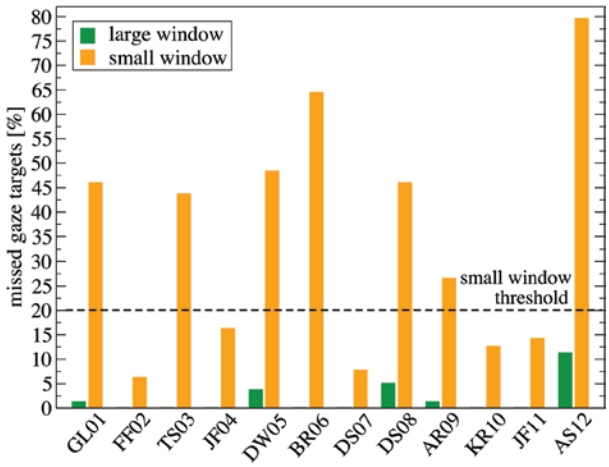
has been chosen. Thereby, five subjects remain in the sample, three males and two females.

Despite these limitations, which may particularly impact on the generalisability of the results, some intriguing effects are revealed by statistical analysis.

Reference Gaze Duration in Large Detection Windows

The observation how drivers' visual attention is distributed between crossing vehicle and displayed avatar or control object is highly instructive. It can be obtained by comparing gaze durations in small and large detection windows for different icons. Since the visual behaviour of the subset

Figure 12. Percentage of encounters without any gaze at the target, for each subject and both large and small windows



of participants may differ from the behaviour of the entirety, the previously presented figures for the gaze duration are inappropriate for this comparison. We therefore discuss the large-window gaze duration for the subset of participants first.

As for all participants, the gaze duration was normalised per subject. The ANOVA yields significant main effects of bend ($F_{2,308}$=8.63, p=.0023) and phase ($F_{2,308}$=3.54, p=0.0303), along with two interactions: The first, of priority and side ($F_{1,308}$=29.65, p<.001), is remarkable as neither of its contributing factors is significant as a main effect. The second one, between bend and barrier, does not appear sensible and is likely an artefact due to small sample size and unbalanced experimental design. It has therefore been dropped from the analysis, reducing the fraction of explained variability from 15.4% to 13.2%.

The interaction diagram of side and priority in Figure 14 shows that the grand mean of the gaze duration of the subset of subjects is greater than the one for all subjects. The increase is particularly pronounced in the main priority condition, leveling out the main effect of priority. This is partly explained by longer encounter durations in this condition compared to all participants. The interaction effect resembles the observation for all participants and allows for the same explanations.

The influence of the displayed icon on the gaze duration is not statistically significant. The plot of the raw averages in Figure 15 reveals that there is also little numerical difference between the conditions displaying some icon (looking avatar or control objects). Only the sole car attracts somewhat less gaze.

Gaze Duration in Small Detection Window

In large windows covering the car and the icon, normalisation of the gaze duration per participant allowed for the largest share of explained variability. In contrast, normalisation by the respective encounter duration provides for the best-fitting ANOVA model for the gaze duration in the small detection windows only comprising the icons. This implies some dependency of the gaze duration on the encounter duration. The normalised gaze duration was computed as

$$t_{g-normE,i,j} = \frac{t_{g,i,j}}{t_{e,i,j}}; i = 1,...N_s, j = 1,...,N_e$$

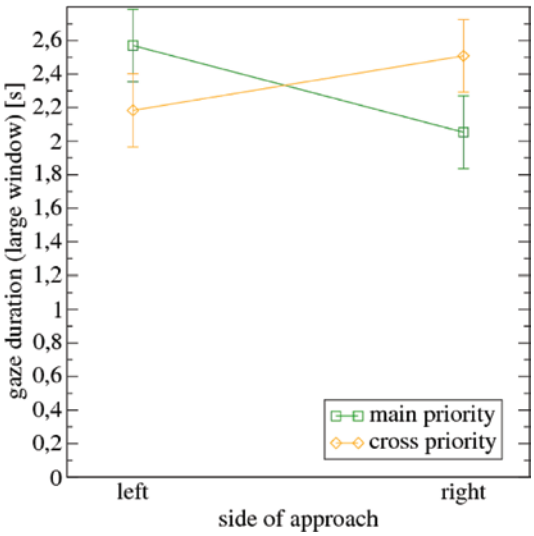
from the gaze duration $t_{g,i,j}$ and the encounter duration $t_{e,i,j}$, for the j-th encounter of the i-th subject. Analysis of variance has been done on this normalised metric, and resulting predictions have been de-normalised by multiplication by the grand mean of encounter durations for presentation.

The implication that small-window gaze durations depend on the encounter duration, while gaze durations for the large windows do not, suggests some valuable interpretations. On the one hand, longer encounter durations tend to

Figure 13. Detection windows

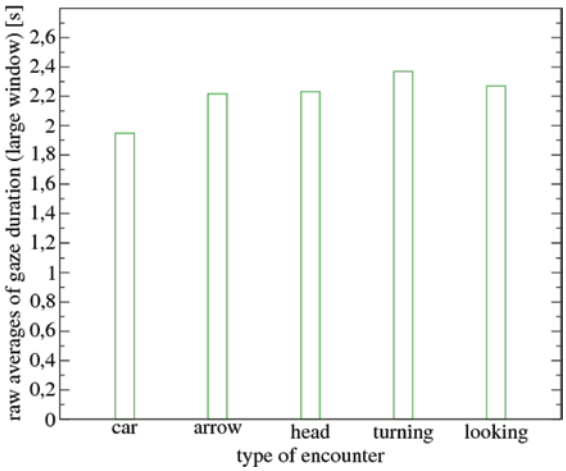
(a) large window (with error margins) (b) small window

Figure 14. Interaction diagram of priority and side for gaze duration of subset of participants in large window



coincide with lower velocities of the participant's car, and independently thereof, are likely to leave the subject more time to react to the traffic situation. Accordingly, extended gazing at the avatar or control object can be considered a luxury only possible in potentially less demanding or less stressing situations. This is partly due to a decrease in the need for gaze at the crossing vehicle under such conditions, since the duration of gaze at the combination of icon or car, being less influenced by the encounter duration, seems dictated by the driving manoeuvre rather than by the demand of the concrete situation. Reformulating the argument, one could say that participants focus their attention on the icon giving additional information when they have the time to do so. Otherwise, i.e. if essential information for driving decisions in a potentially tense situation is likely to be required,

Figure 15. Raw averages of large-window gaze duration depending on displayed icon for subset of participants



they fall back to the unambiguous standard source of such information – the crossing vehicle.

On the other hand, however, the dependence of the duration of gaze at the target on the encounter duration may also trace back to the experimental situation. When encounters are long (in time), chances are that participants already see the combination of vehicle and icon from far. In this case, the avatars and control objects of constant size are a more likely target of gaze than the distant car, which then appears relatively small on the screen. If the encounter is short and the crossing vehicle thus likely to be detected when it is already close, its projection on the screen is considerably larger and may therefore attract more gaze than the icon.

Besides this preliminary analysis, the influence of the encounter parameters is of particular interest. The ANOVA performed on the usual set of factors found 16.1% of variance explained by the three main effects of priority ($F_{1,310}$=34.61, p <.001)), side ($F_{1,310}$=5.04, p=0.0255), and type of icon ($F_{1,310}$=8.57, p<.001).

The interaction diagram of side and priority for the gaze duration in small windows in Figure 16 suggests that there is a considerable main effect of priority, unlike for gaze at both car and icon (i.e. in the large window) by the subset of participants. This suggests that participants, while attributing equal amounts of visual attention to the approaching objects (i. e. vehicle and icon) in both priority conditions, spend a larger share of this attention on the icon when they have right of way. This fact allows for an interpretation supporting hypothesis H_2: When having right of way, the crucial information drivers need is whether the crossing car is going to slow down in order to give way, as demanded by the road signs. That is, information on the other driver's intention is required, and apparently participants referred to the icon in these cases. When having to give way, in contrast, the crucial information drivers need is the relative distance and speeds of the crossing car in order to adapt their velocity to pass behind the other vehicle. Such information is more precisely obtained by gazing at vehicle itself, i. e. by the real object in the natural environment, rather than by the – artificial – icon which is additionally displayed. Accordingly, a larger fraction of gaze is attributed to the vehicle in the cross priority condition.

Figure 16. Interaction diagram of side and priority for gaze duration in small windows for subset of subjects

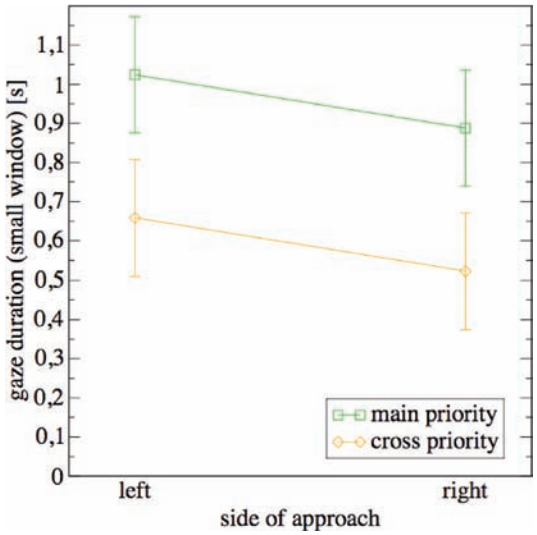


Figure 17. Dependency of gaze duration of the subset of subjects in small windows on the type of icon

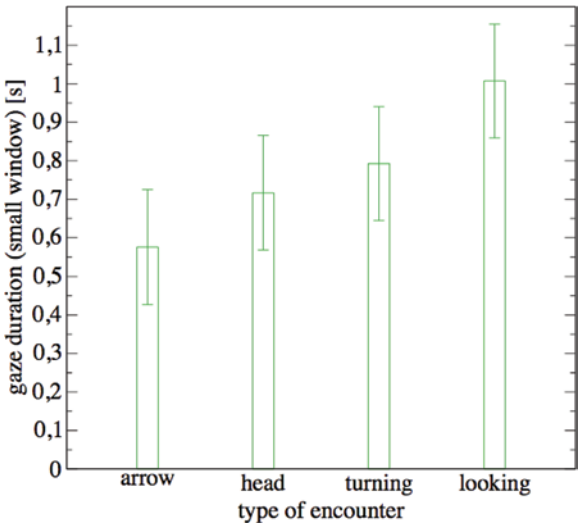


Figure 17 depicts the impact of the 4 types of displayed icons on the gaze duration. Differences between the "looking" avatar and all other cases are statistically significant, as is the difference between the static "arrow" and the "turning" arrow.

As expected, a significant effect of movement is observed for both the "looking" avatar and other control icons. There is also an – at least numerical – effect of the type of icon, the humanoid avatar attracting more gaze. The fact that the difference in gaze durations between the "looking" avatar and the "turning" arrow is larger than the one between the respective static objects is remarkable, as it may be indicative of the occurrence of perceived eye contact.

This observation supports H_1 hypothesis. As indicated by the glance durations, the system complies with the in-vehicle design requirements in terms of distraction (H_3). In particular, the gaze duration was measured on moving objects. Concretely it refers to "smooth pursuit" of a moving object relevant to the primary driving task. The gaze duration is not on a static object which is not relevant to the primary driving task. If it was the case then it would generate distraction (against (H_3)). The measured gaze pursuit is on moving objects critical to the driving task and could therefore be associated with cautious behaviour towards critical cues (H_2).

CONCLUSION

27% of crashes in the US occur on intersections. 80% of them are due to human errors where (i) lack of awareness of the presence of others or (ii) lack of knowledge of the others' intentions are contributing factors. The second most cited commuter frustration is aggressive drivers (IBM,2008). Gaze is an important component of social interaction. This project developed a largely unexplored multidisciplinary methodology on the dynamic interplay between social awareness, traffic psychology and Intelligent Transport Systems (ITS). It builds on existing social theories, in which eye contacts play significant roles. We introduced new techniques for conveying social/intentional information through avatars with the view to improve situational awareness and decision making. Extensive research is needed to show that in-vehicle avatars can objectively reduce road

rage and improve road safety. However this preliminary study laid the basis for such future study.

The gaze directed at an avatar was of fundamental interest for this study aiming at the evaluation of the impact of icons on drivers' gaze behaviour. It showed the 3 hypotheses are verified.

H_1: *The presence of avatar's gaze has social influences on drivers' behaviour.*

- Though this study did not use objective measurement such as questionnaires to assess social occurrence, the longer gaze durations to looking avatars are coherent with the assumption of the existence of eye contact. Drivers do not gaze significantly at icons which do not convey eye contacts. The perception of being looked at was reported informally by a majority of participants, supporting this hypothesis.

H_2: *Drivers refer to the provided icons/avatars when they require information on the intention of other road users*

- The experiment showed that drivers refer to the avatar when needing information on the intention of others. It could be argued that conveying gaze directions may solve the problem of coordination in intersections by easing turntaking. Eye contact is a good cue for providing information on who saw who on a shared road. Furthermore eye contact helps to know about the intention of others.

H_3: *The presence of avatar does not distract the driver*

- The number of glances and time spent gazing at the avatar does not indicate an unsafe distraction by standards of in-vehicle device design and is not expected to increase driver's workload.
- Avatars seem to be consulted primarily in less demanding driving situations, which underlines their non-distractive nature.

Making eye contact and looking into the eyes of another person is recognized as one the most potent non verbal cues that human possess. These findings have implications for theories in CVE, context awareness, computer mediated communication, and driver assistance systems. As existing technology becomes more pervasive, the ability to improve the awareness of the presence of the others would transform social interaction pattern on our roads.

LIMITATIONS

The broad social claims on which this research is based could be seen as not directly linked to the experiment as we focused on objective measures resulting from manipulating social context. However we have shown how the different experimental conditions relate to the informational role of the avatar in helping to predict the behaviour of the other driver (as shown by the static and moving arrows) versus the social role of the avatar in reminding the driver that the approaching vehicle is being driven by a person just like them (as shown by the turning avatar). It should be noted that this is a pilot study and represents one step in working towards an understanding of the social context of driving.

This driving simulator study is a simplified version of the complex real world situation. It lacks the social context provided by a naturalistic condition. A naturalistic study was not feasible due to safety reasons. Therefore caution should be taken in extrapolating the validity of this preliminary study to real driving conditions. Research should be further continued in both real and simulated driving conditions to assess the safety benefits of this new method. Furthermore, the small sample size and representativeness limits the expressive-

ness and robustness of results. With respect to the experiment, the random order in which the icons were presented may have limited effects as the participants could not get habituated to the presence of the same icon. Lastly, as many in-vehicle sensors, the eyetracker introduces spatial imprecision and delay when synchronized with the driving simulator events. Such errors could affect the quality of the analysis.

Our analysis of eye contacts would need to be extended with comprehensive psychology based subjective assessments. For example it might be argued that excessive eye contacts (e.g between male and female) could generate hostility and have the opposite effects of the desired behaviour described in this study.

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ENDNOTE

[1] The 3D model the avatar is derived from is licensed under a Creative Commons Attribution 3.0 United States License and is Copyright © 2003-2009 Andrew Kator & Jennifer Legaz.

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