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Values and Perspectives Affecting IT Systems Development and Usability Work

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Abstract

Computer supported work is often stressful and inadequate computer systems and poor usability contribute to the problem. Still the work situation, and work environment of users are seldom considered when developing computer systems, and it is difficult to incorporate the ideas of User Centred Systems Design (UCSD) in practice. Hence, this research addresses the difficulty in integrating usability, UCSD and occupational health issues in IT systems development in order to improve the resulting work situation and well-being of users. How do basic values and perspectives of stakeholders in systems development projects affect the work with UCSD, usability and users' health issues in the organisations studied?

This research aims at influencing systems development in practice; hence, research is carried out in real life settings with an action research approach. Data is gathered and analysed with a qualitative research approach with interview studies, meetings with stakeholders, analysis of documentation, observations and field studies. The theoretical framework adheres to situated action, participatory design, and UCSD that stresses the importance of involving users in the design process.

This research shows that several basic values and perspectives affect systems development and hinder the usability work, for example, the perspective on user representatives, the value of rationality and objectivity, and the perspective underpinning descriptions and discourse on work. Moreover, this research indicates that the strong business values of automation, efficiency and customer satisfaction shape the development of new technology, and ultimately the tasks and work practices of the civil servants. In short, the studies show that there are some contradictions in business values and the implementation of user-centred systems design, usability and health issues in systems development.

Attitudes and perspectives are not easily changed, and change comes gradually. In these organisations, we continuously discuss the integration of health issues in systems development, and by introducing and changing the models of systems development these will hopefully enable communication and change forwards of new perspectives and values. However, a focus on models alone is insufficient and therefore we need to develop a systematic approach to include reflection and new perspectives. Perhaps the reflection itself would help us see our values and perspectives and to alter them?

List of Papers

The following papers are included in this thesis, and they appear in chronological order.

Paper I: Work Environment and Computer Systems Development.
Authors: Bengt Sandblad, Jan Gulliksen, Carl Åborg, Inger Boivie, Jenny Persson, Bengt Göransson, Iordanis Kavathatzopoulos, Stefan Blomkvist and Åsa Cajander.
Publication: Behaviour and Information Technology (2003), Vol. 22, No. 6. pp.375-387, Taylor & Francis.

Paper II: Key Principles for User-Centred Systems Design.
Authors: Jan Gulliksen, Bengt Göransson, Inger Boivie, Jenny Persson, Stefan Blomkvist, and Åsa Cajander.
Publication: Behaviour and Information Technology (2003), Vol. 22, No. 6. pp.397-409, Taylor & Francis.

Paper III: Management Perspectives on Usability in a Public Authority – a Case Study
Authors: Åsa Cajander, Jan Gulliksen and Inger Boivie.
Publication: Proceedings of NordiCHI 2006, ACM Press, 2006

Paper IV: Usability and User's Health Issues in Systems Development - Attitudes and Perspectives
Authors: Åsa Cajander, Inger Boivie and Jan Gulliksen.
Publication: Forthcoming in E. Law, E. Hvannberg, G. Cockton (eds.) Maturing Usability; Quality in Software, Interaction and Value. Springer Verlag (2007).

In addition to the papers above, I have participated in a HCI 2005 Workshop on Lost - or Liberated – Without Theory in Edinburgh, UK. At this workshop we discussed theory in HCI and wrote a short position paper. Moreover, I have presented my research at the Doctoral Consortium at the HCI 2006 Conference (Cajander 2006) and at the Doctoral Colloquium at NordiCHI 2006.

In this summary the papers are referred to as paper I, paper II etc.

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Outline of Thesis

This thesis consists of two sections. The first section contains a summary of the research, followed by a section with the four papers that are included in the thesis.

The summary aims at giving a richer picture of the work performed and consists of the following chapters: Chapter one gives an introduction of the research including research focus, a presentation of the organisations studied and a description of the research project. Chapter two describes the theoretical framework which includes organisational theory, the area Human Computer Interaction, organisational culture, values and perspectives, the Demand-Control-Support Model, Situated action and Participatory Design and UCSD. Chapter three describes the methodology and briefly presents action research, qualitative research as well as data collection, analysis and quality criteria. Chapter four gives a more descriptive analysis of the research results, and this is followed by a summary of the four papers. Chapter six includes a discussion and interpretation of the results, and chapter seven suggestions for future research work. Finally, the thesis contains a brief summary in Swedish and acknowledgements.

Contents

Preface

A few months ago we interviewed system developers, the project manager and users in a project that was referred to as an ideal systems development project working according to user centred principles. The idea behind the interviews was to capture the success factors of the project, and after having interviewed the system developers, and the project manager we were astonished, and amazed of how well the collaboration in the project seemed to work. During a short lunch, we talked about what we had heard, and the senior usability researcher who participated in the study said something like:

> "For the first time it seems that I have come across a project where things really work well".

However, this picture really changed in the afternoon when we talked to the users and the procurer of the system. It was true that they had meetings with the system developers, and that the project complied with many principles of User Centred Systems Design (UCSD). Nevertheless, they experiences that the system developers set all the rules, and that they had no control of how the project was going and how the system would work. They felt that they trusted the system developers, but that the system developers were in control of the system - not the users, nor the procurer. Moreover, the users had had to describe their work as flow diagrams in use cases, and they saw no point in this, and they had rather described their work in ordinary text.

During these interviews, it became clear to me that principles of UCSD, methods and system development processes alone cannot change design practice, even though they contribute in different ways. There has to be a shift in values, and perspectives as well, or as Eleanor Wynn puts it:

> "Perhaps the shift in design practice also is more a way to be than a thing to do". (Wynn 1991)

Hence, this thesis focuses on why it is so difficult to work with usability in practice, and how values and perspectives affect the integration of UCSD, usability and user's work in the systems design process.

Uppsala, 2006-11-08
Åsa Cajander

1. Introduction

Poor usability[1] and a stressful work situation is still a significant problem in computer supported work, despite several years of research efforts to increase focus on these issues. A number of health[2] problems related to Information Technology (IT) use have emerged, e.g. muscle ache, and stress-related disorders, both mental and somatic. Some people in our studies also describe a close connection between their work environment and the computer system that they use, for example a civil servant in one of the organisations:

> ”We lived a rather happy life until a couple of years ago when we introduced two new computer systems”

Even though some health problems relate to inadequate IT systems with poor usability, the work situation of users is seldom considered when developing computer systems (Boivie 2003). In spite of efforts to change the situation, the work organisation and job design are often largely shaped by IT systems. Or, as Clegg et. al puts it:

> “Regarding the impact of new technology on the way which work is organized and upon individual job design, the majority view that this is hugely important but largely ignored in practice” (Clegg, Axtell et al. 1997).

In our research, we have found numerous examples where the job design and the work situation of users will change, but this is seldom considered

[1] The ISO 9241-11 definition of usability is used throughout this thesis:
”Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specific context of use”
ISO (1998). ISO, 9241-11: Ergonomic requirements for office work with visual display terminals. Geneva, International Organisation for Standardiza-tion.

[2] This thesis is based on the WHO constitutional definition of health is "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”
WHO. (2006). "WHO Constitution." Retrieved 2006-10-05, 2006, from http://www.searo.who.int/LinkFiles/About_SEARO_const.pdf.. The WHO definition has been criticised, as one can argue that health cannot be defined as a state at all, but must be seen as a process of continuous adjustment to the changing demands of living and of the meanings we give to life. Therefore, the WHO definition is here considered to be an idealistic goal.

when developing IT (Sandblad, Gulliksen et al. 2003). Or, as one system developer realized during one interview:

> "In a way one can say that the new systems will make it more boring for the civil servant. I mean, /…/ 80% of the cases will be processed automatically. We develop windows for the exception, and mainstream cases are supposed to be processed automatically"

Society might face significant problems concerning the health effects of computer-supported work, for example stress related problems partly due to lack of overview (Boivie, Blomkvist et al. 2003). Usability of computer systems, the future work situation, and social and organisational issues must therefore be taken into consideration when developing IT systems. The complexity of work must be acknowledged, and system developers must consider users as people that perform skilled work. According to Åborg (2002) many methods used in IT systems development are insufficient to prevent work environment and health problems encountered in administrative case handling work, and hence needs to be complemented or altered to better address health problems and work environment problems.

This research focuses on understanding the difficulty in integrating usability, user-centred systems design and occupational health issues in IT systems development in order to improve the resulting work situation and well-being of users. This thesis particularly focuses on how basic values and business values affect this integration.

1.1. Research Focus

Systems development is a social process consisting of complex organisational and human problems and there are often representatives from several business units within the organisation who participate in different ways and with different goals in the system development projects. Hence, this research considers the organisational environment in which systems development takes place. The unit of analysis is people in the organisations who are stakeholders in systems development project, and who have power to change or impact systems development methods. The main motivation behind the work is to improve the work situation of users, and to impact systems development in practice. In this thesis I try to understand why it is so difficult to work with UCSD, usability and users' health issues in practice, and specifically how values and perspectives affect the introduction of usability, UCSD and user's health issues in systems development.

Hence, the main goal for this research is to impact systems development to include usability, health aspects of computer-supported work, user involvement and the future work situation.

Complexity of organisations is one area of interest in this research, and in Human Computer Interaction (HCI) in general, from this perspective, systems development is not merely about developing software, it is about business development and organisational change as well. Organisational culture can hinder or help organisational change, as organisational culture is a set of ideas, values and norms in an organisation. The organisational culture shapes ideals and guidelines for understanding and actions made in the organisation, and affect for example decisions and communication (Nationalencyklopedin 2006). This research does not specifically address organisational culture, as organisational culture is a broad subject, but addresses the subset here defined as basic values, perspectives and organisational business values. Organisational business values are here defined as beliefs and ideas about what kinds of business goals members of an organisation should pursue, as well as ideas about the appropriate kinds or standards of behaviour organisational members should use to achieve these goals. Basic values and organisational business values differ in that basic values are general, and not specifically connected to business goals. The concepts of values and perspectives are further explored in section 2.4.

This is the research focus of this licentiate thesis as illustrated in Figure 1.

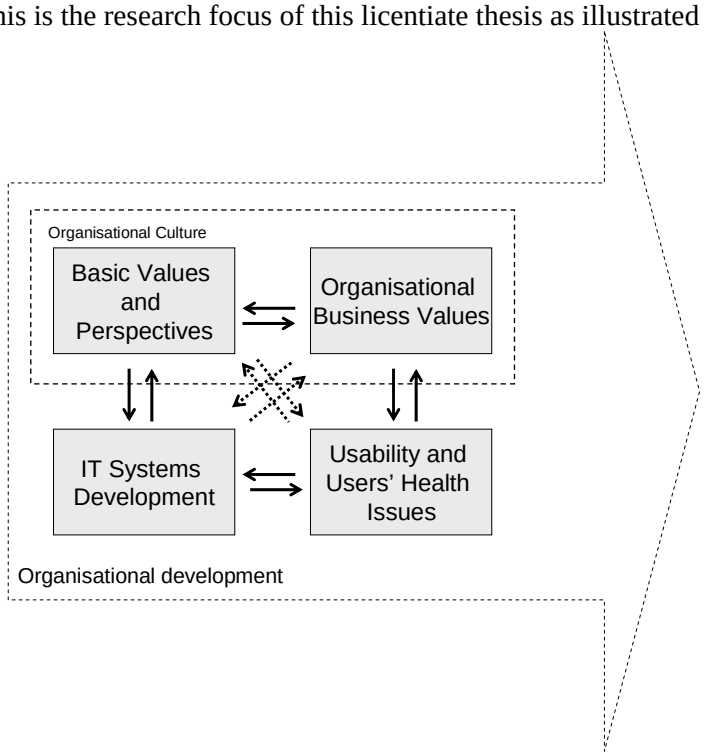

Figure 1. A model of the research area

In the figure my research interest is the relation between basic values and perspectives, and usability and user's health issues. However, the relation

between these two is discussed in relation to organisational business values and IT Systems development. My main research question in this work has been to better understand:

How do basic values and perspectives of stakeholders in systems development projects affect the work with UCSD, usability and users' health issues in the organisations studied?

During the analysis of the results, my main research question has been broken down into two detailed questions.

What perspectives and basic values underpinning IT systems development complicate the goal of improved users' health and increased usability?

How do organisational business values affect the work with usability and UCSD?

The two first papers included in this licentiate thesis provide background information about systems development and computer supported work and key principles of UCSD. The last two publications present studies where the discussion focuses on attitudes and values. In this summary the results from these studies will be further compiled and reflected on in order to answer my research questions. However, these results are far from complete, and this licentiate thesis only includes preliminary results and findings.

1.2. The Organisations Studied

This research studies in-house systems development where developers and users work in large government organisations. The systems development projects included concern maintenance or production of computer systems used primarily by civil servants in the organisation. The civil servants work in an office environment (see Figure 2) with cases concerning for example student loans and legal business documentation.

Figure 2. A picture illustrating the work domain of the research: office environments.

Most of these civil servants perform computer supported administrative work where they use information from different computer programs, or web services together with paper manuals and instructions to make decisions (see Figure 3). When a case is completed it is saved in a database, and often it is retrieved and reviewed later when a new case concerning that person or business is initialized. Since the majority of work is performed using computer systems, users spend most of their time in front of their computers.

Figure 3. An example of a civil servant sitting in front of his computer doing case handling work.

In these organisations, a typical systems development project is initiated due to changes in the legislations. There is often a tight time limit, as the computer system has an absolute dead line that cannot be changed. Further descriptions of the different organisations can be found in paper III and IV.

1.3. The Research Project - Satsa Friskt

The research presented in this thesis is a part of a large action research project where five senior researchers and three Ph.D. students work together towards the project goals. In this research group participants have different backgrounds, and different experiences that contribute to an interdisciplinary research group. This teamwork is essential in our research, and contributes to better understanding of the organisations and the research area.

The project is financed by Utvecklingsrådet, in the area of Human – IT, and is called Satsa Friskt (Utvecklingsrådet 2006). Satsa Friskt has the following goals

- To improve the work environment.

- to reduce sick leave
- to prevent long-time sick leave
- to reduce future sick leave

The purpose of Satsa Friskt is also to increase knowledge about usability and a good computerized work environment and to improve the work situation of the civil servants in the government. Moreover, focus is on increasing knowledge among all parties involved in developing computerized work with lectures, workshops and other information activities.

Here follows a short description of each of the authorities participating in Satsa Friskt and their subprojects.

Bolagsverket (the Swedish Companies Registration Office). Their subproject is called NyttIT and started in June 2006 and will continue for three years. So far we have had an introductory series of three workshops where problems related to systems development and work environment were discussed. The first workshop concerned health risks generally, and methods for analysing consequences of new IT-systems on the work environment. When changes are made in organisations that affect the work environment, the employer is obliged to perform a consequence analysis to capture future risks[3]). The second workshop concerned user participation, and problems and possible solutions were discussed. The third workshop aimed at suggesting improvements in implementation and education when introducing new computer systems. Moreover, we have worked with a usability index for the organisation, and have made two exploratory interview studies. Currently we are planning a pilot project at Bolagsverket that will focus on implementing the ideas that were discussed in the workshops. I spend most of my time in this project and participate in most of the activities included in the NyttIT project. Paper II is partly based on studies performed at Bolagsverket.

CSN (the Swedish National Board of Student Aid). CSN started their AVI project about two years ago, and plan to continue another year. I have worked in the project with different activities, for example interview studies and participation at meetings. Papers III and IV describe studies from this work.

Migrationsverket (the Swedish Migration Board) and SMHI (the Swedish Meteorological and Hydrological Institute) have merely started their 3 year long projects. So far I have not participated in this project.

Lantmäteriverket (the National Land Survey of Sweden) and TPB (the Swedish Library of Talking Books and Braille) participated in the introduc-

[3] "When planning changes in tbe business, the employer is to judge if these changes will imply health risks or accident risks that might need attention" Arbetsmiljöverkets (2001). Arbetsmiljöverkets författningssamling (AFS), Systematiskt arbetsmiljöarbete."

tory studies but due to different reasons they have not started any project financed by Utvecklingsrådet, Satsa Friskt.

2. Theoretical Framework

In this licentiate theses, the word theory is used in the sense of “an idea or set of ideas that is intended to explain something about life or the world” and consists of “general principles and ideas about a subject” (www.ldoceonline.com 2006).

This research is based on a constructivist perspective, where we create and understand our reality by using language through communication, and interpretations are flexible, situated and socially constructed. When people talk about usability, they might use the same words on a communication level, but the conversation might still mean different things for them as they have different perspectives. Thus, our perspective loads usability with different meanings, assumptions and attitudes at the same time as the word usability might alter our perspective and way of looking at and interpreting the world around us.

In my research I use theory in different ways. Before and during action research projects I reflect on my role as a researcher, on my attitudes and assumptions since data is socially constructed between the researcher and the informant. I aim at understanding my own preconditions guiding the research even though it is difficult. Moreover, I strive to iterate between the parts and the whole that they form of the complexity in a system development project. I also try to understand the social and contextual situation of the research project, and multiple interpretations of phenomena. When writing up about the studies try to relate and interpret the findings through theoretical and general principles.

The first cornerstone of my research is that our perspectives will mirror what we see when looking at the world in general and the research questions in particular. Consequently, all research is based on some underlying assumption about what constitutes valid research, and what research method is appropriate (Hirschheim 1992). It is however complex to describe perspectives and frameworks since descriptions reflect our personal conceptual framework within which our approach to the world is framed (Kammersgaard 1990; Chalmers 1994). My view is that researchers can only present their view of a problem, which may contain valuable insights and thoughts that can contribute to a deeper understanding. I do not believe that there is a single, objective or factual account of events or situations. Instead, I seek a deeper understanding of a phenomenon. Research of complex phe-

nomena like systems development projects can never be an objective description of reality or as Wolcott puts it in his unfinished sentence:

> "Never forget that in your reporting, regardless of how faithful you attempt to be in describing what you observed, you are creating something that has never existed before. At best it can only be similar, never exactly the same as what you observed. And at worst.." (Wolcott 1994)

2.1. Organisational Theory

My theoretical framework partly based on theories underpinning organisational theory. Different perspectives and their contribution to a better understanding is an area discussed in organisational theory, and the literature within the area often reflects the perspective that organisations are socially constructed. People create meaning and understanding of what organisations are, and what organisations do. Thus, it is impossible for researchers to study organisations without studying people's images and understandings of organisations. Consequently, there is not only one aspect of organisational studies since there are multiple views and interpretations.

Metaphors and models are often used in organisational theory to explore and develop the art of reading and understanding an organisation (Bolman and Deal 1997). Morgan's Images of Organisation (Morgan 1997) has been of great importance in defining different metaphors. However, metaphors have different implicit images that "can create powerful insights that also become distortions, as the way of seeing created through a metaphor becomes a way of not seeing" (Persson 2004). Morgan's idea is that organisations can be many things at the same time, depending on what perspective you use when looking. The complexity, ambiguity and paradox nature of an organisation must be taken into consideration if we want to gain a deeper understanding of an organisation. In Morgan's opinion, the machine or structural metaphor has a pervasive influence that is beyond dispute, and consequently it is of special interest. "Scientists have produced mechanistic interpretations of the natural world, and philosophers and psychologists have articulated mechanistic theories of human mind and behaviour" (Morgan 1997). This metaphor elevates the importance of rational and structural dimensions of organisations, and we have learned to use the machine as a metaphor for ourselves and our society in accordance with mechanical principles. This metaphor can prove extremely effective in some contexts, but every so often it can have unfortunate results as it is biased, and obscures human aspects.

2.2. Human Computer Interaction

Over the last decade, the area of Human Computer Interaction (HCI) has grown substantially. Cognitive psychology and theories about how a human interacts with a computer, that were once viewed as providing sound foundations for HCI have become obsolete "as the focus of research moved beyond information processing to include how the use of technology emerges in social, cultural and organisational contexts" (Kaptelinin, Nardi et al. 2003). Many argue that the study of HCI is now effectively a boundless domain (Barnard, May et al. 2000). New theories emerge at a rapid pace, and the situation is somewhat overwhelming. Theoretical foundations include for example phenomenology, distributed cognition, grounded theory, etnomethodology and activity theory (Rogers 2004). This development has contributed to a scientific foundation "far more rich, far more diverse than the starting points in the early 1980s" (Carroll 2003). Consequently, HCI is multidisciplinary and multi-theoretical with a diversity of perspectives, which is both difficult, confusing, and a part of the dynamics in this research area. However, humans and human actions are complicated and therefore I believe that different angels, different perspectives and mental models complement each other rather than exclude each other. That which holds the variety of perspectives together is their potential to contribute to a better understanding of computers in use and study of work.

In HCI there has been a process of mutual learning between computer science and social science (Sommerville, Rodden et al. 1993). People interested in technology issues have become interested in the social world of work, and researchers working on common projects have at times turned to qualitative methods and studies. Moreover, and I agree with previous workshops on theoretical frameworks in HCI indicate that "the field is far too complex and rich to be forced into hypothesis that can be quantitatively tested" (Rogers 1994). However, this shift towards social science confronts researchers with different philosophies of science that have existed in social science for a long time. These alternative frameworks support research methods that may not appear to be scientific to scientist schooled only in positivistic traditions (Hirschheim and Klein 1989; Hirschheim 1992). Qualitative studies are seen by some as subjective, not testable and simply not scientific, and others see them as the only meaningful studies (Wallén 1996).

Moreover, there are a number of different opinions of the role of theory in HCI research, for example: "Theory, theory on the wall… there is no magic mirror after all" (Castel 2002). Castel expresses the opinion that "computing itself is just too unwieldy a field for any theory of substance." Many researchers and practitioners believe that HCI will not benefit from further development of theories, while others claim that a common body of theory is the only solution. Furthermore, considerable time and effort is required to fully understand how to use many of the new approaches in HCI since "HCI

can still be seen as a rather young discipline, which is reflected in a methodological mix in which one can easily lose a clear frame of reference" (Persson 2004). It is a challenge to attain the width and depth of knowledge needed. Moreover, it is not easy to compare and contrast different approaches since they differ on many dimensions. It has even been argued that theories may be incommensurable (Feyerabend 1975), and consequently such a comparison is unrealistic.

2.3. Organisational Culture

Culture is a complex concept, and this area will only be briefly discussed in this thesis as it is a part of the future work and the future doctoral thesis.
In anthropology, culture refers to a way of living among particular people. Organisational culture can be interpreted to refer to the same phenomenon in an organisational context where culture consists of the ideas, values and norms that are specific to an organisation. These ideas and values guide the way people in the organisation interact with each other and with stakeholders outside the organisation. It is an informal, interpretive aspect of an organisation, and the climate or spirit that shapes ideals and goals. Organisational culture affects decision-making and communication as well as systems development and usability as it consists of beliefs and ideas about what kinds of goals members of an organisation should strive for as well as ideas about how to achieve these goals. The culture in an organisation is communicated and displayed in symbols, stories and scenarios that reflect ideals and values, as well as in other aspects such as organisational structure (Nationalencyklopedin 2006).

One of the main ideas behind organisational culture is that an organisation can be seen as a small society in itself with its own cultural features. However, it would be naive to believe that a single culture exists in all organisations, or that it would reflect the interests of all stakeholders within an organisation. Complex organisations have many sub-cultures, and that these might overlap and contradict each other.

In HCI organisational culture has been recognized as an important object of study, and the effects of organisational culture on computer systems implementation have been studied. Iivari and Abrahamsson have described studies of organisational culture and User Centred Design (Iivari and Abrahamsson 2002; Iivari 2004) as well as how organisational culture affects user involvement, and how usability experts represent the users (Iivari 2006). Previous studies have also focused on the subculture of Information Systems Employees in organisations (Guzman, Stanton et al. 2004). Moreover, analyses have been made from a socio-cultural point of view on procurement and meanings that have been attached to usability. Here results have shown that

usability is seen from a business perspective and not from a user perspective (Artman 2002).

2.4. Values and Perspectives

We are continuously exposed to different situations and impressions, and our ability to simplify, create order and interpret these are crucial for our survival. To be able to create order we need a perspective as a starting point of our interpretations. The creation and reproduction of our perspective will inevitably affect our way of acting and thinking in different situations. When we reconstruct the world through our perspective, we will also construct our own identity. However, this process of continuously interpreting and reproducing is seldom something we think of as we seldom think of how language, models and artefacts are tools for us to interpret the world through different perspectives. Hence, language and the use of words help us create our understanding, at the same time as words also are carriers of implicit assumptions and perspectives of the world. Moreover, perspectives and values affect the choice of different behavioural alternatives, which are perceived to be possible for us.

Parts of our perspective might be known to us, while other parts are unknown, and our perspective is based on assumptions that might be implicit or explicit. Moreover, different perspectives are much influenced by the thoughts of our time, and the current trends as they are shaped by contemporary culture. Things are indeed seen differently from different perspectives and the perspective used determines many essential characteristics of our actions (Nurminen 1987), and one example is that they impact the result and the systems we build. As a result, it is of great importance that we consider what perspective and values we have, and its implications on the result.

At first glance the words perspectives, values and attitudes might seem related. However, when looking them up in a dictionary you realise that values is “your ideas about what is right and wrong, or what is important in life” (www.ldoceonline.com 2006). The world perspective is more general, and is not connected to the notion of right and wrong and is “a way of thinking about something, especially one which is influenced by the type of person you are or by your experiences” (www.ldoceonline.com 2006). The word attitude, on the other hand is “the opinions and feelings that you usually have about something” (www.ldoceonline.com 2006).

The discussion and interest in values and perspectives in systems development is not new in HCI, and the conflict between different perspectives has been extensively discussed, see for instance (Kammersgaard 1990; Greenbaum and Kyng 1992; Orlikowski and Gash 1994; Persson 2003; Persson 2004; Boivie 2005). Others, for example Liam Bannon have concluded

that when working with user centred design, problems arise due to implicit views of humans:

> “Part of the problem resides in an implicit view of ordinary people which, if surfaced, would seem to treat people as, at worst, idiots who must be shielded from the machine, or as, at best, simply sets of elementary processes or “factors” that can be studied in isolation in a laboratory. (Bannon 1991).

Previous research from our department relates to the topic in this licentiate thesis, for example Jenny Persson (Persson 2003; Persson 2004) who looks at values and systems development, and how research related to common sense, and Inger Boivie (Boivie 2005) who discusses different ways of viewing users and their work.

Moreover, other research has shown that the systems theoretical perspective, and systems perspective, as described by Nurminen (1987) and Kammersgaard (1990) respectively, is deeply rooted in software engineering projects. Many approaches to systems development origin in an engineering-oriented view of the world which is closely related to the systems theoretical perspective. This system perspective is of course not bad in itself, but it is necessary to understand that it is not sufficient to use any perspective alone. Some researchers stress that by shifting between perspectives, it becomes possible to gain a better understanding when designing computer systems (Nurminen 1987).

Recent research related to perspectives and values includes the ideas of reflective design where researchers have argued that "reflection on unconscious values embedded in computing and the practices that it supports can and should be a core principle of technology design” (Sengers, Boehner et al. 2005). This research has resulted in a set of principles and strategies for making systems development a reflective design process. Moreover, HCI research on values has focused on design to support moral values of human welfare and justice in the world (see for example (Friedman 1997)).

In contrast to this research agenda, I emphasize values and perspectives of people in the organisation, and how these affect the organisational development. Hence, this research considers the different perspectives and basic values that affect the work when trying to introduce the principles of UCSD in systems development.

2.5. Healthy work, the Demand-Control-Support Model

In the 1970's Robert Karasek developed a model for analysing work-related stressors associated with cardiovascular illness. His demand and control model was thereafter further developed together with Töres Theorell (Karasek and Theorell 1990), and is now one of the most widely used models for explaining psycho-social work conditions, and their effects on health. This model suggests that the combination of perceived demands and perceived control at work is a determining factor for stress. Figure 4 illustrates the Karasek and Theorell model. High job strain, i.e. high demands in combination with low decision latitude, is associated with the highest risks for health problems.

When new IT systems are introduced in the work place, users sometimes feel that the demands on their performance increase which can be stressful. Karasek Theorell's model shows that this is not a problem provided that the control and support factors are within acceptable limits. However, research shows that subjective control and support factors often decrease when new systems are introduced (Åborg 1999; Åborg 2002). The relation between IT systems development and work environment is further discussed in paper I.

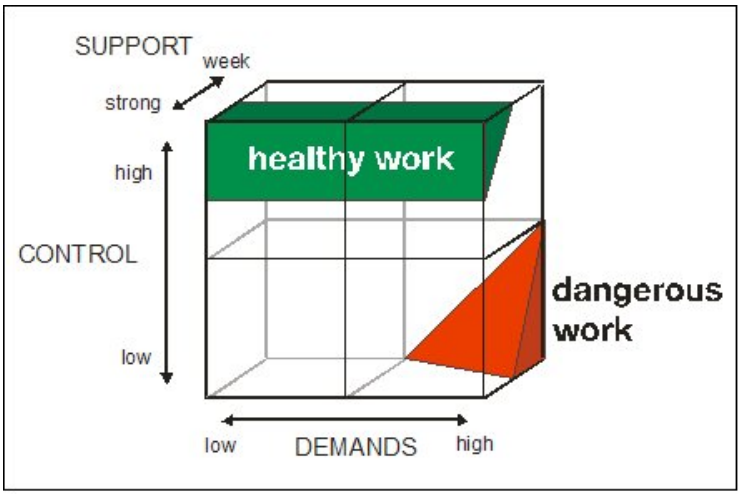

Figure 4. The model illustrated the relations between demands, control and social support in a work situation (Karasek and Theorell 1990). This version of the model originally appears in (Johansson 2005).

2.6. Situated Action

My theoretical framework adheres to situated action (Suchman 1987), as I perceive users to be highly variable in how they use computers in their work. Often users carry out their work in quite a different way to that modelled or predicted. The Situated Action approach views human knowledge and interaction as being inextricably bound to the world, and claims that it is impossible to study phenomena extracted from their context. Work and work practice is situated, and depends on and is shaped by circumstances in situations, as described in the Situated Action approach. Most people do not carry out their task sequentially, but tend to be multi-tasking, dealing with different kinds of interruptions, and at the same time carrying out a range of activities. The area of interest in situated action is how users use their particular circumstances to achieve intelligent action. Hence, situated action argues for a bottom-up approach, where work is described from the point of view of practical accomplishments of people.

Situated Action and ethnographic studies can provide descriptive accounts of informal aspects of work, and can constitute a complement to formal methods and models of software engineering. The study of work has developed as a method within the field of system design and Situated Action has contributed with a framework from which to talk about work practices and high-level concepts like context. Systems development could benefit from analysis that focuses the users' particular work situation rather than creating models of how people ought to interact with computer systems. In short, computer systems must be flexible enough to meet these needs of users.

However, it is sometimes difficult to remain faithful to the descriptive epistemology of ethnography when it comes to working and acting in real projects and action research projects working with improvement of system development methods and practices. One problem is time, and another is the focus on describing work and practice, rather than inventing and changing the future. In-depth analysis of work is interesting, but difficult to fully apply in our research to the extent required by ethnographers due to lack of time and money.

2.7. Participatory Design and UCSD

My theoretical framework also partly originates in participatory design, PD (e.g. (Greenbaum and Kyng 1992; Asaro 2000; Bødker and Iversen 2002) PD stresses the importance of involving users in the design process, and argues that they have a right to be involved in the design of the systems that they will subsequently use. However, there is no clear definition of what research assumptions underpin the approach since the area of PD has been growing rapidly--in terms of numbers of practices, extent of theoretical development, numbers of practitioners, and geographical and institutional diversity of practice. Participatory design has evolved during the last twenty years and has somewhat moved away from its political agenda towards a pragmatic view where the quality of experience is in focus (Asaro 2000; Bødker, Ehn et al. 2000).

Moreover, UCSD (see paper II) is a starting point in my research. UCSD is a user-centred process focusing on usability throughout the entire development process, and further throughout the system lifecycle. As has been noted by other researchers, however, user-centeredness is a multidimensional concept (Iivari and Iivari 2006), and therefore the key principles of our view of UCSD needs to be included in this thesis (for further details see paper II):

1. User focus – the goals of the activity, the work domain or context of use, the users' goals, tasks and needs should early guide the development
2. Active user involvement – representative users should actively participate, early and continuously throughout the entire development process and throughout the system lifecycle
3. Evolutionary systems development – the systems development should be both iterative and incremental
4. Simple design representations – the design must be represented in such ways that it can be easily understood by users and all other stakeholders
5. Prototyping – early and continuously, prototypes should be used to visualize and evaluate ideas and design solutions in cooperation with the end users
6. Evaluate use in context – baselined usability goals and design criteria should control the development
7. A professional attitude – the development process should be performed by effective multidisciplinary teams.
8. Usability champion – usability experts should be involved early and continuously throughout the development lifecycle
9. Holistic design – all aspects that influence the future use situation should be developed in parallel
10. Processes customization – the UCSD process must be specified, adapted and/or implemented locally in each organisation.
11. A user-centred attitude should always be established.

3. Methodology

3.1. Action Research

Perhaps the best way to transfer and test theory-based knowledge to the real world is to participate in real organisational development, as applied research. Action research is an approach that is "unique in the way it associates research and practice, so research informs practice and practice informs research synergistically" (Avison, Lau et al. 1999). Action research has dual aims and is intended to produce both action (change) and research (understanding) as it encourages researchers to reflect on the effects of interventions and the implication of their theories. In our projects, researchers cooperate closely with the other participants in the systems development projects and "research is conducted with people rather than on them" (Lauge, Baungaard et al. 2004). The dual aim of action research as both practical problem solving and testing theory provides a win-win scenario for both researchers and participants.

The epistemology of action research is that there is a strong connection between knowledge and action, as described by the pioneer of the methodology Kurt Lewin: "if you want to know how things really are, just try to change them" (Lewin 1958).

Action research is a research approach with a cyclical process in contrast to traditional research which is often presented as proceeding from research question via method to results and discussion, as a linear process. Hence my research process is not linear, but circular and the empirical data and previous results drive the research as it evolves. Different researchers have illustrated the action research cycle in different ways and most illustrations include at least planning, acting and evaluating or reviewing. Figure 5 illustrates one Action Research cycle. Some cycles also illustrate the dual aims of action research, as one problem solving process and one research process (McKay and Marschall 2001).

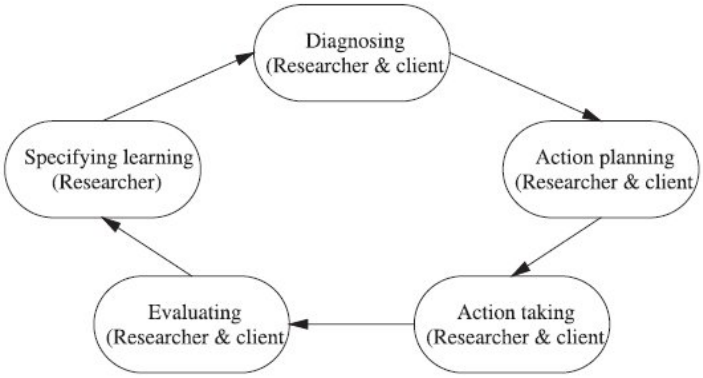

Figure 5. One example of an action research cycle. (Susman and Evered 1978)

Action research is the methodology within which my research is framed, however one needs to be aware that it has been criticized, and there is a methodological discussion about threats and antidotes in the methodology (Kock 2004). Moreover, action research articles are rarely published in major North American publications (Baskerville and Wood-Harper 1996). Here should be noted that the critics often reject some of the paradigmatic assumptions embodied in Action Research (McKay and Marschall 2001). One of the issues that is criticized is the question of objectivity, as the researcher participates in the planning and works in the projects. Moreover, action research is based on case studies, that are difficult to generalize from and some critics have difficulty in recognizing the scientific value and rigour of action research.

The dual aims of action and research, described above, also constitutes one of the most difficult parts to deal with, as time is an important factor in the organisations we are working with in our research project. The organisations and people constantly change; hence we are trying to gain deeper understanding of a moving target. Studies are made, and results from the studies are reported back to the organisations thus generating development and change. However, since time is limited, the analysis needs to be done quickly and as soon as possible in order to generate the intended result.

3.2. Qualitative Approach

I position myself as an interpretive researcher, in the qualitative research tradition. The interpretive research tradition tries to attain a deeper understanding of reality, and research can be classified as interpretive if it is assumed that our knowledge of reality is gained only through social constructions such a language, consciousness, shared meanings, documents, tools, and other artefacts (Klein and Myers 1999). Interpretive research does not

predefine dependent, and independent variables, but focuses on complexity of human sense making as the situation emerges and it attempts to understand phenomena through meanings that people assign to them. However, I will also conduct quantitative research as well to further understand user participation since I believe that qualitative and quantitative research methods may complement each other. Different scientific epistemologies might be incommensurable (Feyerabend 1975), but that does not mean that the practical methods are impossible to use together.

Data has been gathered through a research diary, notes on paper, mindmaps and mp3 recordings of interviews, meetings and less formal conversations. The research presented in paper III and IV is based interview studies, meetings with stakeholders, analysis of documentation and observations. When writing up data in paper III and IV, data was first reviewed to identify general patterns and later reviewed again to iteratively develop patterns and categorize the informants' statements and to verify and elaborate data. In both studies, mind maps were used in the analysis when identifying patterns. Individual quotes illustrating a perspective or basic value were compared, grouped and regrouped. To enhance validity several researchers have analysed and interpreted data. In Paper III data was collected through semi-structured interviews as well as through a case study. Results from the case study and from the interview studies were analysed with the aid of mind maps with quotations and relevant information on paper strips.

Much positivist research is based on the criterion of replication, which means that if the same or other scientists repeat the research process they should come to the same conclusions. However, this criterion is not relevant in qualitative research, as both the participants and the researcher have changed during the project and it is not likely that results would be replicated. Instead, qualitative research should be measured by other quality criteria, and in papers III and IV we have try to conduct research according to the seven quality criteria and principles established by Klein and Myers for interpretive qualitative research (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

Moreover. we adhere to the quality criteria described by Lange, Baungaard et al (2004): Transparency, Consistency and Validity. Transparency means that persons who have not been involved in the project should be able

to follow the process through descriptions and illustrations. Consistency implies that the researcher must be able to explain why a specific research method is used to understand a specific problem. Finally, researchers must apply some criteria of validity and address the question: “Am I doing good work” (Lauge, Baungaard et al. 2004)

This research has been conducted with a qualitative approach, as the goal has been to better understand why it is so difficult to work with usability in practice and users’ health issues, and how values and perspectives affect the work with introducing usability and health issues in systems development. Action research and qualitative research leads to contextual in-depth knowledge, and should not be generalized but is sometimes possible to transfer to other settings. The organisations and the findings are not unique or unusual and hopefully the reader will find this research applicable in other settings.

4. Results

My main research question concerns perspectives and values, and how they affect the work with UCSD, usability and users' health issues in practice. Paper III and IV both address this research question whereas Paper I and II are to be seen as background descriptions. In the below summary of results, I will briefly present results related to my two detailed research questions. In this description, scenarios and quotes from the research illustrating perspectives and basic values will be added. The first detailed research question concerning what values and perspectives in systems development affect the work with UCSD, usability and user's health issues in practice, is discussed in the first results section and the second question is discussed in the last section.

The results in this thesis are not fully developed and a detailed analysis and discussion will be found in my doctoral thesis. For a detailed account of the results so far please read papers III and IV.

4.1. Values and Perspectives in IT systems Development

4.1.1. Perspectives on User Representatives

In my research diary I have often written about how people in the organisation talk about user representatives, and how they believe that they contribute in the system development projects. Working with user representatives is considered optional in several of these organisations (see paper III), hence indicating a perspective on systems development where user participation is not seen as a central part, but as something that adds extra value. User representatives are not seen as crucial for the success of a systems development project.

Moreover, there are several perspectives that affect who is appointed user representative in the systems development projects. One of the most prevalent perspectives affecting this choice is *time and efficiency* (see paper III). A consequence of the efficiency perspective is seen in the choice of users for the role of user representatives. Here user representatives that are used to working in systems development projects, and who know the methods and

language used are preferred as participants in the systems development project since it perceived to be the most efficient way to work. Often the same people participate in different development projects, and many of them have not worked with case handling in years. Hence, civil servants become “IT workers” to the extent that this is considered a career path in the organisations. Preferably, the user representative should also be a skilled domain experts, as well as skilled users of the computer systems.

Often people in the organisations maintain that they do have many user representatives. From their perspective, the domain experts who have worked in the systems development projects for years are still representing the users. However, my experience is that knowledge and experience from systems development disqualifies them as user representatives since they have become much more knowledgeable than the average user of the system. Hence, the number of domain experts gives a false feeling that the organisation works according to the principle of active user involvement (see paper II).

Furthermore, generally the IT projects seem to be appointing user representatives, and they have the power to decide who will work in their project. One example of this is that during a lunch with a system developer, she described an argument where a business unit had appointed a user representative without discussing the matter with the IT department, and this resulted in a crisis meeting. Moreover, the practice of appointing the same user representatives over and over again is not easily changed even though people agree that it is better:

> "You pick your dream team. You agree on a theoretical level that it is important to pick new people from the organisation, but when it comes to practice it is difficult"

The role of the users and their contribution in the projects vary to a large degree, both between the organisations, but also between different projects within the same organisation. However, it seems that the most common task is to test functionality and to review specifications, requirements and system descriptions. Users are seldom involved in prototyping activities or in the system design. Some of the user representatives we interviewed said that their role in the projects was unclear and confusing. They sometimes felt frustrated and uncertain about what they were supposed to do. On the other hand, some of them saw an opportunity to define their own role and areas of responsibility, seeing that this makes it possible to work with parts that interest them, and where their contribution matters the most.

Another problem described by the user representatives was that the language used in system development is different from their own. They cannot use their every day vocabulary when participating in projects, and this makes

it difficult for them to understand and to contribute in discussions in the projects:

> "You speak different languages".
>
> "You are silent. You don't understand anything that they say."

The user representatives said that these language barriers make it difficult to talk to programmers, and that it takes years to learn the programmers' vocabulary and way of speaking. Moreover, some of the user representatives felt that they are "on lowest rank" in the development projects, and that they have little possibility and power to make changes.

In the systems development projects, user representatives are referred to as "resources", which reflects a perspective of these civil servants as the word resource is technical, and impersonal. A resource has the connotations of being someone outside the project who is not in charge of the result or having any real power in the project, or as Longman Dictionary describes the word: "all the money, property, skills etc that you have available to use when you need them" (www.ldoceonline.com 2006) . When talking of human beings as resources it implies a person without personality, motivation and inspiration.

When users are invited to workshops on future work for example, some still have their day's quota of case handling when they return to work. Hence, some civil servants maintain that they are hesitant to volunteer as participants in workshops, since that gives them extra work.

4.1.2. Perspectives on Work

Furthermore, the studies revealed that there is a gap between the users' work and work situation, and the discourse in the systems development. In the systems development projects, the civil servants' work is frequently discussed in terms of simple steps and operations, that may be predefined and automated in accordance with clearly defined rules and regulations (Boivie 2005). Little attention is being paid to such issues as routinisation and repetitiveness of work tasks, control over work situation, control over pace and order of tasks, social support and deskilling, all of which are well-known risk factors for occupational health complaints.

It was seen as a problem that civil servants have to make decisions in complex cases where the computer fails to generate a decision and where "human" judgement is required. These "human" decisions were seen as subjective and open to interpretations – which is the reason that the computer fails to make them in the first place – and the civil servants making the decisions were seen as incompetent (see paper IV)

The design and development of computer systems are based on information flow models of e.g. the case handling process. This results in IT systems

that do not support the situated nature of work. One example of this is that the system does not support that the civil servant works with several cases at once, and there is no possibility to save the work done so far in a case if you want to move on to another case or if the telephone rings. Moreover, this perspective may lead to inflexible and rigid computer systems that shape and confine work situations, as is illustrated by this comment:

> ”The new computer system forces you to do things in a specific way. Previously we had different alternatives”

In this context it should be noted that the work performed in the It systems development projects is viewed in the same rational manner. Detailed system development processes, like for example RUP, is believed to describe the work in the projects.

4.1.3. Perspectives on Usability

Several informants from the IT departments described usability as a vague and unclear concept. The perspective on usability presented in the results section is confirmed in other studies (Boivie, Gulliksen et al. 2006). Usability is perceived by some as too vague, too complex and the feeling of uncertainty, instability, and uniqueness often does not fit into their perspective on systems development. Users participation and users’ experience of usability is seen as subjective, less stable and more unique which gives a feeling of uncertainty and uniqueness that some dislike. Some informants still saw usability as an objective quality feature that is possible to evaluate and address without users. In one organisation some people from the IT department considered usability not applicable to the particular technical platform that was used. These different interpretations of what usability is makes it difficult to discuss usability and different views on usability may interfere with usability work, in that it often requires cross-sectional approaches and support across different units in the organization.

> "Usability is really difficult to talk about since it means one thing to me and something completely different to someone else”

Generally, there has been little usability focus in systems development in these organisations. Participants in the systems development projects in the authorities in the study do not fully understand what usability is, and in what way it will improve the IT systems. Usability has not been an integral part in systems development, and there have been few usability activities in the projects. Usability experts are few and they felt that they seldom had enough time to do all activities needed to ensure usability in the system. Several of

the informants believed that this was due to lack of understanding of what usability is and what usability experts do:

> “No one really understands what I do”

The IT departments have previously not seen the need to include usability expertise when staffing the development projects. Their perspective on system development is primarily technical, where functionality is prioritized due to lack of time. The usability activities that have been included are often limited to test activities towards the end of the development process, when there are limited possibilities to make any significant changes. Two informants illustrated the perspective on usability in the following way:

> ”usability is seen as a shell that you put on, outside the system”

> “You already have finished and ready systems, and then you try to design a little on the surface of them”.

In several interviews, informants have described that they build systems according to requirements specifications. If usability, usability methods or aspects were a part of the requirements specification, it would be a part of their focus.

In one of the organisations, the internal procurer and the project manager of their sub-project in Satsa Friskt maintain that usability and UCSD are possible to address without any usability experts. Specifically, they would think that the project and the usability related activities will succeed to about 80 % of the results without any previous usability experience or knowledge in the field. This might indicate a perspective on usability as common sense, and something that is easily incorporated in systems development. Few people in the organisations understand how much work needs to be done in their organisation to incorporate the ideas of UCSD, health issues and future work situation, or as the project managers of another subprojects said:.

> “This project just gets bigger and bigger [deep sigh]! “

4.2. Business Values

Customer satisfaction, efficiency and a high degree of automation are the main goals in the organisations, and these factors drive the IT development to a high extent. A good work situation is an organisational goal, but in our studied it has low priority.

4.2.1. Automation of Case Handling

In one of the first interviews with a manager in one of these organisations, a manager expressed her view of the future organisation, where there are no civil servants and the only people working in the organisation monitor computers that process all the case handling work. Another manager in the organisation has also expressed this vision of the future. :

> "My vision of the future is three men in a bunker inside a mountain."

In another interview, and in discussions following that interview, one manager expressed the perspective that there is no need to work with usability in their organisation since case handling will be automated to a large extent in the near future. Even though the managers cited above have an extreme view of the level of automation, there is indeed a strong focus on automation of case handling in all authorities participating in Satsa Friskt. Automation is seen as a way of increasing efficiency in the organisation, and it is the way forward in organisational change. Increased automation of case handling has top priority, and all the authorities but one have implemented electronic case handling at least to some extent. Visions about the future are based on the idea that citizens (customers) fill out and send forms and applications, etc, electronically, the main part of the case handling will be done automatically and computers will "make" the decisions. The role of the civil servants will be to take care of complicated cases and to "support" the computer when it fails to process a case, due to for instance incomplete or incorrect information. Several informants pointed out that there is a high risk for deskilling and routinisation of the civil servants' work, which is in direct contradiction to the goal of creating challenging, healthy and satisfactory work for them.

Moreover, the managers in the study described in Paper III experience a conflict between automation and the usability aspects of human work.

> "If the automation is our focus, then our focus isn't on the user and how he is supported by the system. And that becomes contradictory I think. And from this perspective the user is irrelevant, if you know what I mean".

One of the basic values underpinning automation of decision making, is the notion that human decisions are objective and based on facts only that can be translated into computer code based on computer logic with if, else etc. There is little recognition that decisions can be judgements, and that case handling might include subjective and contextual elements that will be impossible to transfer to computers.

4.2.2. Focus on Customer Satisfaction

A few months ago, I was invited to a meeting where we were going to discuss a new mail system and its functionality. There was a lively discussion about the functionality of the mail program, where managers had clearly expressed that the most efficient solution for the customer should be implemented and prioritized. This solution, however, would have the effect that civil servants would have no overview of their work load, would not be able to control their work pace or be able to save difficult mails for later. Civil servants would simply have to answer one mail at a time, and when that mail is sent, receive another mail. In this example the Demand-Control-Support model clarifies the stressor (Karasek and Theorell 1990). The new mail program would create an unhealthy work situation quite similar to the criticised and stressful work situation of a call centre where the employees reported "low control and limited opportunities to influence their work" (Norman, Nilsson et al. 2004). In this discussion, the health issues were not equally important as customer satisfaction, and by the end of this long Friday of discussions customer satisfaction was still the focus. The main reason for this was that the participants in the discussion did not believe that the civil servants would to their best at answering mail as quickly as possible. However, Monday morning I received a mail from the one of the participants who thanked me for a good discussion and plainly explained that he had changed his mind. Now the design would focus on control and overview instead of customer satisfaction.

Customer satisfaction and efficiency in case handling is prioritized in these organisations. The informants describe that e-services must be right for the customer, and usability is often addressed in design and development of these services. The customer satisfaction focus dominates the discussion to such an extent that the health perspective and the work environment perspective are often ignored.

In most of these organisations, usability was a natural part of systems development aimed at producing external web applications for the customers.

4.2.3. Focus on Efficiency

The focus on efficiency, time and money is reflected in the IT systems. For example, when working with telephone services, the civil servant automatically receives a new call 5-10 seconds after a phone call has been finished. This may increase efficiency but is perceived as one of the most stressful features of the work situation created through IT. The civil servants in our interviews also pointed to the focus on production in quantitative terms, and that there is little focus on the quality of their work. Civil servants describe that management measures work performance in terms of the number of cases being processed and quality aspects are ignored:

> "You look at the pile of paper, and from the size you can tell if you've done a good job or not".

In several authorities the focus on efficiency has led to an increased workload for the civil servants, as one of the managers expresses:

> "It is very hard for them, and there is much overtime".

Managers in the study are concerned with the financial implications of usability, and express the view that that if the concept is to gain true acceptance in the organisation, it should focus on efficiency (see paper III).

In one of the organisations, the word *case handling* is replaced by the word *production* in daily conversations, as in sentences like: We have to focus on *production*, and time can not be taken away from *production.* Case handling becomes the act of producing a product with this industry inspired vocabulary, and it has the connotations of being an efficient and structured process with well defined components.

5. Summary of Papers

Our research group has a long tradition in research about work environment and usability in computer systems development. Hence my first paper (Paper I) describes previous research done in this area and it is my starting point. However my contribution in this paper was as a researcher in the project described. In the second paper (Paper II) we focus on communicating an approach and an attitude to user-centred design through key principles. In this paper I took active part in the discussion, and the key principles reflect my previous experiences of systems development[4]. In the third paper (Paper III) we have looked at management and their perspectives on usability in a public authority in trying to understand the problem of implementing user-centred systems design and health issues. What are their interpretations of usability and their view of usability? Why do managers interpret usability as they do, and what are the consequences for the organisation and for usability? In this paper I conducted the study and wrote the paper with help from my supervisors. The last publication of the thesis (Paper IV) describes an interview study conducted in six authorities in Sweden. In this study, we have identified values and perspectives underpinning discourse about users, usability and work and discuss how these perspectives affect usability work in these organisations. In this paper I conducted the study and wrote the paper together with my supervisors.

Paper I: Work Environment and Computer Systems Development

Authors: Bengt Sandblad, Jan Gulliksen, Carl Åborg, Inger Boivie, Jenny Persson, Bengt Göransson, Iordanis Kavathatopoulos, Stefan Blomkvist and Åsa Cajander

Publication: Behaviour and Information Technology (2003), Vol. 22, No. 6. pp.375-387, Taylor & Francis.

Abstract. Abstract. Work environment and occupational health problems of different nature are constantly increasing in computer supported work. Most efforts to improve the work environment are focused primarily on

[4] Before starting my Ph.D studies I worked as an IT consultant for some years.

physical aspects, and to some extent on psychosocial aspects. Mental workload and cognitive problems are of a more complex nature, more difficult to measure and provide efficient solutions to, and are more seldom studied or solved. Solutions to work environment problems are usually applied to already existing work situations through improved equipment and work place design, health programmes, education, reorganisations, etc. The problems are seldom prevented by means of applying relevant methods early in the systems development process, before the artefacts have been designed and implemented. This paper, and the following papers of this special issue, will focus on the need to integrate different interdisciplinary methods at different phases in the development process of computerized support systems, with the ultimate goal to prevent work environment problems and decrease the health risks to the users.

Paper II: Key Principles for User-Centred Systems Design.

Authors: Jan Gulliksen, Bengt Göransson, Inger Boivie, Jenny Persson, Stefan Blomkvist, and Åsa Cajander.
Publication: Behaviour and Information Technology (2003), Vol. 22, No. 6. pp.397-409, Taylor & Francis.

Abstract. The concept of user-centred systems design (UCSD) has no agreed upon definition. Consequently, there is a great variety in the ways it is applied, which may lead to poor quality and poor usability in the resulting systems, as well as misconceptions about the effectiveness of UCSD. The purpose of this paper is to propose a definition of UCSD. We have identified 12 key principles for the adoption of a user-centred development process, principles that are based on existing theory, as well as research in and experiences from a large number of systems development projects. The initial set of principles were applied and evaluated in a case study and modified accordingly. These principles can be used to communicate the nature of UCSD, evaluate a development process or develop systems development processes that support a user centred approach. We also suggest activity lists and some tools for applying UCSD.

Paper III: Management Perspectives on Usability in a Public Authority – a Case Study

Authors: Åsa Cajander, Jan Gulliksen and Inger Boivie.
Publication: Proceedings of NordiCHI 2006, ACM Press, 2006

Abstract: In trying to understand the problem of poor usability in computer-supported work, this article looks at management and their perspective on usability in a public authority. What are their underlying basic values, assumptions and attitudes? Why do managers interpret usability as they do, and what are the consequences for the organisation and for usability? The empirical basis is an interpretive case study where 19 semi-structured interviews were conducted. Results indicate that usability is interpreted differently, depending on the formal roles of informants. Furthermore, a majority of the informants express personal, but limited, responsibility for usability. Moreover, we found that basic values are based on an instrumental view of work where efficiency and economy are important constituents. We identified that even though users participate in IT development, they have no formal responsibility or authority. They have become IT workers in that they perform highly technical tasks such as integral testing.

Paper IV: Usability and User's Health Issues in Systems Development - Attitudes and Perspectives

Authors: Åsa Cajander, Inger Boivie and Jan Gulliksen.
Publication: Forthcoming in E. Law, E. Hvannberg, G. Cockton (eds.) Maturing Usability; Quality in Software, Interaction and Value. Springer Verlag (2007).

Abstract: Poor usability and hence a stressful work situation is still a severe problem in computer-supported work, despite efforts to increase focus on these issues. Consequently, Sweden has a high level of sick rates, particularly in the civil service sector, and some problems relate to inadequate IT systems with poor usability. Hence, we aim at understanding attitudes about and practices for integrating usability and users' health issues in systems development. Quality in value – i.e. users' well-being, productivity and user satisfaction – is shaped by attitudes and perspectives underpinning discourse in systems development. These attitudes and perspectives are embedded in the methods, models and representations used in systems development as well as in discourse and action. In our qualitative study data was collected through semi-structured interviews with 127 informants, and in a case study of an ongoing project in one organisation. During analysis of data we identified problems with attitudes and perspectives on users and their work, for example the strong focus on automation, efficiency and surveillance of work, which shaped the development of new technology and ultimately shape the work situation of the user. Furthermore, we identified that the

work of civil servants were frequently discussed in terms of simple steps and procedures, that may be predefined and automated in accordance with clearly defined rules and regulations. Finally, we suggest user-centred design and field studies to address the problems and to improve the understanding of the users' needs and work practices in the development projects.

6. Discussion

Usability, users' wellbeing, productivity and user satisfaction are related to attitudes and perspectives underpinning discourse about users and their work in the development process as well as in the organisation at large. These attitudes and perspectives are embodied in methods, models and representations used for analysing and describing users' needs and their work. The models and representations are used as input in the development process, determining design, contents and structure of the IT systems. In this discussion I will put the perspectives described in a wider context and relate them to more general trends in society, and in systems development.

Consequences of the Perspective on Work

In the perspective on work presented in the results section, humans and their work are often thought of rational and predictable. My studies indicate that there is a tendency to elevate the rational and structural dimensions of work, as in Morgan's machine metaphor (Morgan 1997), and models of work represent the explicit view of work that is the official and structured, as described by (Sachs 1995). This perspective on work obscures human aspects of work as a complex, situated and social process (Suchman 1987).

However, work is more than procedures that can be defined and fully understood. Work is also a complex social process, and civil servants constantly communicate and interact with each other to solve problems and to make decisions. From the engineering oriented perspective these aspects are blurred and ignored. Instead computer supported work is seen almost as a flow of information between the computer and the user, as in use-cases[5] for example. However, work has a purpose and is driven by goals or intentions and that work is specific to the context and shaped by circumstances of the situation as it evolves – i.e. it is situated and contextual (Suchman 1987). Thus the engineering-oriented perspective on users' work and work practices as well-defined models ignores the situated and social nature work. The engineering-oriented perspective does not address users' practical knowledge

[5] **use case** is a technique for capturing requirements of systems that is used in Rational Unified Process (
Kruchten, P. (2003). The Rational Unified Process: An Introduction, Addison-Wesley Professional. for example

about their work, their understanding about "what-to-do" as well as "how-to" in a specific situation (Schön 1995).

It is essential to understand users' current work practices, and how these practices may be affected and improved by new technology. A fragmentary understanding of the work situation, and the perspective on work as procedures and sequential steps or operations, may result in IT systems that are poorly adapted to the users' needs causing frustration and strain in the work situation. The system built does not support the situated, contextual nature of the work. In the studies I have seen that systems development is often based on an engineering-oriented view of problem solving, where users are tailored through a workflow divided into a number of windows on the screen. Each window containing only what is believed to be relevant information for the specific task, and with no possibility to go back-wards or forwards or to save or pause. This engineering-perspective is closely related to the systems theoretical perspective, which places emphasis on technical and formal aspects of the relationship between man and machine (Nurminen 1987; Kammersgaard 1990). In an engineering-oriented perspective, users are primarily defined by their relation to a technical system. In Rational Unified Process (Rational 2002), for example, the word actor is used to denote both humans and computers, and an actor is defined as

> "Each type of external phenomenon with which the system must interact is represented by an actor"

The user's tasks, goals, and needs are described as sets of predefined steps and rules defining the interaction between users and systems

Another consequence of the perspective on work used is that the models used "effectively limits the shared understanding of the work practice to what the users perceive the model allows them to express and how the system developers understand the relevance of that information" (Boivie 2005). social and is that users find it difficult to talk about their own work in terms of flow diagrams.

Consequences of the Customer Satisfaction and Efficiency Focus

One result of the business values of efficiency and customer satisfaction is that managers interested in usability and health issues, want to hide the usability concept behind these more motivating words. They maintain that if usability is to be a successful part of their organisation, it needs to be connected to efficiency and customer satisfaction, which is illustrated by this comment from one of the managers:

"If you use [usability] then you turn it into a work environment issue, and then you don't get the same status for these issues in the organisation. You should turn it

around, and say it is important for our clients, our business, it is important for our assignment, and then it will be good for the personnel too. That's the way to do it!"

Moreover, the focus on efficiency is clearly seen in the discussions about usability, where one example is the desire to develop a usability index that will indicate the usability level of the organisation. Measurability is seen as a success factor for usability, as it would make it less vague and difficult to grasp. The organisation would have preferred that this index would calculate the price of poor usability in the systems, hence calculating the importance of usability work and usable systems. This is also an indication of the focus on rationality and objectivity.

Another consequence of the efficiency focus in the IT projects is the discussion that usability will not be addressed in the projects, if it is not a part of the acquisition or procurement specification. The importance of integrating usability in the requirements process is elucidated by for example Artman (2002). The focus on efficiency affects the choices of how and what to focus on in the projects, and things that are not included in the requirements specification will not be addressed. Efficiency in the system development project is given priority, and long-term effects on health and work are seldom considered. From their point of view issues related to healthy work are difficult to incorporate in the projects since they are time consuming and are seen as inefficient.

When looking at society as a whole, the efficiency focus is prevalent, and perhaps one of the health risk factors that contribute to stress-related reactions.

Consequences of Focus on Automation of Business Processes

The perspective that organisations should focus on making business processes as automated as possible influences these organisations to a large extent, and it affects the work with UCSD and users' health issues. Technical solutions to solve problems with automation, detailed descriptions of how civil servants work, as well as adjustments of the complex legislation system are needed to fulfil the goal of a completely automated case handling process. In the future automated organisation described by informants, usability issues are irrelevant as there will be few users, only a few programmers that maintain the computers.

Moreover, when deciding on what aspects to automate in the computer systems, the work situation is seldom considered and consequently consists of what is left when the computer has done its best:

> "We automate things, and the rest is a bunch of tasks for users. And these are closely connected to how we have developed the automatic process. And what is left there is something I feel we have no control of"

This automation focus will not contribute to a better work environment, as people want to feel that they contribute, and are an essential part of an organisation.

Consequences of the Perspectives and Values Taken Together

The strong business focus on automation, efficiency customer and satisfaction shape the development of new technology, and ultimately the tasks and work practices of the civil servants. In short, the studies show that there are some contradictions in perspectives and business values and the implementation of user-centred systems design, usability and health issues. Taken together, these different perspectives and values might partly explain why it is so difficult to work with usability in these organisations.

The descriptions and discussions of the different perspectives can be used as a starting point when deciding the way forward of usability work in these organisations. Perhaps usability is at a crossroads of choices, where one possibility is to accept the values and perspectives in the organisation and to make usability as attractive as possible from this perspective to be able to get funding for this work. The other choice is to try to change or alter the values and perspectives. However, this requires a long-term perspective, as attitudes and perspectives are not easily changed, and change comes gradually, as noted by for example Göransson (2004)

> "to fully understand and take a user-centred systems design approach involves a major attitudinal and social change in a development organisation. Such a change does not happen quickly or easily".

By introducing and changing the models of systems development in these organisations, we will not have direct influence on systems development practice, but the model will hopefully work as an enabler of communication. Models can have an effect on practice, although indirectly, by providing new concepts upon which participants in systems development can construct a joint reality (Engwall, Kling et al. 2005). However, a focus on models alone is insufficient and therefore we need to develop a systematic approach to include reflection and new perspectives into the practice of systems development (Sengers, Boehner et al. 2005). Perhaps the reflection itself would help us see our basic values and perspectives and to understand their implications?

In the organisations included in the study, we continuously discuss the integration of health issues in systems development, and people are indeed interested in what we have to say. At the same time one researcher has developed a usability index, as a measure of the usability work which is seen as extremely important in the organisations. In short one could say that we have chosen both roads, as described above, to impact as much as possible.

7. Future Research

This is not a final piece of work since I have only begun my journey to become a researcher, and this licentiate thesis is to be considered a first step towards my future doctoral thesis. It is a description of where I stand now in my quest for answers. Hopefully I will receive valuable feedback on this thesis and input to my future work.

My future research will include extended studies about the relation between organisational culture, values and perspectives as well as their impact on organisational development and systems development in particular. Here it would be especially interesting to understand basic assumptions made in the requirements phase and how methods form the way people think and talk of users and computer supported work. Is it possible to see how basic assumptions and representations used in the requirements phase affect work situations created by systems?

Moreover, organisational development and its relation to systems development and IT projects needs to be further explored. Here managers' perspectives and view of IT systems development is an interesting area. What do they think motivates people in their work? Further analysis of the results from the interview study in paper III could be a starting point in this work.

Another interesting area of research would be the project as an organisational form that strives to deliver on time and budget – often without considering the long-term goals of the organisation. What implications does this division of systems development and organisational development have? What strategies can be used to improve the relationship between these two organisational units (see for example Peppard and Ward 1998)?

8. Summary in Swedish

Användbarhet, hälsa och datorstött arbete – Värderingar och perspektiv

Sverige har höga sjuktal och människor mår allt sämre av stress och stressrelaterade sjukdomar. Arbetslivet blir dessutom mer och mer datoriserat, och vi tillbringar hela arbetsdagen framför datorer på jobbet, vilket i sig bidrar till fler sjukskrivningar. Datorer blir en allt viktigare del av vårt arbete, och därför blir datorsystemens egenskaper allt viktigare för att vi ska prestera bra, vara effektiva och må bra. Kort sagt leder dåliga datorsystem till dåligt arbete, och är därmed ett arbetsmiljöproblem. Trots detta är arbetssituationen, och arbetsmiljöfrågor, sällan något man tar hänsyn till när man utvecklar nya datorsystem. Mot bakgrund av detta är forskningen som presenteras i denna licentiatavhandling inriktad på att förstå *varför* det är svårt att *integrera arbetsmiljöaspekter, användbarhet*[6] *och hälsa i utvecklingen av nya datorsystem*. Mer specifikt undersöks på vilket sätt *perspektiv* och *värderingar* påverkar arbetet.

En utgångspunkt för forskningen är användarens delaktighet i utvecklingen av de nya systemen och arbetsprocesserna för det datorstödda arbetet. En annan utgångspunkt är att våra grundläggande värderingar och perspektiv påverkar hur vi agerar och tänker, och avspeglas i de datorsystem vi inför i organisationen.

Syftet med forskningen är att studera och förbättra systemutveckling i praktiken. Vår forskargrupp deltar därför i förändringsprojekt på olika myndigheter, där vi avgränsat oss till utvecklingen av datorsystem för administrativt kontorsarbete. Forskningsansatsen kallas aktionsforskning och den kunskap som forskningen genererar måste vara tillämpbar i praktiskt sammanhang.

Forskningen pekar på att grundläggande värderingar och perspektiv tydligt påverkar arbetet med användbarhet, och systemutveckling. Studier som

[6] Användbarhet enligt ISO
ISO (1998). ISO, 9241-11: Ergonomic requirements for office work with visual display terminals. Geneva, International Organisation for Standardiza-tion.: Den utsträckning till vilken en specificerad användare kan använda en produkt för att uppnå specifika mål, med ändamålsenlighet, effektivitet och tillfredsställelse, i ett givet användningssammanhang

presenteras i avhandlingen pekar till exempel på attityder om användarrepresentanter i projektet, den grundläggande tanken på rationalitet och effektivitet samt det oreflekterade sättet på vilket man använder metoder som användingsfall och flödesdiagram över arbete.

Attityder och värderingar är inte enkla att förändra, och förändringen kommer gradvis. Vi arbetar kontinuerligt med att diskutera hälsa och arbetsmiljöaspekter på dessa myndigheter, och genom att förändra systemutvecklingsmodellerna kommer dessa förhoppningsvis bli bärare av nya perspektiv och värderingar. Men fokus på modeller är inte tillräckligt, och vi behöver utveckla en metod för att på ett mer systematiskt sätt integrera reflektion och nya perspektiv i systemutveckling. Kanske är det genom reflektion som vi kan se våra egna grundläggande värderingar, och genom dem påverka vårt agerande?

Licentiatavhandlingen består av fyra vetenskapliga artiklar som beskriver en rad olika studier som genomförts på CSN, Migrationsverket, SMHI, Bolagsverket, Lantmäteriverket samt Tal- och punktskriftsbiblioteket (TPB). Den typ av forskning som genomförts leder till en förståelse för händelser i sitt sammanhang, och är inte generaliserbar. Varken organisationerna, eller resultatet av forskningen är unikt eller ovanlig, och därför är förhoppningen att resultaten kan användas som utgångspunkt för förståelse även i andra sammanhang.

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PAPER I

Work Environment and Computer Systems Development.

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Work environment and computer systems development

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Abstract. Work environment and occupational health problems of different nature 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. Mental workload and cognitive problems are of a more complex nature, more difficult to measure and provide efficient solutions to, and are more seldom studied or solved. Solutions to work environment problems are usually applied to already existing work situations through improved equipment and work place design, health programmes, education, reorganizations, etc. The problems are seldom prevented by means of applying relevant methods early in the systems development process, before the artefacts have been designed and implemented. This paper, and the following papers of this special issue, will focus on the need to integrate different interdisciplinary methods at different phases in the development process of computerized support systems, with the ultimate goal to prevent work environment problems and decrease the health risks to the users.

1. Introduction

The purpose of this editorial paper is twofold. First, to discuss basic work environment and health problems in computer supported work, and the inability of the systems development process to deal with these problems. Secondly, to introduce the other articles of this special issue, which present research concerning the connection between the development process, usability and health in some large Swedish administrative organizations.

The rapidly increasing use of computer support systems in all sectors of working life has had a tremendous effect on efficiency and benefit for the organizations, flexibility and work environment – often a positive effect but sometimes, unfortunately, also negative. This development has in other words had undesirable side effects that have generated health risks, e.g., neck and upper limb disorders and stress.

Today, around 3 million people in Sweden, which is 66% of the Swedish work force, use computers in their work. Thirty-five per cent of the women and 30% of the men in the total work force use computers at least half of the working day (AV 2001). These figures have been increasing at a fast and steady pace since the workplace computerization began spreading in the late 1970s. According to the surveys on computer use performed by Statistics Sweden (SCB), the proportion of computer users in the total Swedish workforce increased from 24% in 1984 to 32% in 1989 and 51% in 1995 (SCB 1995). The proportion of users working half their working day or more at a visual display unit (VDU), i.e. with a computer, has also increased, especially for women (Ekman *et al.* 2000). Approximately one-third of the work force has clerical office work and, as expected, the use of computers is higher in that group. From 1989 to 1997, the proportion of computer users among office workers increased from 65–90% (Marklund 2000). For women, the corresponding figure has continued to increase from 91% in 1997 to 94% in 1999 (Ekman *et al.* 2000). The introduction of computers in working life has had a great impact, dramatically changing the very nature of many jobs and the whole work situation for a vast number of people. As the use of computers has increased, health concerns and the reports of negative effects on users health have also increased steadily since the early 1980s (Bergqvist 1993, Punnett and Bergqvist 1997, Sandsjö and Kadefors 2001). These studies have mainly covered administrative work, office and case handling work in a broad sense.

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All these reports indicate that we are continuously introducing more and more information technology (IT) of a kind that is harmful to its users!

There are several interacting mechanisms through which work with computers affect the users, mechanisms related to the person, the work organization, the work tasks, the physical work environment and the technology that is used. To counteract the adverse health effects of computer use, we need to know more about the relative importance of different factors and about interactions between these factors.

We also see that the systems development process can not handle this problem. All normal and commercially available models and methods for systems development fail to address usability and work environment issues in an efficient and functional way. The efficiency of the development process is also, according to both large investigations and our own experiences, too low. When the development project faces problems to keep deadlines or to stay within budget limits, most often usability and work environment aspects are the first to be traded off.

To be proactive, so that we can improve the quality of tomorrow's computerized work support systems, we have to gain a better understanding of the software development processes and try to improve and complement them. Within the research field of human–computer interaction (HCI), such efforts are made, often aiming at increased usability of computer systems. Considerable effort is spent on developing design methods emphasising the needs of the users, including methods for user-centred design (Norman 1986, Göransson 2001). However, the results of these efforts are in practise far from satisfying. The impact on software development from research on usability and user-centred design has been quite limited and health aspects are often completely ignored (Clegg *et al*. 1997, Vicente 1999).

A class of work environment problems that becomes especially important to consider in intensively computer-supported work are the cognitive work environment problems (Åborg *et al*. 2003). With cognitive work environment problems we mean when properties of the work environment hinder the workers to use their skills efficiently. These obstacles are often associated with the design of the information system but may also be the effect of an inappropriate work organization or inadequate managerial support. If the system has an inappropriate functionality, a poorly designed user interface or if the user does not have adequate skills, such problems can occur. If a user is constantly interrupted mentally by the need to interpret an error message, recall information that is no longer visible on the screen, or judge the size of the scroll bar, the user's cognitive load is increasing. Knowledge on the effects of a high cognitive load is required to be able to analyse cognitive work environment problems, as the users themselves are often not aware of these problems. Addressing the cognitive work environment problems is very important as they may lead to inefficient work procedures, bad performance and low user acceptance as well as somatic and mental health symptoms.

Most activities aimed at improving the work environment for professionals in intensively computer supported work situations are adopted very late, i.e., when physical or psychosocial problems already have been manifested and reported. We believe that it is both important and fully feasible to address potential work environment problems already during the development process. We know, however, that organizations already have difficulties in addressing aspects related to the usability of artefacts under development. If we add the challenge to also include work environment aspects in the systems requirements, the task will become even more difficult in practice.

1.1. *Work efficiency problems*

Concerning the effects on work efficiency, we find some studies of the influence on productivity growth. Or, rather, we do not find the expected effects on productivity. Questions why IT resources are not used in an efficient way are vital also in relation to work satisfaction and the well being of the users. As Robert Solow noted: 'You can see the computer age everywhere but in the productivity statistics' (cited from Gunnarsson *et al*. 2001). Solow formulated the term 'the IT productivity paradox' in response to the fact that massive IT investments did not seem to have an effect on productivity figures. Numerous empirical studies have failed to find positive effects, and those that did find positive effects show that the effects were very small; in some studies, significant negative effects on productivity were even observed (Nickerson and Landauer 1997, Vicente 1999, Gunnarsson *et al*. 2001).

Landauer (1996) has in his book 'The trouble with computers' discussed the fact that the massive introduction of computer systems during the last three decades has not resulted in comparable productivity payoffs. He argues, and illustrates by many examples, that this is mainly because the artefacts are too hard to use and do too little that is sufficiently useful. His recommendation is that techniques for user-centred development can be used to turn the situation around. We have seen that this is not so easy in practice, but must be combined with substantial changes in development models, organization and competencies.

There have been a number of explanations suggested to the productivity paradox. A frequently described

factor is the introduction of computer systems with poor usability, causing the users to spend a significant part of their working hours on unproductive computer problems (Nielsen 1993, Vicente 1999). The position that IT investments have to be combined with organizational changes (e.g., decentralization) has gained support (Nickerson and Landauer 1997, Gunnarsson *et al.* 2001). One explanation that has both theoretical and empirical support is that too much attention has been paid to technical equipment, mostly the hardware but also the software, and too little to 'human capital', the people using the technology. The most important variable in the human capital factor is the workers' level of education (Gunnarsson *et al.* 2001). Organizations with high levels of both IT and human capital show better productivity growth than other organizations, while organizations with a high level of IT but low human capital are even less productive than those with low levels of both IT and human capital. One conclusion from these findings is that IT investments have to be combined with skill upgrading to have a positive effect on productivity growth. One obvious reason for this is that easily computerized activities are already automated. Now more creative, intellectually demanding tasks have to be dealt with. 'The low hanging fruit has already been picked', as Vicente (1999) noted.

In a Swedish study of 1532 Swedish computer users mentioned above (Wigaeus Tornqvist *et al.* 2001), the productivity loss caused by musculoskeletal problems was estimated (Hagberg *et al.* 2001). In addition to the huge costs that are caused by sick leave, there are costs because many people try to do their work despite suffering from pain or other symptoms. The respondents in this study were asked if their productivity level was affected by symptoms and, if so, to estimate how much. Eight per cent reported a loss of productivity and they estimated the loss to be 15% of their ordinary work performance as a mean over the latest month. If these results are translated to all computer users in the Swedish work force with more than 50% of the working time at a VDU, 3 million working days per year are lost because of musculoskeletal problems, which means that an enormous amount of money is lost in this way. These costs have to be added to the alarming costs for absenteeism and health care that are caused by work-related health problems. A favourable conclusion from these dismal facts is that we clearly can see an enormous potential to improve health and save money at the same time.

2. The health problems

In our research we have mainly focused on artefacts used in administrative work, e.g., for case handling in tax offices, social insurance offices etc. The main health problems in such computer-supported work situations are (Bergqvist 1993, Punnett and Bergqvist 1997):

- Users are bound to use the computer for a major part of their working hours. This means constrained, static work postures for long periods of time.
- The computer controls the work pace and task order, leaving the user little or no control over their work.
- Users suffer from stress, caused by excessive workload, time pressure and poorly designed computer support as well as by a growing significance of moral problems and ethical issues (Kavathatzopoulos *et al.* 2002, 2003).

Health problems in computer-supported work are well known and well documented. We know fairly well what they are. We know what causes them. Then, why do we not design computer applications so as to avoid health problems, or at least reduce them? Why are applications designed, built and deployed without taking ergonomics and health aspects into account?

Traditionally, occupational health experts work in isolation from the software development process. They evaluate and suggest improvements to existing workplaces and tools. It is, however, often too late to do something about poorly designed software tools once they have been installed and are running. Thus, poor and inadequate design leading to health problems cannot be sufficiently modified.

Instead, occupational health and ergonomics experts must be involved in the actual software development process.

Work-related stress has increased in the past years and is a growing health problem (Marklund 2000, SOU 2002). Work organization and work content are important factors underlying stress problems, and in office work IT support systems, especially computer software, plays a major role. The mental workload tends to increase when new IT systems are introduced (Aronsson *et al.* 1994), and the decision latitude is lower for extensive computer users than for others (Wigaeus Tornqvist *et al.* 2000).

The introduction of new IT systems is often combined with other organizational changes and with reduction of staff. Reduced staff costs is a common means in which the IT investment is supposed to pay off, i.e., more and better IT systems is one way to enable downsizing of organizations. IT development and more computer use has a close connection to the negative effects on work environment, health and well being caused by a more insecure and less stable work situation. Studies of the

effects of staff reduction have shown negative effects, both on the laid-off persons and on persons still employed (Barklöf 2000a, Barklöf 2000b). The employees that remain in the organization after a downsizing process experience less security and trust, which can cause less effectiveness and increased stress-related health problems.

3. A model for healthy work

3.1. *The demand/control/support model*

During the 1970s, Robert Karasek introduced a model to analyse work-related stressors associated with cardiovascular illness. He used the two variables work demands and decision latitude (control opportunities). His model has then been further developed in collaboration with Töres Theorell to the demand/control/support model (Karasek and Theorell 1990) and is now the most widely used model to analyse psychosocial work environment factors and their relation to health and well being. According to this model, the combination of perceived demands and perceived control at work is a determining factor underlying negative stress. High demands create stress responses that could be stimulating if combined with high personal control, but that cannot be effectively handled if control is low. The combination of high work demands and low decision latitude is referred to as high job strain and has been shown to be associated with the highest risks for health problems.

Most work demands are mainly psychological stressors (e.g., time pressure) in the work situation. If we look closer into the psychological demands, we can separate them into cognitive and emotional categories. Cognitive demands have gained considerable attention in the HCI research field (Helander *et al.* 1997). Memory load is one typical example of a cognitive demand that has been thoroughly studied within that field. Control can also be divided into sub-concepts. It is often defined as consisting of two major components: the degree of personal control/decision latitude in the work situation and the degree of control over the competence used. Decision latitude describes the opportunity for the individual to exercise control over very concrete and practical decisions in the personal work situation, such as when to take a break. Competence control refers to the opportunity to use different parts of personal competence and to obtain stimulation and development through, e.g., variation in tasks.

The model was subsequently extended, becoming three-dimensional by adding the factor social support (i.e., support from supervisors and/or colleagues) (House 1981). House identifies several forms of social support; emotional, appraisal, informational and instrumental support. Scientific evidence exists suggesting that social support has an important effect on experienced work stress and on health (House 1981, Cohen and Syme 1985, Wahlstedt 2001). The feeling of having access to social support affects the individual's appraisal of and reactions to a stressful situation, and affects emotions, physiological responses and behaviour. The most favourable situation is one characterised by reasonable demands, high decision latitude and high social support.

Despite the strong scientific support for the demand/control/support model, see figure 1 (Karasek and Theorell 1990), there has been some criticism and several studies have failed to find the expected correlations (Punnett and Bergqvist 1997). One possible explanation for this failure is that social support plays a more important role than suggested by earlier studies. This hypothesis is strongly supported by the work of Kurt Wahlstedt, which has shown that high decision latitude counteracts the negative impact of high workload only when social support is at an acceptable level (Wahlstedt 2001). Studies by Töres Theorell and others (Barklöf 2000b) have demonstrated the importance of support from management in order to counteract negative health effects that result from organizational changes. According to the classification in the demand-control model, work life is rapidly changing and an increasing number of people in more and more types of work find themselves in situations of high job strain (Marklund 2000). At the same time, there is also a growing group with both high demands and high decision latitude. Downsizing and lean production have

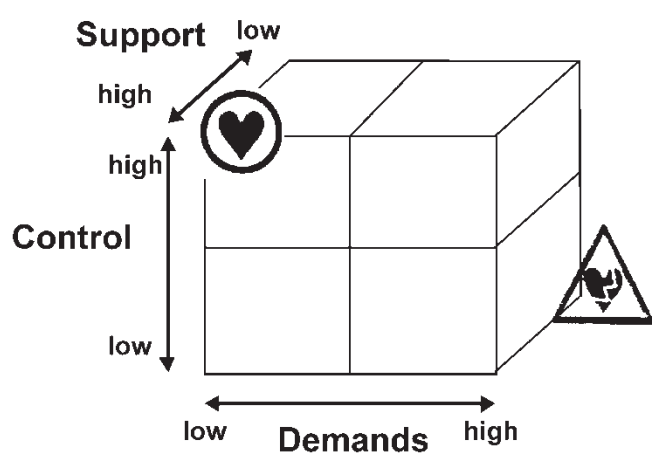

Figure 1. Relations between demands, control and social support in a work situation, according to the demand/control/support model (Karasek and Theorell 1990).

characterized the structural changes in Swedish work life during the 1990s. Some of the effects are more jobs characterized by high decision latitude but also high demands (and often more unclear demands than before) as well as more stress-related health problems (Barklöf 2000a, Barklöf 2000b). In the debate on the growing problems with stress-related illness the term 'honey trap' has been used to label this work situation, where people in 'good' jobs with high salary and high decision latitude seem to voluntarily work so much that they become ill.

Analyses based on the demand-control-support model use psychological data, subjective perceptions and judgements. According to this psychological approach, negative stress arises when the person judges the demands in the specific situation as too high in relation to his or her resources to handle them. This means that it is not the objective situation but the person's interpretation of it that determines the type and degree of stress experienced. Cannon was one of the first to clearly describe the importance of psychological-emotional reactions and the interrelations between psychological and physiological reactions to threatening stimuli (Cannon 1949). He calls the emotions fear and aggression, 'the keys' to all the astonishing complicated physiological reactions he studied in the human body. The emotional reactions are responses to threats, telling the individual that it is time for fight or flight, in which case the physiological responses prepare the organism for effective attack or escape.

In our research, we have related changes in the work situation, caused by changes in the IT-support, to the demand/control/support model (Karasek and Theorell, 1990). All experiences show that when new and often extended computer support is introduced, the subjective demands increase. This is not a problem if the control and support factors are within acceptable limits. However, what we often see is the opposite. The subjective control and support factors move in a negative direction. This is a severe problem, but even more problematic is the fact that these effects are not even considered in the development process. We mean that this is not acceptable, and that it is fully possible to include demand, control and support considerations in the development process, provided that development models and available competencies allow this.

4. The systems development process

In our research, we have seen evidence for the hypothesis that the system development process itself is inefficient. Many large development projects are either complete failures and are cancelled without producing any substantial results, or completed with large changes in time of delivery, budget or functionality. This is also confirmed by the 'Chaos report' (Standish Group 1995) that confirms that system development projects face a high risk of having their development plans thwarted, or even being cancelled. In the USA, 250 billion dollars is spent every year on 175 000 different IT-development projects. The CHAOS Report showed that out of 8380 investigated large projects in the USA, only 16.2% were completed successfully; that is, on time and on budget, with all features and functions as initially specified. Among the projects 52.7% were delayed or performed according to changed plans. On average the costs for the changing plans increase by 189%. Some of the projects (31.1%) were cancelled without producing any results at all.

There is no reason whatsoever to believe that this should be different now, almost 10 years later, or that the conditions should be different in other areas, such as Europe. In fact, in a later version of the Chaos report (Standish Group 2001) one can see a slight increase in the proportion of successfully completed projects, mainly due to the higher proportion of smaller projects. But, for very large projects (projects with a budget above 10 billion dollars) there is a success rate of 0!

When the projects that succeed are analysed, a pattern of success factors can be seen (Standish Group 1995). Important aspects that characterize successful projects are according to our experiences e.g.:

- Functional user involvement in all project phases.
- Focus on usability throughout the project.
- Clear directives and a consensus on projects objectives.
- Small projects or stepwise development.
- Using well established technology and system platforms.
- A well planned deployment (installation of the system, introduction of the users to the system, education program, etc.)

This is why we feel that it is important to focus on aiding system development projects to produce better (more usable) results within the time and budget limits. To do this, we assume a user-centred system design (UCSD) framework that promotes both active user involvement and greater focus on usability and work environment in the development process. Although a UCSD approach is no guarantee for usable systems, we argue that without a UCSD approach, genuine usability is usually nothing more than a coincidence.

Our own experiences, from a number of large systems development projects in large organizations and authorities in Sweden, are that these figures and conclusions are valid for Swedish conditions as well. We have, so far,

seen no large IT project that has managed to meet project time plans, budget and to deliver according to specifications.

Today most large systems development projects are planned, managed and conducted in accordance with some commercially available development model, such as Rational Unified Process™ (RUP) (Kruchten 1998). RUP is a software engineering process that significantly has contributed to the software development practice. Today, it is widely used. RUP has become more or less the de-facto standard for software development in Sweden. There are currently 6000 licence owners in Sweden and almost all of our studied development organizations are using RUP. According to Rational themselves (Rational Software was recently acquired by IBM and are the original developers of RUP), RUP has been used in more than 10 000 customer projects world wide and it is taught as part of the computer science curriculum in hundreds of universities. RUP has contributed to creating a more unified view on software development.

However, from a usability point of view, RUP has several drawbacks (see for example Göransson *et al.* 2003). RUP is not a user-centred method in itself. On the contrary, there are fundamentals in RUP that actually prohibits a true UCSD process:

- RUP is an 'architecture-centric' and a 'use case driven' process rather then user-centred. Use cases drive the Rational Unified Process end-to-end over the whole lifecycle, but the design activities are centred on the notion of architecture – system architecture, or for software-intensive systems, software architecture. (Jacobson *et al.* 1999)
- The definition of iteration within RUP differs significantly from how it is defined in for instance UCSD. In RUP, iteration is 'A distinct sequence of activities with a base-lined plan and valuation criteria resulting in a release (internal or external)' (Rational Software Corporation 2002). The activities inside the iteration are laid out as a waterfall. This prohibits iterations to formally occur within workflows and activities. From a UCSD point of view iteration is a refinement of a certain part of the system (an increment), going through the stages analysis, design and evaluation until goals are reached.
- Usability related activities in RUP do only occur within the Requirements discipline (workflow) and primarily in the Elaboration phase. To consider usability only when gathering requirements is fundamentally wrong. From an UCSD perspective, usability related activities should be included from the start of the project to the very end.
- RUP focuses too much on artefacts. There is a risk that the 'big picture' gets lost and that each role puts too much effort in writing documents (fill out forms). Also, the project members are encouraged to get 'his/her work done' and not to collaborate. In UCSD a lot of the work is done in multi-disciplinary teams.
- There is no support for user interface design. The focus in RUP is on the use cases and the interaction between the actors and the use cases but it does not give enough support when it comes to designing the user interface supporting that interaction (Lif 1999).

Problems with the use of the process have been observed in several projects (Gulliksen *et al.* 2001). It does not provide the support needed to produce a usable system. Given the extensive use of the process, and the fact that it does not support usability work, it becomes a major obstacle for usability workers and hinders work with the purpose of increasing system usability on a strategic level. On the other hand, bearing in mind the vast amount of resources organizations have invested in the use of such a process, they are usually not very interested in purchasing a new development process. Therefore, it is very important that we produce practical solutions that can work with the organization's current use of these processes, regardless of the limitations. By doing so, you gain much more credibility from the developers within the organization.

5. Requirements for an improved process

In order to improve the situation and to solve major problems, we must develop the process itself, so that major shortcomings are eliminated. This will be further elaborated in a coming publication, but we here want to point out the following critical areas.

5.1. *Usability and work environment requirements*

The major goal for every professional involved in user interface development is, presumably, to develop systems that are usable. This should be especially important for user interface designers, as their efforts have the most immediate effect on system usability. We use the term usability as defined in the ISO 9241 standards on 'Software ergonomics for office work with visual display terminals (VDTs)' Part 11 – Guidance on usability:

> 'Usability is 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).

Several researchers have put the blame for the lack of usability on the users themselves not requiring sufficient usability in the process of ordering or purchasing the systems (Thimbleby 2000). Studies of requirement specifications with respect to usability and work environment aspects show that these requirements (however, in practice very few) were not particularly useful in the development process, mainly because they were not concrete and related to a measurable entity. Directed efforts to help the users specify measurable requirements on usability and the work environment resulted in very few measurable requirements, and of these most of them related to efficiency.

If the system developers are supposed to consider work environment and occupational health requirements, of course the directives from the ordering organization and the project management must include details on such aspects in the specifications. The directives must also specify that usability and work environment requirements must not be traded off unless this is explicitly approved by the organization.

5.2. *Integrated methods*

Integrated design refers to methods in which all aspects of usability and a healthy work environment evolve together (Gould *et al.* 1997). Our view on integrated design is a further elaboration of Leavitt's (1958) integration of organization, work, competence and technology to involve all aspects that can influence the development of a computerized work environment, particularly health aspects that are so often ignored. In our research we also focus in particular on work environment aspects normally not included in 'integrated methods'.

We have tried to apply integrated methods in the sense of applying true interdisciplinary cooperation in real work settings, e.g.:

- Integrated analysis – Experts in organizational development, knowledge production processes, work environment and human computer interaction perform semi-structured 'observation-interviews' in a real work setting in parallel sessions. Immediately after the sessions the experts gather and present and give priority to their findings according to the relevance and the degree of seriousness of the discovered problems.
- Integrated design – Experts in systems development, usability, human computer interaction, organizational development, knowledge production processes, and work environment participate in cooperative design sessions. In these sessions, groups of users do prototype design in parallel design sessions mediated by the various experts. They later reconvene to present their different design solutions for further elaboration. The experts gather to present and report their observations back to the development team.
- Integrated evaluation – A usability inspection is performed, in which one could use the various multidisciplinary competencies in the evaluation process.
- Integrated deployment – The deployment phase must be considered as an integrated part of the total development project, and important aspects must be included in order to assure a good introduction, preparation and training.

All preliminary results point to the fact that integrated design requires the introduction of the specific competencies in the development process. The complexity of all aspects relating to the health and well-being of a worker using a computer artefact cannot be introduced without bringing in experts in these different areas.

5.3. *A user-centred development process*

Most systems development work is performed in a more or less industrial manner. The purchasing organization is specifying the requirements on the system as far as their knowledge extends. The development organization is doing its best in trying to interpret the requirements and turning it into a functioning system with as efficient use of their resources as possible. In this context user involvement is avoided to as large extent as possible to minimize project risks, modified requirements, and iterations. But user involvement is a necessary input for user centred design.

For an organization to learn new procedures for development, and to change their development process, it is essential that the development work is initiated and driven by the organization itself. To our knowledge, no one has successfully deployed a user-centred development methodology towards an organization that is not appreciative. We have performed re-engineering work with a large governmental in-house development organization with successful results (Gulliksen and Görans-

son 2001). With our help, they defined their ways of looking upon and performing user-centred design and to initiate further development of their user-centred design process by themselves.

The next step is to include the findings in the prevalent development methodology, because if it is not included in the organization's standard procedures for design and development it will most likely never be performed at all. We have made some studies on the benefits of the existing commercial system development methodologies such as the Rational Unified Process (RUP) and found, as mentioned above, severe problems with the process from a user-centred design perspective (Gulliksen *et al.* 2001).

For work environment, competence development, organizational change, etc. to work out properly, it first of all requires methods and processes that well fit the prevalent software development methodology of the organization.

5.4. *Usability designers to improve the user-centred process*

Usability champions are one way to introduce HCI knowledge into the development work from within. We introduced the concept of the usability designer as a specific competence to keep the development process user centred (Göransson and Sandbäck 1999). We have seen examples where HCI researchers have apprenticed as usability designers and we have also acted personal support in organizations that have employed their own usability designer. The best results occur when the usability designer works as a mentor in an organization that consciously works towards a UCSD methodology.

Due to the complexity of the task, the size of the organizations and the limited authority of the usability designer in the organizations, we have not been able to have the usability designer be in charge of the work environment aspects as well. Work environment problems require a different set of skills and methods, which would make the responsibility far too heavy for the usability designer to shoulder.

There is, however, a risk that the organization takes the usability designer as hostage, not giving the role the mandate to make appropriate decisions, but blaming the usability designer for any failures to create usable systems. In our case this has been overcome by the support from the research community to the usability designer. It is therefore essential that this role gets appropriate status in the development organization so that the rest of the team feel confident to cooperate with the usability designer.

5.5. *Deployment of computer support – a critical phase*

When a new computer support system has been purchased, developed or changed, the day comes when it shall be implemented, i.e., introduced as a new tool for the users at the work place. This phase is, according to our experiences, a very critical one. Very often the deployment phase is totally neglected, it is not considered to be a part of the development project. The deployment is left to the local managements at the different offices, and when it is considered, the focus is almost always on teaching and training of the potential users in the technical handling of the new system. Even if this is done with a high ambition, some very important aspects are missed. Of course it is important that all potential users obtain a timely and adequate training in the technical use of the new system and its functionality, but it is definitely not enough. In many projects the deployment of an otherwise well developed and functional system has failed, which has resulted in years of confusion, irritation and low performance. We see that especially the following aspects must be properly covered:

- *The new work situation*. It is important to not only focus on the new technical support systems, and provide education and training for this. This is of course important, but even more important is the education and training in the new work roles, situations, procedures and tasks that have been created. First, this means that the new work situation also must be designed, something that often is neglected. Secondly, the training of the users must be focused on how they can work efficiently in the new work situation, using the new tools. We have seen several examples where users keep on working according to old patterns, but with new tools designed for a new context. Sometimes this is not discovered until after a long time, and in the meantime users both are inefficient and feel inefficient, leading to irritation, stress and health problems.
- *To handle worries and fears*. All changes are associated with a normal frustration. If this is accepted, and the introduction covers what will happen, why, what the result will be etc., the anxiety and stress can be reduced or avoided.
- *Give competencies to handle introduction problems, technical problems etc*. When a new work situation, work organization and computer support tools are introduced, a lot of problems and disturbances always occur. Technical malfunctions, unexpected errors etc. are a part of the normal. If users are aware of this fact, and also

know how to act when problems arise, both irritation and disturbances can be reduced.

- *Give competencies to handle new and unexpected work related situations and problems.* This means that the new work that is being created can never be completely foreseen and designed for. The only thing we know for sure is that we do not know everything that can occur in the new situation. Therefore we can not give the users competencies to handle all possible questions and problems that they will be confronted with. But what we can do, is to give them the competence to handle the unknown and unforeseen. An important part of this competence is how to cooperate in groups, in order to both get social support and use each other's skills and experiences (Kavathatzopoulos 2001a,b).

6. The VERKA project

6.1. *The objectives*

A research project called VERKA started in the spring of year 2000 and ended in December 2002. The overall aim of the project was to investigate how usability and work environment aspects could be addressed efficiently in the systems development and deployment processes. Our aim was to identify such aspects in the systems development process, that are particularly important when designing and implementing future work practices that minimize experienced problems and ultimately lead to healthy work. Some of the important issues include: how usability questions can become part of a general consciousness among the developers, how to use knowledge concerning usability, organizational development, systems development and healthy work, and how to apply this in the systems development processes. The research project included two of Sweden's central authorities, the Swedish National Social Insurance Board, RFV, and the Swedish National Tax Board, RSV. Each of these organizations has some 10 000 users who spend most of their working hours at the computer. An action research perspective was used in the VERKA project, meaning that the researchers did not only observe the studied object, but they were also active in sharing knowledge and participating in the studied development projects.

6.2. *The research activities*

Main research activities within the VERKA project were:

- Describe important work environment problems related to computer supported administrative work.
- Describe and analyse the systems development processes of the participating organizations, especially with respect to how usability and work environment aspects are addressed (or not addressed).
- Investigate relations between the development processes and the problems experienced at the work places.
- Formulate ideas for new and improved development processes.
- Test and evaluate the new development processes in practice, in connection with real systems development projects.
- Contribute to local improvements of work environment at local work places.

6.3. *The results*

Some of the results of the VERKA project will be presented in more detail in other publications in this special section of Behaviour and Information Technology. The list below summarises the main results of the project:

- A comprehensive summary of what is known concerning IT-related work environment problems, and the important success factors for creating good, healthy and sustainable working conditions in computer supported administrative work (Åborg 2002, Boivie 2003, Persson 2003).
- Description and analysis of existing development models in the involved organizations. The descriptions were mainly based on extensive observations, interviews and questionnaires. We described both the formal models and how the processes were actually carried out in practice. The result was a description of how computer support systems are being developed, both in theory and in practice (Gulliksen and Göransson 2001).
- Formulation of new complemented development processes. The objectives were to add modules addressing usability and work environment issues to the existing development models of the organizations. This was done by specifying principles for UCSD in practice (Gulliksen *et al.* 2003, in this issue) and models for user-centred development using RUP (Göransson *et al.* 2003). We also defined the role of the usability designer

(Göransson and Sandbäck, 1999) and participated in design activities.

- Extensive involvement in the development of a new system for the Swedish National Registration. This includes involvement in all phases of the development project, from initialization and requirement specification to deployment and the training of users. The researchers were directly involved in the development activities, and at the same time observing and analysing the processes and the outcome (Persson 2003).
- Evaluation of the different steps in the introduction of a new generalised case handling strategy and of supporting computer systems for this process. The objective of this project was to introduce a generalised process, according to which all different administrative cases are handled. For each specific case type, specific modules can be attached, in order to create all different case handling systems required in the organization. The evaluation was aimed at analysing how worker's demand, control and support were influenced by the introduction of the new generalised system.
- Support, by participation, in developing and improving the work environment at a number of local offices (Åborg 2002).

6.4. *The conclusions*

There is a need to increase the awareness and maturity when it comes to addressing usability aspects and particularly work environment issues already in the system development process. To be able to do this efficiently, the following activities could help:

- Increase the awareness both among the developers and the development organization as well as among the users and user organizations.
- Enhance the possibilities for the user organizations to order and require usability and work environment aspects.
- Complement software development processes with methods and techniques to address work environment aspects. This means that most of the projects phases must be supported by methods that assure that usability and work environment issues are treated in a satisfactory way.

We see that too much focus is put on system and product specific issues to increase the usability of systems in general. We believe that it would be more efficient and successful to put the workload into focusing on the development process instead. The following are some of the observations that we have made:

- Commitment in the entire organization that usability and a good work environment are important and that such aspects can not be traded off unless explicitly agreed upon.
- Skills and knowledge development. Education programs would be useful if they repeatedly would be directed towards all participants in the development work. Resources must be invested in experienced staff for the development of the user interfaces and the usability work. Organizational mentors can also provide the necessary space for reflection and evaluation.
- Process improvement. Existing development processes do not provide enough support for integrating the required competencies in the development work. One idea would be to provide process guidelines for user-centred design and criteria for the selection of users in the development process.
- Success stories. Despite all existing methods and tools for improving the work environment and the usability of the computer support, what we really need are success stories that may serve as inspiration and examples. Unfortunately there are too few success stories out there.

There are several important conclusions that can be drawn, with regard to the demand/control/support model for a healthy work environment (Karasek and Theorell 1990). We can see, from many different investigations, that the introduction of new and extended computer support in working life is almost always combined with increasing demands. We also know that increasing demands is not by necessity something negative, as long as within reasonable limits. But this requires that it is matched by high control and high social support. The conclusion is that extra effort must be put into activities aimed at improving control and support, something which is possible if the problems are identified and if attention is given to good solutions. It is, however, our experiences that this very often is not the case. We have seen several examples where increasing demands are combined with reduced control and reduced social support, and all experience tells us that in this way a dangerous work environment is created.

7. Designing IT for healthy work – papers in this special section

In this special section of BIT, our purpose has been to show that there is a lot of knowledge about users' health

and well being in computer supported work, but that this knowledge has not to any larger extent been communicated within the HCI community, nor used in practice.

The first paper, by Åborg and Billing, describes examples of health problems that can occur in a computer supported work situation as a consequence of a poorly designed IT. The paper describes the effect of the introduction of electronic document handling (EDH) in two different settings. They observed an increased risk of work-related musculoskeletal disorders and stress-related mental and somatic symptoms. The effects on the physical and psychosocial work environment, and on self-reported health, were analysed in two studies at eight different Swedish work places. The results showed a significant increase in time spent at the computer after introduction of the EDH system. The paper concludes that the main problems are increasing workload, increased feelings of being more constrained and controlled, higher frequencies of static work postures, usability problems and increasing health complaints. Except for the usability problems, such problems are seldom in focus when traditional methods for analysis, design and evaluation of the computer systems are applied in the software engineering process.

Consequently, there is a need to put more focus on the design of IT for healthy work. One of the important approaches for doing so is to work in close cooperation with the users, e.g., applying a user-centred approach. However, there is a great variety in what people understand with a user-centred approach and the user focus is often lost in practice.

The second paper, by Gulliksen, Göransson, Boivie, Blomkvist, Persson and Cajander, aims at clarifying this confusion and takes a user-centred systems design (UCSD) perspective on systems development. They propose a definition of UCSD containing 12 key principles based on state of the art research and the authors' own experience in trying to achieve UCSD. One of the incentives of this is to focus on the system development process as such, since an integration of user-centred perspectives into development processes gives the opportunities to take these perspectives into account. The paper also presents a case of the rise and fall of a user-centred development project, illustrating the success factors for UCSD as well as some crucial obstacles.

A user-centred systems design process is a necessary, but not sufficient, condition for being able to design IT for healthy work. In the third paper, by Boivie, Blomkvist, Persson and Åborg, the authors claim that occupational health expertise should be directly involved in the software design process. They describe an exploratory study addressing the problem of poor overview and control in electronic case handling. Health experts and users cooperated in analysis, design and evaluation of a prototype, with the purpose of overcoming some of the stress-related disorders that are common in this type of computer supported work. Observation interviews were conducted focusing on the risk factors such as high demand, low control and poor social support. The risk factors could then be made explicit and turned into requirements, design criteria and scenarios that formed the basis for design.

These three papers together with the editorial introduction, intend to give the essence of the research work performed in the VERKA project. More research and more development is needed to solve important problems. Health complaints relating to extensive use of poorly designed computer systems are still growing in many working life applications. The knowledge about what can be done exist, and has been there for a long time, but the systems engineering processes still have a long way to go before they reach a level mature enough to take these aspects into consideration.

Future work within this field involves addressing the issues of designing IT for healthy work on a strategic level, incorporating UCSD into the overall development framework and to continue our focus on the end-users and improving both the efficiency of their artefacts and their work environment.

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PAPER II

Key Principles for User-Centred Systems Design.

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Key principles for user-centred systems design

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Abstract. The concept of user-centred systems design (UCSD) has no agreed upon definition. Consequently, there is a great variety in the ways it is applied, which may lead to poor quality and poor usability in the resulting systems, as well as misconceptions about the effectiveness of UCSD. The purpose of this paper is to propose a definition of UCSD. We have identified 12 key principles for the adoption of a user-centred development process, principles that are based on existing theory, as well as research in and experiences from a large number of software development projects. The initial set of principles were applied and evaluated in a case study and modified accordingly. These principles can be used to communicate the nature of UCSD, evaluate a development process or develop systems development processes that support a user-centred approach. We also suggest activity lists and some tools for applying UCSD.

1. Purpose and justification

This paper describes the results of our current research on UCSD and our experiences of applying UCSD in software development projects. Our purpose has been to compile knowledge and experiences of UCSD, in order to give the concept a more precise meaning and to increase its power. The main point in our paper is that applying UCSD requires a profound shift of attitudes in systems development, and our main goal is to promote that attitude shift.

2. Background

Our main concern has been the lack of an agreed upon definition of UCSD, turning it into a concept with no real meaning. 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)

Several other definitions and understandings have been proposed over the years. The lack of a shared understanding of the meaning of UCSD (or User-Centred Design, UCD) has actually been pointed out as a quality in its own right by Karat:

> 'For me, UCD is an iterative process whose goal is the development of usable systems, achieved through involvement of potential users of a system in system design.'
>
> (Karat 1996)

> 'I suggest we consider UCD an adequate label under which to continue to gather our knowledge of how to develop usable systems. It captures a commitment the usability community supports—that you must involve users in system design—while leaving fairly open how this is accomplished.'
>
> (Karat 1997)

The consequence of such general and non-specific definitions of user-centred design is that it, in practice, becomes a concept with no real meaning.

We have therefore identified a set of key principles[1] for UCSD. The principles summarize our research

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results and experiences from software development projects in a large number of organizations and projects. They are based on principles specified elsewhere (Gould *et al*. 1997, ISO 13407, 1999) and on our experiences made from trying to apply UCSD in systems development projects using processes such as the Rational Unified Process (Kruchten 1998). Our principles also take into account the Scandinavian tradition of extensive user involvement in the development process (Greenbaum and Kyng 1991) in some communities known as participatory design. Other well-known approaches such as contextual design (Beyer and Holzblatt 1998), goal-directed design (Cooper 1999), usability engineering (Nielsen 1993, Mayhew 1999) have also contributed to the result.

Below we describe one of the projects that had particular impact on the principles in that it was conducted with the explicit goal to capture critical success factors for UCSD.

3. The project

The pilot project was an in-house development project within the Swedish National Tax Board with the purpose to develop a new computerized case-handling tool for administrators working with national registration. We were able to follow the project from the very start. In the first project meeting we emphasized the importance of following a UCSD approach and introduced our set of principles to the project team.

These principles were specific for the organization and had been identified in an earlier research effort (Gulliksen and Göransson 2001). They were:

- *The work practices of the users control the development*. Early focus on users and tasks. The designer must understand the users, their cognitive behaviour, attitudes and the characteristics of their work tasks. Appropriate allocation of function between the user and the system is also important to prevent unnecessary control;
- *Active user participation* throughout the project, in analysis, design, development and evaluation. This requires a careful user selection process emphasizing the skills of typical users, including both:
    - work domain experts (continuously through the development project);
    - and actual end-users (for interviews and observations as well as evaluation of design results).
- *Early prototyping* to evaluate and develop design solutions and to gradually build a shared understanding of the needs of the users as well as their future work practices;
- *Continuous iteration* of design solutions. A cyclic process of design, evaluation and redesign should be repeated as often as necessary. The evaluation process should include empirical measurement in which tests are conducted where users perform real tasks on prototypes. The users' reactions and attitudes should be observed and analysed;
- *Multidisciplinary design teams*. Mainly achieved by including a usability designer (Göransson and Sandbäck 1999) in the process;
- *Integrated design*. The system, the work practices, on-line help, training, organization, etc. should be developed in parallel.

The project decided to act in accordance with the above principles.

3.1. *Research methods*

We used an action research approach in the project, i.e. our aim was to introduce changes in the development process as regards user involvement and usability issues, and to observe and record the outcomes of these changes. Our activities included introducing a set of UCSD principles as described above, and facilitating the project team's commitment to these principles. We also facilitated collaborative prototyping activities with users.

To observe the outcomes of the activities and actions, we used qualitative data collection methods as described below.

- observations of the work of the development team, for instance, by continuously participating in the project meetings of the software development team;
- observations of the current work practices (mainly paper-based) of the administrators working with national registration;
- semi-structured interviews based on open-ended questions with software developers and user representatives about their attitudes to and experiences with working with users and usability;
- semi-structured interviews based on open-ended questions with users about their work;
- continuous discussions with members of the software development team and representatives for the current work practices to check possible discrepancies in our interpretation of the observed activities and actions.

Meanwhile, we continued working with the principles. As a result of intermediate findings in the pilot project and findings in other, parallel, research efforts we modified the set of principles to cover the 12 key principles described in this paper. The applicability of these principles was then assessed in a number of workshops with researchers and practitioners.

3.2. *Results*

As a result of the introductory meeting, the project group decided to apply UCSD as defined by the initial set of principles.

We could not influence the choice and customization of the development process – the organization had recently shifted to using the Rational Unified Process (RUP) (Kruchten 1998). We were, however, able to introduce additional activities to complement the process as needed, e.g. activities for performing a thorough user and task analysis, for developing design solutions iteratively and in cooperation with the users, and for including a usability designer throughout the project.

One of the more successful events was a collaborative prototyping activity in which the users could develop their vision of the future system and work situation, integrating a future system and future work practices (figure 1).

These collaborative prototyping sessions were facilitated by a usability designer in cooperation with a researcher. The users brought sketches illustrating their own view of the future system as a basis for a negotiation on the most appropriate design of the system.

Low-level prototyping tools were used since the users regarded them as the most flexible tool for their purpose (figure 2).

Prior to the collaborative design sessions the usability designer had conducted a user analysis and created personas. According to Calde *et al*. (2002) user models, or personas, are fictional, detailed archetypical characters that represent distinct groupings of behaviours, goals and motivations observed and identified during the research phase. Cooper (1999) describes personas as a tool for communication and design within the group of designers, software developers, managers, customers and other stakeholders. The purpose is not to give a precise description or a complete theoretical model of a user. Instead, it is aiming at a simple, but good enough description of the user to make it possible to design the system (figure 3).

From the software engineering side they had been performing use case modelling to specify the detailed requirements on the system. A use case specifies the sequence of actions, including alternatives of the sequence, that the system can perform, interacting with actors of the system (Jacobsson *et al*. 1999). Use case modelling is today one of the most widely used software engineering techniques to specify user requirements. Unified Modelling Language (UML) is one of the most common formal notations to describe use cases (Fowler 1997). Rational Unified Process (RUP) (Kruchten 1998) builds heavily upon these techniques.

According to the users, the personas gave a much more concrete picture of typical users than what came out of the use case modelling sessions running in parallel with the collaborative prototyping activities.

Figure 1. Collaborative prototyping in which the usability designer facilitates the users' production of mock-ups.

Figure 2. Low-fidelity prototyping tools were used as these were the most convenient for visualizing the future use situation without limiting the design space.


Gudrun

Personal background

Gudrun är 61 years old and lives together with her husband in a small town. Hennes barn är vuxna och har för länge sedan flyttat hemifrån.

Gudrun började arbeta med folkbokföring på patentverksexpedition 1971. Hon arbetar 80% och uteslutande med folkbokföringsärenden. Hon tar dock även emot besökande i skatteärenden på den gemensamma expeditionen.

Professional background

Gudrun har motsvarande gymnasiestudier. Hon har dessutom läst 10p juridik på högskolan. Hon har fått utbildning i folkbokföring, totalt 3 veckor, på patentverksbetet. Dessutom fick hon 1991 en vecka utbildning i det då nya folkbokföringssystemet. Gudrun får också löpande information om nyheter genom träffar som regionens Moff arrangerar några gånger per år.

Work settings

Kontorets upptagningsområde består av mycket landsbygd, och småorter.

Alla folkbokförarna har egna rum iställ varandra. Kontoret har en expedition där skatteärden och folkbokföringen tarvs om ett arbete.

Gudrun sitter normalt i expedition varje tisdag förmiddag. Ibland blir det dock ytterligare en dag i veckan. Den som sitter en halvdag i expedition har även telefonjouren.

Även på tisdagseftermiddagarna när skattepersonal sitter på expedition har Gudrun telefonjouren. Då fungerar hon även som bakjour åt expeditionen. På tisdagarna hänvisar hon även med att göra en del ärenden som kommit in via porten. Då tar hen bara enkla ärenden eftersom hen kan bli avbruten när som helst.

Man har ca 50 telefonsamtal och ett tiotal besök varje dag som avser folkbokföringen.

Varje måndag och tisdag tar Gudrun hand om den inkomna folkbokföringsporten.

Colleagues and contacts

På Gudruns kontor arbetar ytterligare 2 folkbokförare. Den ena är jämnårig med Gudrun och den andra är i 50 åldern.

Gudrun är förutom kontorschefen den enda som får ta hand om känsliga ärenden. Gudrun är mycket kunnig och erfaren när det gäller det materiella och hennes kollegor kommer ofta och frågar henne hur de ska göra i ett visst ärende.

Gudrun har byggt upp ett stort kontaktnät genom tiden, speciellt inom regionen, men hon har även en del kontakter på RSV.

Miscellaneous

Gudrun brukar sortera sina ärenden och köra en ärendetyp åt gången. Har hon mycket att göra därtill hon först eller läter någon av deras entrejer hoppa in och därifrån åt henne.

Hon föredrar att arbeta på papper, hon har samlat utdrag ur de databaser i Lotus Notes som berör folkbokföringen i pärmar. Gudrun har inte börjat använda MS-word, utan föredrar att fortsatt använda WordPerfect eftersom hon kan det.

Ibland använder hon även datorsladdn för vissa utskick.

Gudrun använder varken Intranet, eller Blankettbeställningssystemet då hon menar att hon inte har någon nytta av det.

Gudrun älskar att arbeta men tycker att det blir lite vill mycket arbete framför datorn. Hon tycker också att det är lite jobbigt med expeditionens döda öppettider.

Figure 3. Personas were used to describe typical users. In this example, the persona 'Gudrun' is described based on personal background, the work setting, colleagues and contacts.

Halfway through the project all participants were very satisfied with the activities so far and the results achieved. The project was committed on all levels to UCSD. The principles communicated the essentials of UCSD very well.

From then on, however, there was a gradual increase of problems and obstacles to the user-centred approach. Despite efforts from our side and from the project, the problems were never really resolved. Some of them were outside the control of the project.

The major problems in the project are briefly described below. The problems reflect why the initial principles were not sufficient, and therefore each of the problems is related to the subsequent definition and 12 key principles of User Centred Systems Design. The outcome of the project can be compared with the consolidated list of 12 key principles, and each problem in the project maps well against one or more of the principles.

- *No lifecycle perspective on UCSD*. The developers focused on short-term goals, such as, producing models and specifications prescribed by RUP. The long-term goals and needs of the users regarding their future work situation were ignored or forgotten. Moreover, towards the end of the project, meeting the project goals and deadlines became much more important than achieving some sort of minimum level of usability. We believe, that had the project decided to give the usability activities higher priority than, for example, to develop absolutely all the functionality the end result could have been a lot better, without any of the missing functionality causing any big problems in the long run. We emphasize the importance of a lifecycle perspective in our definition of UCSD in the next chapter as well as in a number of the principles, for instance, the user involvement principle and the usability champion principle. The lack of lifecycle perspective also indicates that there was no real commitment to UCSD in the project which points to an attitude problem;
- *Usability designers were ignored*. Despite the skilful and experienced work that the usability designers performed, their results and their opinions were ignored in the later phases of the project. The usability champion principle points out that the usability champion/designer[2] should have the mandate to decide on usability matters. The project ignoring the input of the usability designer clearly indicates that this was not the case;
- *Use case mania*. When the project started, the organization did not have enough experience with use case modelling. The modelling went out of hand and the results could not be used efficiently in the development process. The project got literally bogged down in use cases, but did not really know what to do with them. The use case mania indicates that there was a problem with user focus in the project. Despite the confusion regarding the use of the use cases, producing them became more important than understanding the users' real needs;
- *Poor understanding of the design documentation*. The design was documented in UML and the users were invited to evaluate it. The users had severe difficulties predicting their future use situation based on the UML notation. One of the users said that after having worked with use case modelling, the collaborative prototyping was like 'coming out of a long dark tunnel'. The design representation principle emphasizes the impor-

tance of using representations that are easy to understand for all the stakeholders, in particular as regards the future work/use situation. UML is clearly not suitable in that respect;

- *Major changes in the project*. Halfway through the project a strategic decision was made within the organization, against our advice, to change the technical platform and continue the development in a web-based environment. The decision was crucial in that it made it very difficult to meet the usability requirements. Insufficient experience with and expertise in the new technology as well as the page metaphor in html created problems. The decision was made with little or no attention to usability matters. This indicates that there was a problem with the attitudes to UCSD and usability within the organization and a problem with user focus;
- *Problems establishing a user centred attitude*. Single individuals in a project can make a crucial difference when it comes to UCSD. We noticed, for instance, problems with resolving conflicts between personal goals and business goals within the project, on an individual level. Again, this indicates that there was a problem with attitudes and user focus in the organization. It also indicates problems with the professional attitude described in the principle on multidisciplinary design.

This case describes how a project with explicit intentions to apply UCSD, nevertheless ran into several problems and obstacles that made it very difficult to pursue the UCSD approach. Our conclusion is that one needs to be very specific about what it takes from the process to comply with UCSD to prevent problems such as the ones described in the pilot study.

Based on the results of the project, we concluded that the principles listed in Gould *et al*. (1997) and ISO 13407 (1999) are not sufficient to maintain a UCSD approach in a project or in an organization. We therefore modified our initial set of principles to clearly indicate that it takes much more to work in a user-centred fashion. We have also run a number of workshops with researchers and practitioners to discuss and confirm the principles. The resulting set is listed below together with a definition of UCSD.

4. Definition and key principles

User-centred system design (UCSD) is a process focusing on usability[3] throughout the entire development process and further throughout the system life cycle (figure 4). It is based on the following key principles:

- *User focus – the goals of the activity, the work domain or context of use, the users' goals, tasks and needs should early guide the development* (Gould *et al*. 1997, ISO 13407 1999). All members of a project must understand the goals of the activity, the context of use, who the users are, their situation, goals and tasks, why and how they perform their tasks, how they communicate, cooperate and interact, etc. This helps in creating and maintaining a focus on the users' needs instead of a technical focus. Activities, such as identifying user profiles, contextual inquiries and task analysis, must be a natural part of the development process. Make sure that all project members have met real or potential users, for instance, by visiting the workplace. Descriptions of typical users, tasks and scenarios could be put up on the walls of the project room/area to maintain a user focus;
- *Active user involvement – representative users should actively participate, early and continuously throughout the entire development process and throughout the system lifecycle* (Nielsen 1993, Gould *et al*. 1997, ISO 13407 1999). The users should be directly involved, both in the development project and in related activities, such as, organizational development and designing new work practices (Greenbaum and Kyng 1991). The users must be representative of the intended user groups. Plans for involving users should be specified from the very start of the project.

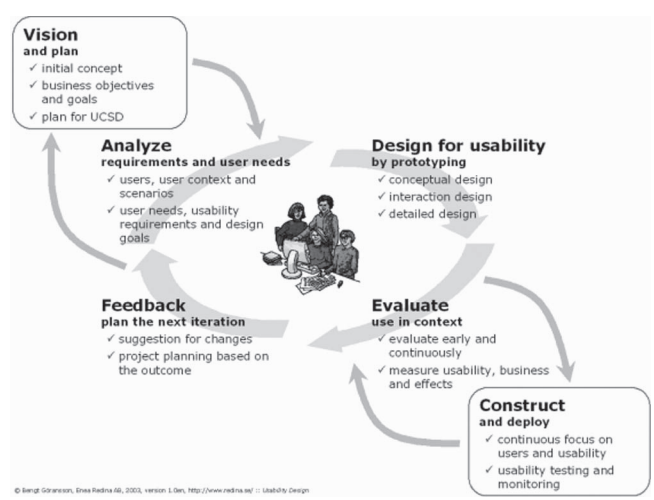

Figure 4. User-centred system design (UCSD) is a process focusing on usability throughout the entire development process and further throughout the system life cycle.

Identify appropriate phases for user participation and specify where, when and how users should participate.[4] Emphasize the importance of meeting the users in context, for instance, at their workplace;

- *Evolutionary systems development – the systems development should be both iterative and incremental* (Boehm 1988, Gould *et al.* 1997). It is impossible to know exactly what to build from the outset. Hence, UCSD requires an approach which allows continuous iterations with users and incremental deliveries. This, so that design solutions can be evaluated by the users before they are made permanent. An iteration should contain a proper analysis of the users' needs and the context of use, a design phase, a documented evaluation with concrete suggestions for modifications and a redesign in accordance with the results of the evaluation. These activities do not have to be formal. An iteration could be as short as half an hour, as long as it contains all three steps. Incremental development means that, based on an overall picture of the system under development (SUD), priorities are set and the system is divided into parts that can be delivered for real use. Each increment is iterated as described above. Evaluations of the increments in real use should influence the design of the subsequent increments. Let the software grow into the final product;
- *Simple design representations – the design must be represented in such ways that it can be easily understood by users and all other stakeholders* (Kyng 1995). Use design representations and terminology that are easily understood by all users and stakeholders so that they can fully appreciate the consequences of the design on their future use situation. Use, for instance, prototypes (sketches and mock-ups) and simulations. Abstract notations, such as use cases, UML diagrams or requirements specifications are not sufficient to give the users and stakeholders a concrete understanding of the future use situation (Mathiassen and Munk-Madsen 1986, Bødker 1998). The representations must also be usable and effective. The goal is that all parties involved share an understanding of what is being built;
- *Prototyping – early and continuously, prototypes should be used to visualize and evaluate ideas and design solutions in cooperation with the end users* (Nielsen 1993, Gould *et al.* 1997). Use multiple paper sketches, mock-ups and prototypes to support the creative process, elicit requirements and visualize ideas and solutions. The prototypes should be designed and evaluated with real users in context (contextual prototyping). It is essential to start with low-fidelity materials, for instance, quick sketches, before implementing anything in code. Start with the conceptual design on a high level and do not move on to detail too quickly. If possible produce several prototypes in parallel, since this helps the designers in maintaining an openness and creative attitude to what is being built. Far too often the design space is unnecessarily limited by only sticking with the first set of designs produced;
- *Evaluate use in context – baselined usability goals and design criteria should control the development* (Nielsen 1993, Gould *et al.* 1997). Critical usability goals should be specified and the design should be based on specific design criteria. Evaluate the design against the goals and criteria in cooperation with the users, in context. Early in the development project, one should observe and analyse the users' reactions to paper sketches and mock-ups. Later in the project, users should perform real tasks with simulations or prototypes. Their behaviour, reactions, opinions and ideas should be observed, recorded and analysed. Specify goals for aspects that are crucial for the usability and that cover critical activities as well as the overall use situation;
- *Explicit and conscious design activities – the development process should contain dedicated design activities* (Cooper 1999). The user interface design and the interaction design are of undisputed importance for the success of the system. Remember that to the users the user interface is the system. The design of the SUD as regards the user interaction and usability should be the result of dedicated and conscious design activities. The construction of the SUD should adhere to that design. Far too often, the UI and interaction design 'happens' as a result of somebody doing a bit of coding or modelling rather than being the result of professional interaction design as a structured and prioritized activity;
- *A professional attitude – the development process should be performed by effective multidisciplinary teams* (ISO 13407 1999). Different aspects and parts of the system design and development process require different sets of skills and expertise. The analysis, design and development work should be performed by empowered multidisciplinary teams of, for instance, system architects, programmers, usability designers, interaction designers and users. A professional attitude is required and so are tools that facilitate the cooperation and efficiency of the team;

- *Usability champion – usability experts should be involved early and continuously throughout the development lifecycle* (Kapor 1990). There should be an experienced usability expert (usability designer) or possibly a usability group on the development team. The usability designer should be devoted to the project as an 'engine' for the UCSD process from the beginning of the project and throughout the development process and system lifecycle (Buur and Bødker 2000). The usability designer must be given the authority to decide on matters affecting the usability of the system and the future use situation;
- *Holistic design – all aspects that influence the future use situation should be developed in parallel* (Gould *et al*. 1997). Software does not exist in isolation from other parts of, for instance, a work situation. When developing software for the support of work activities, the work organization, work practices, roles, etc, must be modified. All aspects should be developed in parallel. This includes work/task practices and work/task organization, user interface and interaction; on-line help; manuals; user training, work environment, health and safety aspects, etc. Other parts of the context of use such as: hardware, and social and physical environments, must also be considered in the integrated design process. One person or team should have the overall responsibility for the integration of all aspects;
- *Processes customization – the UCSD process must be specified, adapted and/or implemented locally in each organization*. Usability cannot be achieved without a user-centred process. There is, however, no one-size-fits-all process. Thus the actual contents of the UCSD process, the methods used, the order of activities, etc, must be customized and adapted to the particular organization and project based on their particular needs. A UCSD process can be based on a commercial or in-house software development process, where activities are added, removed or modified. Existing methods and techniques may well be re-used, if they comply with the key principles;
- *A user-centred attitude should always be established*. UCSD requires a user-centred attitude throughout the project team, the development organization and the client organization. All people involved in the project must be aware of and committed to the importance of usability and user involvement, but the degree of knowledge may differ depending on role and project phase (Boivie *et al*. 2003). The key principles defined in this paper can serve as a common ground.

The above 12 principles facilitate the development, communication and assessment of user-centred design processes for creating usable interactive systems, covering analysis, design, evaluation, construction and implementation. Several benefits come with applying the principles, such as their help in maintaining the focus on the users and the usability throughout the entire development process. The UCSD poster is reprinted in Appendix 1.

We fully appreciate that it will be more or less impossible to implement all the principles in one strategic shift. Adopting them gradually is probably more feasible and practicable. It is, however, important to comply with the principles to as high a degree as possible at any point in time.

5. Tools for applying UCSD

The principles are, necessarily, general and rather abstract in nature, and cannot be applied as is in practice. We are therefore currently working on activity lists, with potential tools and techniques, for each principle. These lists will provide support for applying the principles and help in understanding and assessing them.

5.1. *Activity list*

The purpose of the activity list that accompanies each principle is to elaborate on what it takes to apply a principle. The activity list suggests activities of a general nature alongside appropriate methods, tools and techniques. The principles are general but the activity lists should be developed specifically to fit each organization.

5.2. *Complying with the activity list*

The lists suggest activities and it is important to evaluate the applicability of each activity within the current project. If one chooses not to perform a particular activity, it is important to make clear why, and that all parties involved agree with the decision. The activity list serves as both a To-do list and a checklist, where each item can be 'ticked off'. There are three options for each activity:

- No = we decided to not perform this activity. We gave rationales for this decision and had a general agreement on the motives;

- Yes = we performed this activity, in full or to the extent that the project team and management, found appropriate;
- N/A = we found that this activity was not applicable. The rationales for this were clearly stated and agreed on. We have conducted other activities to compensate for this.

Below is a draft activity list for the principle User focus:

5.3. *Activity list, tools and methods for the principle; User focus*

- Vision, purpose goal and constraints of the target activity analysed and understood by all project members;
  - *Tools and methods:* Goals analysis, Focus groups;
- Identification, description and prioritization of all user groups;
  - *Tools and methods:* User analysis, personas;
- Visualization and characteristics of target user groups made available to everyone in the project;
  - *Tools and methods:* Decorate a project room with artefacts, etc. that illustrate the users' work situation, environment and characteristics;
- Potential limitations and restrictions in the users' capabilities (for instance vision impairments or language problems) are clear to everyone in the project;
- The development team has focused on the needs of target user groups;
- The users have expressed their impressions of current system and expectations on future system;
  - *Tools and methods:* Users asked about good things and bad things in their current work situation, Think-out loud;
- Users observed as they were performing their tasks in context;
  - *Tools and methods:* Analysis of information utilization, Context-of-use analysis, Field studies, Contextual inquiry;
- Use situation documented;
  - *Tools and methods:* Video and still camera, scenarios, personas;
- Tasks analysed;
  - *Tools and methods:* Task analysis;
- Copies of artefacts (forms, documents archives, notebooks, etc.) used by the users collected.

6. Application

In the pilot project described above, an initial set of principles was used to define a UCSD process. The consolidated list of principles was subsequently used to identify mismatches between the development process and a UCSD approach. The definition and principles for UCSD can, however, be used for a number of purposes as listed below:

(a) *Explanation model* – to analyse and communicate why organizations, projects or processes did not meet their goals as regards usability;
(b) *Process development* – for defining a UCSD process;
(c) *Process/Organization customization* – to customize or adapt an organization, project or development process to UCSD, for instance, a commercial development process, such as Rational Unified Process – RUP (Kruchten 1998). Even though RUP prevents rather than promotes UCSD, it may be modified to integrate some of its features (Gulliksen and Göransson 2001);
(d) *Process/Organization assessment* – to assess the user-centeredness of an organization, project or process. Using the principles to identify mismatches, problems may be identified in time to do something about them, which increases the chances of producing a usable piece of software;
(e) *Knowledge transfer* – to teach and transfer knowledge about UCSD and to communicate the basic philosophy of UCSD;
(f) *Procurement support* – support for procurers as a basis for specifying requirements on the design process as such;
(g) In *client-contractor relations* – the client can demand that the contractor work in accordance with the definition and key principles for UCSD. At present, usability is often taken for granted. Clients do not understand that it takes systematic work according to a UCSD philosophy to achieve usability.

Our definition and key principles originate from our experiences and research in contract and in-house development of bespoke software for work situations. We nevertheless see a potential for applying them in other types of development projects. Regardless of the project and the organization, the principles must always be adapted to the context.

7. Agile approaches and UCSD

Recently, agile approaches to software development have gained a lot of attention. The rationale behind the agile perspective is to shift the overall focus of software development to a more agile or 'lightweight' perspective. This shift can be seen as a contrast to more formal commercial processes. Agile is not a single, well defined process, instead, it is a generic name for several different processes or methods, sharing a set of core ideas, values and principles of software development. The principles are defined in the Agile Manifesto (Agile Alliance 2001). The most well known of the agile processes is probably eXtreme Programming, XP (Beck 2000).

What is interesting about agile methods is that they are addressing some of the problems of the development process that we found in our research project. For instance, the project focused on short-term goals such as producing models and other artefacts while loosing the overall goal of delivering a usable system. Other problems include use-case mania and poor understanding of the design documentation. Agile processes emphasize the pragmatic use of light, but sufficient rules of project behaviour and the use of human and communication oriented principles (Cockburn 2002). Hence, people are more important than processes and tools. Working software is more important than comprehensive documents and model building, Models and artefacts are only means of communication; consequently prototyping and simple design representations are preferred. Agile developers argue that projects should be communication centric, which implies that effective human communication with project members and users are important, e.g. face-to-face is the ideal way of communicating within a project and with users. Usually, there is a direct collaboration with users and customers – preferably, users and developers should sit in the same room during development.

The problems with the agile approach, is that the different processes have not paid much attention to usability and UCSD. The main focus of agile methods is on delivering working software. This is of course excellent, as usable software also must be delivered and be working. But to get there, the development is focused on making coding effective and there is a risk that usability issues get lost as there is no explicit user-centred focus. Agile projects include some roles that are supposed to work with user interface design and user requirements, but this is in most cases not enough. The whole project must be committed to the importance of usability. Another problem is that the users involved in the development are not always end users. Sometimes they are customers or domain experts. The agile methods seldom make a difference.

Agile processes do not themselves apply to all the key principles of UCSD, but so far we have not seen any reason why agile processes could not be customized or adapted to UCSD.

8. Discussion/conclusions

The reader may ask why we have defined yet another set of principles for user-centred systems design, since those existing are not used or do not work the way they were intended. Below, we discuss some of the main reasons why we believe a more precise definition of UCSD is required.

Our pilot study shows that even with an explicit commitment to UCSD and a usability focus, usability may get lost in the software development process. Since few projects have the explicit goal to produce systems with poor usability, we believe that there are obstacles to usability and user involvement in the actual development process. Such obstacles have been described in numerous studies, for instance, Poltrock and Grudin (1994) and Wilson *et al*. (1996, 1997). Our main concern has therefore been to address shortcomings and obstacles in the development process that derail the focus on usability and users' needs.

User-centred design (UCD) methods have gained a great deal of attention recently. According to a recent study (Vredenburg *et al*. 2002) the opinion is that user-centred methods generally increase the utility and usability of computer systems. However, the degree to which organizations adopt UCD methods varies significantly. There is, according to the study, no information on whether or not it is possible to save time and resources by adopting UCD methods. Cost-benefit tradeoffs are, nevertheless, a key consideration when adopting UCD methods (see for example Donahue 2001) This calls for close integration of UCD methods into the development process. Unfortunately, the most common approach is to perform single usability activities using informal UCD methods (Hudson 2001). Such an add-on approach to usability increases the risk of its being cut out when deadlines get tight. We believe that usability faces the risk of becoming a sidecar problem – if somebody in the project is pointed out as having the responsibility for usability all others involved resign from their part of the responsibility. Thus, cost-benefit analysis may in certain situations be used as an argument against usability activities rather than for if they are not tightly integrated.

In a survey examining the attitude about strategic usability (Rosenbaum *et al*. 2000) the authors identified the following obstacles to UCD:

- Resource constraints (28.6%);
- Resistance to UCD/usability (26.0%);
- Lack of understanding/knowledge about what usability is (17.3%);
- Better ways to communicate impact of work and results (13.3%);
- Lack of trained usability/HCI engineers (6.1%);
- Lack of early involvement (5.1%);
- No economic need – customers not asking for usability (3.6%).

We believe that all of these factors are related to a lack of knowledge on how to apply UCD methods and their potential benefits which provides another reason for defining and describing UCSD in more specific terms.

Many organizations pay lip service to usability and UCSD but seem at a loss as to how to achieve it. We have studied organizations that claim that they are committed to usability and UCSD but who are not willing to change their practices in developing software. The same problem applies on the individual level. There is a growing concern among software developers about the usability of the products or software they release on the users. But they often do not know what to do about it.

Yet another reason for a more precise definition of UCSD is that many organizations still do not recognize the benefits of involving users in the development process, despite the fact that active user involvement was judged to be the number one criterion on how to be successful in IT-development projects in the CHAOS report (Standish Group 1995). Clegg *et al*. (1997), for instance, report that most projects in their study had failed to involve users in a satisfactory manner. Nor did they adopt an integrated approach. The impact of new technology on work organization and job design was considered '...hugely important but largely ignored in practice' and if addressed, it was usually late in the process and because it was discovered that the new piece of technology was going to change job designs.

UCD has also been criticized on the grounds of its being ambiguous and vague. Constantine and Lockwood (2002), for example, claim that UCD is a '...loose collection of human-factors techniques united under a philosophy of understanding users and involving them in design...Although helpful, none of these techniques can replace good design. User studies can easily confuse what users want with what they truly need. Rapid iterative prototyping can often be a sloppy substitute for thoughtful and systematic design. Most importantly, usability testing is a relatively inefficient way to find problems you can avoid through proper design' (Constantine and Lockwood 2002: 43). Their remedy is 'usage-centred engineering' where the emphasis is on the usage, not the users, and on model-driven development. We readily agree with the critique against UCD, but not with the remedy. Model-driven approaches rely on skilful designers/developers using abstract models of the domain to base their design on. Model-driven approaches represent a move away from user-centred design, reducing user involvement to that of the users being informants rather than co-designers. We believe, and argue in this paper, that user participation is a key success factor for designing for usability (see also Standish Group 1995, Gould *et al*., 1997, and ISO 13407 1999) and that software development needs to move towards a user-centred approach rather than away from it. Computer systems (in particular in a work context) must support not only the official rules and version of the work practices but also the particularities in each situation (Sachs 1995, Beyer and Holtzblatt 1998, Harris and Henderson 1999), which required a deep understanding of the context of use. Few development teams have that understanding, and we believe that writing requirements documents or creating abstract models is simply not enough to create that kind of understanding. Only the users themselves can provide that.

To summarize the above discussion, we believe that user-centred systems design must be defined in terms of a process where usability work and user involvement are tightly integrated with the development process. Adding the key principles, furthermore, helps in communicating the essence of UCSD where user involvement is an essential part. By providing a more precise definition of UCSD, we can also avoid problems with ambiguity and vagueness and argue against the use of approaches that are not user-centred.

Hence, the main aim of our definition and key principles is to support the *development process*. This can be achieved by incorporating roles, activities and artefacts for maintaining a focus on usability and users' needs throughout the entire system lifecycle. The definition and key principles may also be used when specifying a UCSD process or when customizing a commercial development process, such as Rational Unified Process – RUP (Kruchten 1998). The key principles originate from our experiences and research in contract and in-house development of bespoke software for work situations. We nevertheless see a potential for applying them in other types of development projects.

Our research, as well as our experiences, show that by applying the definition of and key principles for UCSD,

the chances increase of identifying problems in time to do something about them. Consequently, the chances of producing usable software increase.

Finally, we would like to emphasize that what we want to achieve is not simply yet another usability method. We see UCSD as, a new paradigm requiring a profound shift of attitudes towards systems development and user involvement. The attitudes that are required for a truly user-centred approach are embodied in the key principles.

Notes

1. A *principle* is a commonly accepted fundamental rule or law that can be used to define other principles.
2. To us the usability designer is a role that has a clear position in the development project (see for instance Göransson and Sandbäck 1999). Usability champion has more of a mentor status and is not a role that somebody can shoulder. To be able to act as a usability champion you must have extensive knowledge and experience of the work in practice and also an ability to act as a mentor.
3. 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.
4. Please note that involving users on a full-time basis in a project quickly turns them into domain experts rather than representative users. It is therefore important to involve user representatives on a temporary basis as well.

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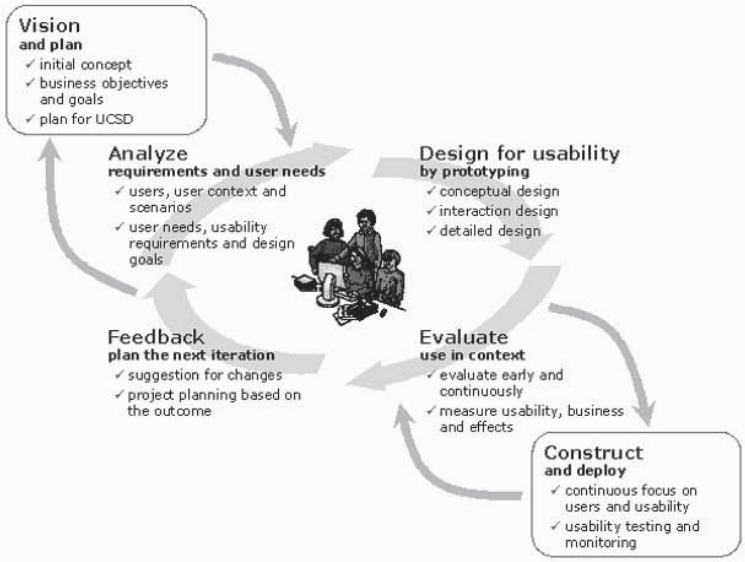
Appendix 1: The UCSD poster

Key Principles for User-Centered Systems Design



User-centered systems design (UCSD) is a process focusing on usability throughout the entire development process and further throughout the system life cycle. It is based on the following key principles.

User focus – the goals of the activity, the work domain or context of use, the users' goals, tasks and needs should early guide the development.

Active user involvement – representative users should actively participate, early and continuously throughout the entire development process and throughout the system lifecycle.

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 end 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 performed by effective multidisciplinary teams.

Usability champion – usability experts should be involved early and continuously throughout the development lifecycle.

Holistic design – all aspects that influence the future use situation should be developed in parallel.

Processes customization – the user-centered systems design process must be specified, adapted and/or implemented locally in each organization.

A **user-centered attitude** should always be established.

acsd.hci.uu.se

PAPER III

Management Perspectives on Usability in a Public Authority – a Case Study
Authors: Åsa Cajander, Jan Gulliksen and Inger Boivie.
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Management Perspectives on Usability in a Public Authority – A Case Study

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ABSTRACT
In trying to understand the problem of poor usability in computer-supported work, this article looks at management and their perspective on usability in a public authority. What are their underlying basic values, assumptions and attitudes? Why do managers interpret usability as they do, and what are the consequences for the organization and for usability? The empirical basis is an interpretive case study where 19 semi-structured interviews were conducted. Results indicate that usability is interpreted differently, depending on the formal roles of informants. Furthermore, a majority of the informants express personal, but limited, responsibility for usability. Moreover, we found that basic values are based on an instrumental view of work where efficiency and economy are important constituents. We identified that even though users participate in IT development, they have no formal responsibility or authority. They have become IT workers in that they perform highly technical tasks such as integral testing.

Author Keywords
Usability, public authority, management, case study, responsibility, basic values.

ACM Classification Keywords
H.5.2. User Interfaces---User-centered design. General Terms: UCSD, Management, Design, Human Factors. Additional Key Words: Participatory Design, Studies of Organizations and Usability Studies

INTRODUCTION
This paper presents a study that is part of a research effort focusing on usability and users' health issues in a number of authorities in Sweden.

Poor usability and hence a stressful work situation is still a severe problem in computer-supported work, despite efforts to increase focus on these issues. Sweden has a high level of sick-leave rates, particularly in the civil service sector and some of the problems are related to inadequate computer support [3]. In the authorities we study, occupational health work often focuses on physical work environment and psycho-social situation– e.g. height adjustable desks, chairs and health promotion activities. However, less focus has been placed on IT systems, in particular, in relation to changes caused by the shift from traditional case handling to high degrees of public web services [5].

In our previous research we have identified factors that prevent successful usability work, e.g. deadlines and short-term focus in IT development projects, involvement of "professional" user representatives, and attitudes towards usability as a user interface issue only [2]. In addition, we have focused on communicating an approach and attitude to user-centered design through key principles [11] and processes that can support usability work [8].

There are several studies describing obstacles to usability work, for example studies that report that usability issues were on the agenda in most IT development projects [7]. However, these move on to say that the usability concept was not sufficiently well understood, and that usability was often defined in terms of user-interface technologies. Moreover, two surveys were conducted among UPA members in 1993 and at CHI '94, showing that usability professionals had a low profile in development processes, and that usability was not considered a key quality factor [22]. Usability and UCD methods were applied to user interface related issues only. Studies also report obstacles to usability, including resistance to usability, usability unawareness, and time constraints [12]. Furthermore, studies have found a number of obstacles to strategic usability, including resource constraints, resistance to UCD/usability, lack of understanding of usability concept, and lack of trained usability experts [23].

In 2003 we conducted a web survey of usability professionals in Sweden, which showed that the main problem seemed to be that the priority of usability issues was fairly low [10]. This study also showed that the three

success factors receiving the highest ratings were: support from project management, support from management in general, and usability being a part of the project plan from the beginning. These findings were in parts confirmed by a case study of usability designers in two organizations [4].

In our subsequent research we have shifted our focus towards organizational issues and issues about attitudes. The organizational environment in which systems development takes place is essential and crucial (see for instance [13]). When systems are developed for a work context, management has the power to decide about changes in the work situations of users, including the way IT is used. IT systems are "frozen organizational structures" in that they prescribe how people should act and interact within the organization [25]. Previous research also shows that obstacles to usability work may be of an organizational character, as for example described in [21].

To our knowledge, little research has been done specifically addressing how management views usability and responsibility for usability. This study focuses on the way managers on various levels in one organization interpret the usability concept, and the consequences these interpretations have for the organization and for the work with usability and the work situation of the user.

PURPOSE

The purpose of this study is to study managers' perspectives on usability. What are the underlying basic values, assumptions and attitudes? Why do managers interpret usability the way they do and what are the consequences for the organization and for usability?

THEORETICAL FRAMEWORK

The empirical basis of this study is an in-depth, interpretive case study. In addition, for the analysis of this case study we also work from a constructivist perspective where usability is a word that is given different meanings in different contexts by different people. For example, studies have shown how different people within a system development team have different views of the system [18]. Professionals working with usability might understand the what, when, and how of system development in a way that differs from someone who focuses on databases. However, on discourse level there clearly exists a common ground (as defined by [6]) of what usability is in conversations.

Furthermore, this study is based on the perspective that human conduct and work is situated as described in Situated Action [24], and that humans are complicated and contradictory. We create and understand our reality by using language through communication, and interpretations are flexible, situated and socially constructed. When managers talk about usability, they might use the same words on a communication level, but the conversation might still mean different things for them as they have different basic values. Thus basic values load usability with different meanings, assumptions and attitudes. Basic values

Usability	Communication	Conversations, models and texts about usability and users
	Basic Values	Underlying assumptions and attitudes about usability and users
	Action	Activities and actions that are labelled as usability.

Figure 1. Our analysis of usability divided into three levels

in this context are deeply rooted ideas that might be known, or unknown to us. Furthermore, our perspective is that "Our language reflects our basic values, in that they are expressed in our choice of vocabulary. For instance when the vocabulary that originates from disciplines such as economics, medicine, systems development etcetera, becomes dominant within a field other than its origin, then our understanding of the new field will change, a change that might not be obvious at all. The new way of using the originally specific vocabulary also becomes the new way of using it metaphorically. The symbolic undertone in the way we use the words will change our way of understanding situations existing in the new field" [20]. Moreover, our basic values affect our actions and way of responding to different situations. Hence, basic values can be traced both through communication and action. In this study the following levels of analysis are used, where we mainly focus on communication level and basic value level (see Figure 1).

Previous research has shown that systems theoretical perspective, and systems perspective, as described by [19] and [16] respectively, is deeply rooted in software engineering projects [2]. Formal representations used in systems development processes reflect this view of work, e.g. use case models, process models, data flow models. Furthermore, in his book [17], Morgan describes a similar organizational perspective that he labels structural or machine perspective. According to Morgan the machine or structural metaphor has a pervasive influence that is beyond dispute. This perspective elevates the importance of rational and structural dimensions of organizations, which affects our way of looking at human work and human work situations. Moreover, it has been noted that the management view prescribed by Taylor [26] is often present in IT development and in computer systems, as is noted by [17, 20] for example. When using the Tayloristic view of work we risk forgetting human aspects of work as for example satisfaction, and we risk creating a work situation with highly fragmented tasks, specialized and created from a process-oriented perspective [17].

METHOD

In our study, we conducted semi-structured interviews based on interview guides. The interview guide covered the following topics; background of informant, their view of

usability, responsibility of usability issues, usability and economy, business development and IT development, strategic goals and usability, user involvement, system development strategies and models. However, questions were adapted in accordance with the organizational role of each informant, and their background. The interviews were conducted on site and each lasted for about one hour. Most interviews were conducted by one researcher interviewing one person; though in some cases two researchers were present. We took detailed notes on paper, the interviews were also recorded and some were subsequently transcribed.

In total 19 key informants were interviewed in the organization. The General Director was interviewed as well as four out of five directors organized directly under the General Director. In addition, nine managers organized under Business Support were interviewed, including for example head of IT resources, head of operation management and head of core business support. Additionally, three representatives of the unions were interviewed, as well as a usability designer and the person responsible for administrating all IT projects.

Data analysis was based on the interview recordings and transcriptions, as well as additional background material supplied by respondents. The materials reviewed include strategic business plan, requirement model and business organization. Data from different interviews were compiled and analyzed by two researchers. First data was reviewed to identify general patterns of response through mind maps, and later reviewed again to iteratively develop these patterns and to categorize respondents' statements and to verify and elaborate data. Some patterns represent a set of inductive constructs while others are rather a set of predefined categories. Moreover, the movement of understanding has constantly shifted between the whole and the parts and patterns, in accordance with the idea of the hermeneutic circle. The role of researchers as interpreters as well as the role of participants in action research project has been given careful attention.

A case study is always contextual, and consequently it is not possible to generalize findings from case studies to other contexts. However, even though this is a case study, the organization and the findings are not unique or unusual, and therefore we hope that this study will contribute to a deeper understanding of management and usability issues.

CASE DETAILS

This interview study was conducted within CSN, a national authority that handle the Swedish financial aid for students. With offices in 13 cities in Sweden, CSN employs more than 1100 employees of whom 350 are situated in Sundsvall (a mid-size city in Sweden) at headquarters.

Computer support that is used has been developed by the organization for the organization, i.e. in-house development. A majority of IT development projects at

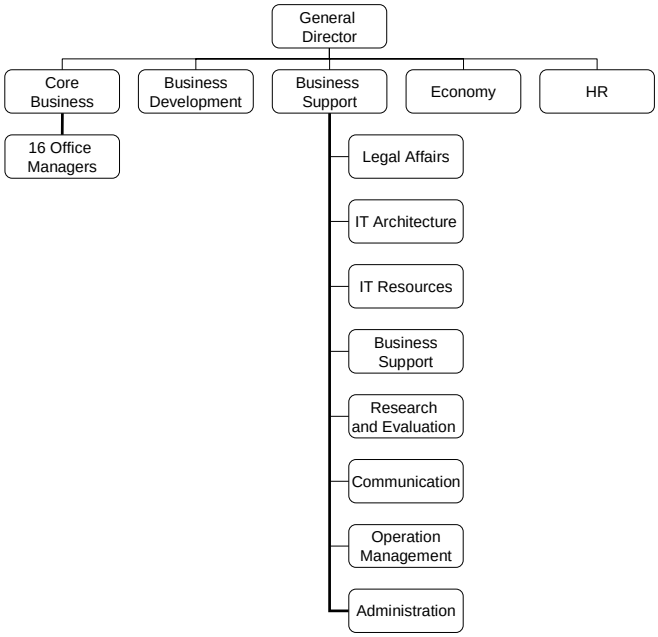

Figure 2. The organization chart of CSN as provided by the authority.

CSN start as a result of changing laws and legislations. Consequently, time is a major factor controlling most IT development since a deadline of a new law is fixed. Furthermore, CSN aims at computerizing and automating case handling to a high degree. Daily work at CSN is computer intensive, and civil servants spend almost all day in front of computers.

The organization is structured with a General Director and five business units that constitute the authority managerial body of CSN (see Figure 2). Moreover, the Business Support unit has eight sub-units working with different kinds of business support as for example, computer systems development, research, and communication. The core business of CSN, the case handling, is situated in 13 local offices elsewhere in the country and organized under Core Business.

IT projects are mostly initialized by the business development department, and often this department follows IT projects in the role of procurers. However, some IT projects are initialized, and run, by other departments, for example the department of research and evaluation or the human resource department. In addition, 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 models and methods provided by the business development department, and the IT architecture department.

The Overall Goals of the Organization

CSN has a vision to become a progressive and active service authority. In their strategy they have an ICT-strategy stating that they should *"Work smarter – use ICT*

better and adapted to humans", a Rule strategy stating that they should have "*Better rules and rule application – a mutual interpretation of the rules*" and "*Better accessibility – particularly when they have high work load - and also to have an openness when it comes to providing opportunities for the client to be interactive and keep track of their case*". In addition they should have "*More efficient work when it comes to repayment and payment claims*". Finally, they have a competence and staff provision strategy stating that they need to: "*Increase the commitment from the staff*".

According to the General Director, the organizational goals represent a fundamentally different attitude compared to previous years.

"*Now the goals are of a more qualitative nature. We need to make people feel involved so that they want to stay in the organization. They need to feel that they are subjects, not objects*"

The AVI project

About one year prior to this study, a large usability project was launched within the organization, initiated by the human resource department, with the purpose to increase knowledge about usability and a good computerized work environment. The project consists of several sub-projects, e.g. developing a specific measurement of usability – a usability index – to assess levels of usability, to develop a vision of future computerized work, and to revise and develop system development models. Moreover, focus is on increasing competence among all parties involved in developing computerized work through the means of lectures and other information activities. The interview study described in this paper is meant to contribute to the development of models that control development within the organization.

RESULTS

Interpretations of Usability

The different ways in which respondents interpret the concept of usability vary considerably within the organization. Our results indicate that usability is a word that is given different meanings in different contexts by different managers. However, on an abstract level there is a common understanding of what usability is, and in the organization the word is used on a daily basis in communication where everyone seems to have a mutual understanding.

Moreover, there is a tendency towards not having a holistic view on usability. Thinking holistically, on an abstract level is interpreted as not contributing to usability issues. *"Thinking holistically makes things fluffy /../You can not talk about these problems on a cosmic level"*

Results indicate that managers interpret usability from their own professional role; hence they tend to view usability as the subsets that regard them the most. For example the head of operation management views usability simply as a question of performance and response times, whereas the head of project office has a completely different perspective based on his responsibility in the organization: *"for me it starts with the process, the business process"*

Even though the AVI project has been running for a year, some answers indicate that informants have an unclear picture of usability, as described by this answer to the question *"How would you describe usability*":

"Well [long silence] I think that the description used in that meeting was very good."[1]

Moreover, informants describe that their view of usability has evolved and changed during the AVI project. The original view point was that usability is equal to font and colour, and their present picture is more complex, for example

"*It has been a journey working in this project. From the beginning usability was green and yellow and font. How the eye moves across the screen. But that is basically just a part of usability; what is implemented on the screen... **Control** is one of the basic issues that is important for the user. It makes you feel better, better communication, you change experiences. Well, usability has grown for me.*"

Informants use efficiency as a synonym to usability, and simply describe usability as efficiency. In interviews this view is motivated by the fact that efficient computer work will contribute to customer satisfaction. Moreover, for some, an efficient or usable system implies that usage is controlled and that certain workflows are followed: *"Usability is that you use the system in the way that it is intended"*.

Usability and performance of systems was an issue discussed in the interviews. One IT manager stresses that usability and performance are the same thing, whereas another claims the very opposite and sees usability and performance as incompatible:

"focus has been too much on usability, to the extent that it has negatively impacted the performance of the system".

Responsibility for Usability

During the interviews a diverse picture emerged when we asked about the responsibility for usability. Clearly, managers in the organization did not have a common view about who is responsible for usability issues, and how this responsibility works in their organization. For example, some mention the organization's usability expert as the one responsible, while others claim that end users are responsible, or the general director. However, a majority of

[1] We use usability as defined in the ISO 9241:11 – Guidance on usability: "Usability is 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" [14].

informants (11 of 14, generously interpreted) accept a personal responsibility for a subset of usability issues, where they interpret usability as a part of their profession. One example of this is the manager responsible for development processes, who describes that he is responsible for subsets of usability that can be *"packed into the procurement model and the parts that can be tested"*. Another example would be the business development department's interpretation of usability:

"we are responsible as system owners of the core business application and we must enable opportunities to work with usability issues in the models and methods"

Informants describe a shared and common responsibility for usability, where everyone contributes. They express that there is no formal responsibility, or formal role that is responsible. *"We simply run things informally here"*

However, informants are critical to having a shared responsibility and conclude that *"a shared responsibility means no responsibility"*. They describe that there is a lack of organization regarding responsibility, which contributes to the notion that someone else should have done the work. Clearly, the managers express uncertainty about who should be responsible and what a shared responsibility means.

"I hate it when they say that this is a shared responsibility; that only means that I am personally responsible"

Moreover, respondents claim that a shared responsibility will result in usability being considered as an optional feature of a computer system. Consequently, it will have low priority, and eventually no priority, as no one is responsible or accepts full responsibility. This is illustrated in the following citations:

"There hasn't been anyone who is responsible for the area, I believe. And you say in the projects: Usability is something we handle on our own somehow. This is something we know anyway, although they might not know it really. Someone needs to be responsible somehow; it has to be a part of the software development model. It needs to be a part of the requirements. Otherwise people say: This is something we skip in order to reduce costs. But that will be expensive in the long run"

One informant has a clearly defined picture and the name of a manager responsible for usability, and answered that the head of operational management is responsible. However, in the interview with that manager he describes that he has no responsibility at all: *"If they deliver a black sheep, I will see to it that the black sheep is put into operation"*

The director of core business maintains that he has no formal responsibility for usability. Moreover, he is not involved in any activity concerning development of computer systems used at his department. Instead, he describes his role as *"unrestrained requirements stakeholder and wild cheerleader"*

Manager's Interpretation of Work

Managers expressed that business processes are true descriptions of work, and work situations. Consequently they are trusted to be one-to-one mappings between work and business processes.

The organization has been through a process of specifying vision seminars of future work situations, a method described by [15] for example. However, some managers claim that they cannot understand how these will influence the development of future work.

End-user Involvement

During interviews managers described that one third of the people working in software development projects come from core business units, and two thirds from computer departments. However, the same people from core business units are involved full time during several years. Managers also described that as a consequence local offices are excluded from software development.

End users participating in software development have no formal responsibility, and they often work with integration testing of programs, which can be regarded as a highly technical skill. Moreover, IT development is based on case handling processes and an information flow perspective, and end users are seen as experts in describing their work according to these abstract models of case handling. Several managers describe this kind of user participation as troublesome and maintain that end users are given the wrong kind of tasks in the software projects *"tricked into playing on the wrong half of the sports ground"*. Another manager describes the end user situation in IT projects in this way:

"the producer of IT systems talks with their fancy computer terms with three or four letters. And then everyone feels that I don´t understand this, but I guess it will be fine ".

Organizational Obstacles in a Lifecycle Perspective

During interviews, we came to understand that core business units, or local offices, do not own the computer systems they work with, and have no formal responsibility or authority to improve them. Neither does the manager of core business have any part in systems development, or in the maintenance of systems. During interviews, managers described that computer systems are owned, and maintained, by the business development unit. Core business units have a responsibility to supply software development projects with resources and end users. However, some offices do not see any advantages in allowing their employees to participate in system development projects:

*"It varies among office managers. There are some who have seen the light, but others who feel "**not now**". Some can see the value of participating."*

In a previous re-organization, maintenance was removed from the organizational scheme, and now all systems

development, including maintenance, is organized in development projects. These projects need to go through a lifecycle involving pre-study, procurement, etc. Operation on the other hand is a line function partly performed mainly by external consultants. Consequently, maintenance and minor changes in the systems have to be regarded as new projects, or somehow dealt with in projects that are allocated extra time and resources. This organization has some disadvantages, and managers commented on the new way of organizing maintenance in this way:

"Well, it was much easier to get things done before. Now everything has to be calculated to the last penny"

Another interesting aspect is how different parts of the organization perceive their role. The managers at headquarters speak about one organization, whereas local offices describe increasing distance between central headquarters and all local offices as described in this citation:

"we are at the head office – we know best /…/to work on the head office is sort of better"

Usability Expertise Within the Organization

The number of usability professionals in the organization is low, and only one person had been recruited specifically to work with usability. However, interviews revealed that there are people with responsibility for usability-related activities in other parts of the organization as well, without the rest of the organization being made explicitly aware of their competence and roles.

Furthermore, when focusing on methods and tools used by usability professionals, it turned out that there are numerous people who work in similar ways as usability professionals. For example, in the communications unit, informers involved in developing the organization's website and intranet used "usability" tools and techniques for analysis, design and evaluation, but from a different standpoint. Given the increasing need to involve people from the communications unit in every development project, these people and the usability professional frequently ran into one another, creating more competition than cooperation. This problem was recognized by managers, but rather than bringing these different roles together to solve problems, the solution described is clearly specified roles and clarity of borders between areas of responsibility.

Moreover, several managers mentioned the absence of a usability champion in upper management. They describe a need of deep commitment to usability issues, and someone who works as a driving force in the organization. They portray a lack of a true enthusiast, someone who is passionately engaged in usability issues is needed at a higher level in the organization.

"All organizations need someone who is truly enthusiastic. In all organizations passion and commitment is needed"

Management Support and Overall Organizational Goals

In this case study, the new general director of the organization was clear about the goal of usability in the organization:

"*…working towards making usability a part of the norms and values in the development work."*

The way in which the general director can ascertain this is according to her by *"…showing the direction and follow up that things get done"*.

One overall goal in the organization is to automate case handling as much as possible. This has been a goal in the organization for some years, and here managers experience a conflict with usability aspects of human work.

"If the automation is our focus, then our focus isn't on the user and how he is supported by the system. And that becomes contradictory I think. And from this perspective the user is irrelevant, if you know what I mean".

Several informants maintain that an actual goal of automation is that 90% of the cases should be dealt with by machine. Hence, only 10% of cases should be dealt with manually, and then only as a result of cases falling out of an automatic process.

"When something drops out of our automatic process, we have not had the connection to how the system really is used. There, something is missing"

"We automate things, and the rest is a bunch of tasks for users. And these are closely connected to how we have developed the automatic process. And what is left there is something I feel we have no control of"

When asked about the use of overall organizational goals, all the managers regard them as crucial for business development. The managers use them and know them relatively well. Results indicate that the managers talk about and refer to overall organizational goals that relate to their work, and implement them in their business.

A usability policy is currently under development, stating process and product principles to meet the organization's goals of increased usability. This document may potentially draw more attention to usability issues. However, some informants express the opinion that they seldom read or use documents stating overall organizational goals or policies:

"We develop God knows how many policy documents in this organization and to 98% they are only dust collectors on the bookshelf"

DISCUSSION

The purpose of this study was to study managers' perspective on usability and the underlying assumptions that have an impact on the organization's work to improve usability. Below, we will discuss the results from the interviews based on different levels of analysis as described in the theoretical framework.

Why Do Managers Interpret Usability the Way They Do?

The results clearly indicate that, on a communication level, different managers interpret usability based on their own perspectives and what they consider important. Also, interpretation of usability is to a large extent based on an instrumental view of the work of the end-users, that is, considering work in terms of economic production and efficiency.

On the level of basic values, managers do see the importance and necessity of taking usability into account, but they do not understand the full complexity of the issues usability implies. In particular, there is little recognition of the complexity and situated nature of work. Taking these aspects of work into account would imply that work is not as predictable and easily captured and understood, i.e. controlled, as an instrumental view of work presumes [3, 16, 19]. It seems that the general view in the organization is based on technological determinism, where technology is seen as driving the organizational development. This view implies that humans are completely rational and always respond in the same way to certain situations and changes. It also implies a framework of though based on the notion that careful planning and structured approaches will provide a complete understanding of changes due to introduction of new technology. This insight is essential for the way usability issues are taken into account in IT development.

Moreover, the management share a belief in the importance of orderliness, and that orderliness will guarantee that decisions are based on rational, logical and objective grounds. Such decisions will ultimately guarantee better systems. In this context usability is not believed to be rational and logical, and hence difficult to incorporate in their models.

On the action level, the measures managers take to promote usability show that usability is primarily regarded in quantitative terms, preferably related to economic factors. The second implication is that usability must be addressed in the procurement process, or it will not receive any attention in development projects [1].

Consequences the Management Perspectives Have on Usability in the Organization

Different views on usability may interfere with usability work, in that it often requires cross-sectional approaches and support across different units in the organization.

"Usability is really difficult to talk about since it means one thing to me, and something completely different to someone else "

As a consequence of this, there are conflicts between various roles as regards the responsibility for usability activities or for managing and leading such activities.

Moreover, we perceive that even though usability has received increasing attention recently, it competes with other quality attributes, such as security and data consistency in the organization. Usability may have difficulties in this "battle" due to it being vague and "fluffy" as a concept.

Furthermore, several managers expressed that usability and work environment issues should be concealed in other appealing concepts, e.g. economic incentives and client satisfaction, as for example:

"If you use [usability] then you turn it into a work environment issue, and then you don't get the same status for these issues in the organization. You should turn it around, and say it is important for our clients, our business, it is important for our assignment, and then it will be good for the personnel too. That's the way to do it"

The management perspective on users and usability seem to be dominated by the structural perspective, as described by [17]. Our findings indicate that this perspective influences the way of acting. The conduct of the employees is planned and organized in advance, for example, detailed instructions of how they are supposed to answer the client in a phone conversation. Moreover, the task of case handling and the work in the IT development projects are described as processes, implying that you can predictmake the process more efficient and optimize its behavior. This way of looking at human work, as predictable processes, does not contribute to crea and describe human behavior in detail through flow diagrams. Seen from this perspective you can look at the descriptions, and thus ting stimulating task and a good work environment. Instead it conveys a picture where humans are reduced to parts of the organizational machine. On the communication level, the notion of work is based on "hard facts", about what the client needs, and on efficiency and automation. The needs of the users and the satisfaction of the clients is something you can measure, just as you can measure the performance of a database. In this view, it is possible to measure and optimize the efficiency in the organization based on these measurements. If a process is inefficient, the way to improvement is to rebuild the process with the help of formal models.

Responsibility for Usability

The managers express a role-related view of responsibility for usability. In our experience this kind of structure is influenced by a basic value promoting orderliness, where the dominating view is a belief that structure will generate increased quality and better overall performance. Provided that the complex question of how responsibility is appropriately structured is dealt with accordingly, the organization will function ideally. These thoughts are illustrated by the following conversation:

- *"In the new organization, the roles and the responsibilities are clear. I am responsible for the production of the systems, NN is responsible for the quality of the delivery being sufficient.*
- *Well, isn't there a risk that the responsibility falls between two chairs?*

– *No! Why would that happen?"*

On the communication level, a shared responsibility for usability is promoted. At the same time the managers claim that they, themselves, are in charge of usability. However, on the basic values level, they want the responsibility to be formalized. They claim that you can distribute responsibilities through role descriptions. The role descriptions are also believed to prevent conflicts. On the other hand, the managers express an eagerness to distribute responsibilities but not a willingness to accept responsibilities clearly. The requests for clear role descriptions involving responsibilities for usability are not meant to emphasize their own role and responsibility, but to define other people's roles and their responsibility. On the action level, no one is formally responsible for usability, neither on a detail nor on an overall level.

Aspects of User Involvement

On a communication level, managers express that the organization controls IT development through user participation, methods and work practice. However, on the action level, headquarters are clearly in charge and not the overall organization: People at headquarters plan, control and follow up. On a basic value level, managers assume that increased quality can be acquired through evaluation and control. One small example of this is the use of time records as a means of control and evaluation.

During the study we have seen tensions between contradictory goals. One major business goal is to promote increased staff commitment. This is however counteracted by the IT management's strive to centralize all development, operation and maintenance, and all management functions to headquarters. It is difficult for those who work at local offices to feel committed when all central activities must take place at headquarters. When specifically asking managers about this division between headquarters and local offices we are informed that it is due to previous history in the organization. Furthermore, managers describe that the present picture is one united organization. On the other hand, even if management communicate one single organization, all activities involving local offices seem artificial to them.

During the study, we came to understand that the user participants at CSN have become IT workers. Managers describe how users talk in terms of development terminology, for example use cases, and IT language has become common ground [6].

"It is too much – what do you say – mumbo-jumbo, too much technical terminology and you do not understand, which makes people inferior or superior in terms of knowledge. He who gets around with the right terminology and seems to know gets in a superior position in relation to the one that is forced to work with these things and does not understand /…/ When the supplier goes on with his fancy terminology with three- or four-letter abbreviations, then everybody feels that – I don't understand that, but it'll be fine!"

Initially the end-users, or user participants work with formal descriptions of their work as business processes and flow diagrams. There are few or no opportunities to develop the work itself, or to see what consequences development of business processes have on the work. Users have no formal responsibility in projects; they consider their own roles to be unclear. They have no authority to make any decisions. Their main task often becomes integration testing.

Access for users should not constitute a difficulty in the organization, as it is mainly an in-house development organization. However, given the nature of the organization as a flat hierarchy it does not provide much opportunity for personal development and promotion. In fact, one way to develop on an individual level may be by participating in overall development work. User participation has in that sense become a "career opportunity". Consequently, the incentive to go back to the old workplace with the new IT competence is low. Hence, there are a number of domain experts in the organization, who are knowledgeable about the organization and business processes but who are not really representative as end users. Also, managers express doubt about their contribution to IT projects:

"In some cases this has lead to the fact that we have user representatives that are IT people. They are simply bad at everything. /…/ They are bunglers when it comes to systems development /…/ Honestly, one can discuss if they are contributing at all"

The organization suffers from what we would call *domain expert overflow*. Managers believe that it is easier to involve a domain expert from the head office as a user representative, rather than going through the hassle of recruiting new user representatives.

"The problem is that you want the same people all the time. Because it is easier that way, and preferably they want them to be from Sundsvall. That is their default somehow"

The number of domain experts gives you a false feeling that you actually have user involvement, when actually you have not. Lacking proximity to real users of course also contributes to this, as domain experts often are located at headquarters, close to organizational units that work with development, operation and maintenance. Real end-users work in different offices located elsewhere in the country.

"You pick your dream team. You agree on a theoretical level that it is important to pick new people from the organization, but when it comes to practice it is difficult"

Organizational Obstacles

During interviews we came to understand that the IT development is organized as projects in the organization, hence we can see classical organizational tensions between short perspectives and long-term perspectives. IT development projects normally have a tough deadline at

CSN, and long-term goals of the organization are often difficult to handle. Hence projects deliver fundamental functionality of systems on time and within budget, and there are a number of development issues that remain unsolved when systems are put into operation; issues with an unclear recipient. The recent re-organization dividing IT into development and operation leaves issues traditionally organized under maintenance in-between. Either they can be resubmitted as suggested improvements to development as projects, meaning that they have to go through a long process of procurement and prioritization in competition with other development projects. Or, they will be regarded as issues that operations should deal with; hence believing in the goodwill of the operations manager to see whether he feels inclined to handle the problems.

"We do not have any maintenance here, but of course we will have to deal with such issues anyway – it is what I would call sneak maintenance."

Problems and Possibilities for the Usability Professionals

Usability is a tricky field to work with, requiring extensive knowledge and experience from different fields in addition to social and communicative skills required, as describes in [4]. Therefore, employment and involvement of usability professionals does not in any way guarantee a usable system. On the contrary, with lacking experience methods could be used in the wrong way, false conclusions can be drawn from field studies and evaluations can be used to promote a particular design solution rather than improving systems. A successful result requires the involvement of an experienced senior usability professional to act as a usability sponsor within the organization as well as involving a number of junior usability professionals to do usability work [9].

On a communications level the organization would like to see one role for usability, with a well-defined responsibility and action space. The responsibility should mainly be to perform usability-related activities, not taking responsibility for usability of systems. On the other hand, when looking at the basic value level we perceive that a general view is that individuals are rational and stabile and act in a predictable way. This implies that changes in roles, responsibilities or processes, will also impact actual IT development. Managers express that changes in policies, models and guidelines will change the actual process of IT development, but it will take time.

"It seems to take about ten years for a change in the model to impact the reality of development."

Looking at actions undertaken by managers to meet the goal of increased usability, we clearly see contradictions in the organisation. Even if managers maintain that usability expertise is crucially important for usability work, there is limited willingness to increase the proportion of usability staff. This follows from a previous difficulty in selling usability competence to projects. Consequently, usability expertise is needed to improve systems used in case handling, but there is little demand. Hence, the usability professional works with other things, such the usability policy mentioned earlier, or usability of systems directed towards clients.

CONCLUSION

To sum it up, here are some main issues found when trying to understand the managers' perspectives on usability

- Managers have an instrumental view of work based on efficiency and economy. Work is carefully planned and optimized through business process analysis.
- There is a tendency to underestimate the complexity of the work of case handlers. Flow diagrams and business processes are believed to be complete descriptions of the case handling work. There is little recognition of the situated nature of work.
- Orderliness, objectivity and control are perceived as key success factors by the managers. From this perspective usability is seen as unclear and difficult to incorporate in the business.

When presenting the results at CSN the following suggestions were made of what could be done at CSN to overcome the problems identified in the study.

- Improve the understanding of usability in the organisation, and discuss the issue of responsibility further.
- Create an understanding of the necessity to meet real users. Avoid domain expert overflow.
- Work with the attitude towards the involvement of local offices.
- Introduce a Usability champion on a management level in the organisation.
- Work for better understanding of the complex and situated nature of work.
- Work with basic values on a management level.

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PAPER IV

Usability and User's Health Issues in Systems Development - Attitudes and Perspectives
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Usability and Users' Health Issues in Systems Development - Attitudes and Perspectives

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Abstract

Poor usability and hence a stressful work situation is still a severe problem in computer-supported work, despite efforts to increase focus on these issues. Consequently, Sweden has a high level of sick rates, particularly in the civil service sector, and some problems relate to inadequate IT systems with poor usability. Hence, we aim at understanding attitudes about and practices for integrating usability and users' health issues in systems development. Quality in value – i.e. users' well-being, productivity and user satisfaction – is shaped by attitudes and perspectives underpinning discourse in systems development. These attitudes and perspectives are embedded in the methods, models and representations used in systems development as well as in discourse and action. In our qualitative study data was collected through semi-structured interviews with 127 informants, and in a case study of an ongoing project in one organisation. During analysis of data we identified problems with attitudes and perspectives on users and their work, as for example the strong focus on automation, efficiency and surveillance of work, which shaped the development of new technology and ultimately shape the work situation of the user. Furthermore, we identified that the work of civil servants were frequently discussed in terms of simple steps and procedures, that may be predefined and automated in accordance with clearly defined rules and regulations. Finally, we suggest

user-centred design and field studies to address the problems and to improve the understanding of the users' needs and work practices in the development projects.

Introduction

Rapidly increasing use of computer systems in all sectors of work life has had significant impact on efficiency and flexibility in organisations, as well as on the work situations of individual employees -- often a positive effect but sometimes also negative. Unfortunately, this development has had undesirable side effects in terms of health problems.

Sweden provides an illustrative example, where 66% of the work force (3 million people) use computers regularly in their work (Statistics Sweden, 2001). From 1989 to 1997 the proportion of computer users among office workers increased from 65% to 90% (Wigaeus Tornqvist, Eriksson & Bergqvist, 2000). The civil service sector is no exception – on the contrary, much work in the civil services has been computerised and automated in recent years.

As computers are more and more used in working life, health concerns and reports of negative effects on users' health have also increased steadily. Symptoms are primarily eyestrain, repetitive strain injury (RSI) and stress related complaints (Aarås, Horgen & Ro, 2000; Åborg & Billing, 2003). In the civil service sector, sick rates are consistently high – with more than 10% in some organisations and for some groups. Furthermore, nearly a quarter of all employed persons in Sweden have suffered some sort of disorder that they relate to their work during the past 12 months (Statistics Sweden, 2005). This is a part of a general trend in Sweden, where sick rates and the costs of sick pay and rehabilitation have increased dramatically since the early 90s.

The problems are caused by multiple, interrelated factors, some of which are job design, repetitive work, strenuous work postures, work organisation, poor social support and high pressure as well as workplace design. Furthermore, inadequate IT systems with poor usability also contribute to the problems. In computer-supported work, development is largely technology driven, and work organisation and job design are to a large extent shaped by IT systems, since technology often comes before work practices (Clegg et al., 1997; Eason, 1997). Therefore, attitudes about and practices for integrating usability and occupational health issues in the IT systems development process are important for the resulting work situation and wellbeing of users. Considerable effort is spent on developing design

methods emphasising the needs of users, including methods for user-centred design (Norman 1986, Greenbaum & Kyng 1991, Göransson 2004). However, their impact on system development has been quite limited. Health aspects are often marginalised or ignored, (Vicente, 1999; Clegg et al., 1997).

Most activities for addressing health aspects in computer-supported work are aimed at redressing problems that are already manifest, i.e. when physical or psychosocial problems have been reported. We believe that it is both important and fully feasible to address potential health problems during the development process. In this chapter we describe empirical work on users' health and usability, with a focus on IT systems development, and discuss the impact of attitudes and perspectives of those involved in development projects. The starting point of our research is user-centred systems design/development (UCSD) of IT systems in the workplace, and in what ways UCSD can contribute to an improved work situation in regards to health issues and usability issues (Gulliksen, et al., 2003). This chapter describes a study, which is part of an ongoing action research project. The project focuses on relations between IT and health risk factors, primarily by exploring and improving processes for designing, developing and implementing IT systems and how issues regarding quality of interaction, usability and work situation are integrated in these processes.

Background

Occupational Health Problems in Computer-Supported Work

In our research we have mainly focused on computer-supported administrative work where the main health risk factors are (Bergqvist, 1993, Punnett & Bergqvist 1997):

- Users are bound to use computers during a major part of their work hours. This means constrained, static work postures for long periods of time.
- Computers control the work pace and task order, leaving users with little or no control over their work.
- Users suffer from stress, caused by excessive workload, time pressure and poorly designed IT systems. The mental workload tends to increase when new IT systems are introduced (Aronsson, Dallner & Åborg,

1994), and the decision latitude is lower for extensive computer users than for others (Wigaeus Tornqvist et al., 2000).

As described above, these risk factors cause a number of health problems, including RSI and stress related disorders

Cognitive work environment problems are particularly important in computer-supported work (Åborg, Sandblad, Gulliksen & Lif, 2003). Cognitive work environment problems occur when properties and factors in work situations prevent users/workers from using their skills efficiently. Such obstacles may be an effect of poor work organisation or poor social support from supervisors and/or colleagues. They may also be related to the design of IT systems, for instance, that the users' train of thought is constantly interrupted by obscure messages or that the user must recall information that is no longer visible on the screen. Addressing such problems is important as they may lead to inefficient work procedures, poor performance and low user acceptance as well as somatic and mental health symptoms.

Landauer discusses the fact that the massive introduction of computer systems during the last three decades has not resulted in comparable productivity payoffs (Landauer, 1995). He argues that this is mainly because artefacts are too difficult to use and provide little useful functionality. In addition, productivity is affected by the fact that many people go to work despite being in pain or feeling stressed. In a Swedish study of some 1500 computer users, respondents were asked to estimate their productivity loss caused by musculoskeletal problems. Eight percent reported a productivity loss of 15% of their ordinary work performance as a mean over the latest month (Hagberg, Wigaeus Tornqvist & Toomingas, 2002). These figures correspond to a total loss of 3 million workdays per year for the entire Swedish work force.

Work and Stress-Related Disorders

The Karasek Theorell model describing relations between stress related complaints and demand, support and control (Karasek & Theorell, 1990) is now the most widely used model to analyse psychosocial work environment factors and their relation to occupational health problems. This model suggests that the combination of perceived demands and perceived control at work is a determining factor for stress. High job strain, i.e. high demands in combination with low decision latitude, is associated with the highest risks for health problems. Control in this respect, consists of two

major components: the degree of personal control/decision latitude in work situations and the degree of control over competence used.

Experiences show that when new IT systems are introduced in the work place, users often feel that demands on their performance increase. Karasek Theorell's model shows that this is not a problem provided that the control and support factors are within acceptable limits. However, research shows that subjective control and support factors often decrease when new systems are introduced (Åborg, 2001).

Usability and Occupational Health Problems

We use the term usability as defined in the ISO 9241 standards on 'Software ergonomics for office work with visual display terminals (VDTs)' Part 11 – Guidance on usability:

"Usability is 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). Although ISO 9241-11 does not explicitly cover occupational health issues, it provides a clear connection between the satisfaction aspect of usability and health problems in computer-supported work. According to ISO 9241-11, satisfaction measures can be obtained from "…rate of absenteeism,… or from health problem reports…." (ISO 9241-11, 1998).

ISO 9241-10 (1996) specifies a number of principles for dialogue design. These principles do not explicitly address occupational health in broad terms, such as, mental and physical variation, social support and computer dependency. Suitability for task requires, for instance, that no irrelevant information be displayed and that the format of output and input should be appropriate for the task. These guidelines address task suitability on a detail level, but fail to take into account whether or not the task as a whole is designed to reduce risks of occupational health problems.

Hence, addressing usability in IT systems development may potentially contribute positively to the reduction of effects on users' wellbeing. However, Clegg, et al, (1997) report that a majority of projects address usability but not occupational health matters. This was confirmed in one of our studies, which indicated that the usability concept does not provide sufficient support for addressing users' health concerns in systems development (Boivie, Åborg, Persson & Löfberg, 2003).

Systems Development and User-Centred Systems Design

In system development, technology often comes before work practices and consequently emerging work practices and work situation are shaped by technology or IT systems (Clegg, et al., 1997; Eason, 1997). Hence, the systems development process has great impact on workers/users, changing the nature of their jobs and their everyday work situation (Sandblad, et al., 2003). In our experience, successful system development is characterised by certain aspects as listed below, some of which are confirmed by the Chaos Report (Standish Group, 1995 & 1998):

- User involvement in all project phases.
- Focus on usability throughout the project,
- Clear directives and a consensus on projects objectives.
- Small projects or stepwise development.
- A well planned deployment process (installation of system, introduction of users to system, training, support, etc.)

User-centred design (UCD) (Norman, 1986; Greenbaum & Kyng, 1991; ISO 13407, 1999) and user-centred systems design (UCSD) (Gulliksen, et al., 2003) provide approaches and methods for addressing usability and users' needs in IT systems development. These approaches and methods emphasise the necessity of involving users, addressing usability, and understanding users' needs and work practices. For instance, they suggest studying users in work situations in order to understand the activity-oriented view of work (Sachs, 1995) reflecting what people really do in their work in order to meet organisational and individual goals. Other user-centred methods involve designing together with users in participatory design sessions, using lo-fi mock-ups and prototypes as communication tools.

We believe that user-centred methods and approaches open up for addressing users' health issues. Understanding and designing for work practices must surely result in an IT system that is well adapted to the users' work situation and provides proper support for their tasks, and thus less likely to cause frustration, RSI and cognitive work environment problems. However, involving users and usability expertise is probably not sufficient. Occupational health experts must also be involved, which requires communication tools and representations that can capture health issues and risk factors (Boivie, Blomkvist, Persson & Åborg, 2003).

For authors that require more information on how to apply User Centred Systems Design according to our approach we recommend studying the key principles for UCSD (Gulliksen et al., 2003) and for more details on

the usability design process for practically conducting the work we point towards (Göransson, Gulliksen & Boivie, 2003)

Studies

Background

The studies described in this chapter are part of an ongoing action research project involving six public authorities focusing on improving their computerised work environment. The project aims at improving the long-term impact on users' health through more efficient and effective IT use. Each authority involved has one subproject, and these projects are in different phases. This book chapter describes the results of the project after approximately 1 ½ years.

Organisations

The six authorities included in the study comprise a wide set of services provided to customers. These services include student loans and various student allowances, matters concerning talking books and Braille, geographic information (maps, satellite pictures, etc), immigration, services in meteorology and services related to starting and running a business enterprise. The authorities have all faced major changes in the past and will face significant changes in the future, for instance, e-government and 24/7 availability. There have been major reorganisations driven by external as well as internal factors. One authority, in particular, is subject to large variations as regards the demands for their services, owing to events in the world at large. Another authority is facing privatisation of some services it offers to the general public. These changes affect the organisations at large as well as the individual employees in their role and work. There is a certain amount of anxiety among employees in virtually all the organisations, owing to personnel cuts and job insecurity.

The organisations vary in size, from small with less than 100 employees, to fairly large with more than 3000 employees. In one of the authorities some 10% of the staff is visually impaired to various degrees. They use assistive technologies in their work, for instance, screen readers. Employees in these organisations range from specialists with academic degrees in, for instance, law, hydrology or sociology, to administrators with

no academic degrees. All the organisations have a mix of newly employed staff and employees who have worked in the organisation for some period of time, up to 20 or 30 years.

Four of the organisations are distributed across the country with offices in various places in Sweden, whereas two have one main office only. All the authorities have been relocated to towns outside the Stockholm area (the capital of Sweden) as a result of government programmes for regional development.

All the authorities are highly computerised and automated. For example, IT is used for case handling, for compiling and providing information and for providing services to customers. This means that work is sedentary to a large extent where the employees spend a large proportion of their work hours in front of computers. In some authorities, virtually all work has been computerised. In two of the authorities, some work tasks are highly mobile, and mobile technologies are developed and used. Risk factors regarding occupational health problems include for example high pressure regarding productivity, sedentary work, low control over ones work situation and conflicts with customers.

The different services provided by these six organisations place different demands on employees and their communication with customers (or citizens). Some of the organisations process cases that are highly sensitive where customers may be frustrated, desperate or otherwise negatively affected by the situation, and where threats and even violence occur once in a while. Other organisations provide services that are less likely to produce strong emotions. However, communication between customers and authorities is never unproblematic, and there is always a certain number of frustrated or upset customers that employees in all these organisations have to deal with, for instance, conflicts about land use, or problems with repayment of student loans.

IT development is primarily driven by external factors, for instance, new legislation, and controlled by deadlines (new legislation coming into effect on particular dates). IT development, operation & maintenance is organised in different ways. Four of the organisations have in-house IT development departments, responsible for developing applications and for the operation & maintenance of existing applications and infrastructure. These departments have outsourced some operation & maintenance functions as well as certain helpdesk functions. They also hire external consultants as resources in their development projects. One of these organisations is special in that a large part of their ”ordinary” staff work with technical issues that are closely related to IT development, for instance, writing scripts and database queries. The remaining authorities have outsourced the main part of their IT development and/or use standard products for e.g. case handling

and production. One of the latter is currently rebuilding an in-house IT development organisation.

The studies focus primarily on the work situation of the civil servants, i.e. white-collar workers in these organisations who provide services to customers.

Qualitative Approach

We have used a qualitative approach in our research study since the aim is to gain an deeper understanding of attitudes towards and practices for e.g. usability, users' health issues, IT development and user involvement. Our role as researchers has been that of compiling, interpreting and analysing data, as well as that of participating in projects implementing and evaluating actions suggested in the initial studies.

Positivist research is based on the criterion of replication, which means that if the same or other scientists repeat the research process they should come to the same conclusions. However, this criterion is not relevant in qualitative research, as both the participants and the researcher has changed during the project and it is not likely that results would be replicated. Instead, qualitative research should be measured by other quality criteria, and in this study we try to conduct research according to the seven quality criteria and principles established by Klein and Myers for interpretive qualitative research (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

Moreover. we try to adhere to the quality criteria described by Lange, Baungaard et al (2004): Transparency, Consistency and Validity. Transparency means that persons who have not been involved in the project should be able to follow the process through descriptions and illustrations. Consistency implies that the researcher must be able to explain why a specific research method is used to understand a specific problem. Finally researchers must apply some criteria of validity and address the question: "Am I doing good work"(Lauge, Baungaard et al. 2004)

Qualitative, interpretive research based on case studies leads to contextual in-depth knowledge, and should not be generalized. However – the organizations and the findings are not unique or unusual and therefore I hope that the reader will find my research applicable in other settings.

Data was collected in semi-structured interviews and in a case study, as described below. After the interview studies, most authorities started subsequent projects for implementing and evaluating some of the measures suggested in the initial study. Some authorities decided not to continue with an implementation project owing to various factors, e.g. major reorganisations.

Interview Studies

Semi-structured interviews with key informants were conducted and the data was collected and analysed separately in each organisation. The results were compiled into one report for each authority and reported back to the stakeholders to ensure objectivity and to get feedback on the results. In total, six different researchers interviewed 127 key informants. The objective of each study was to identify problems, obstacles, and strengths in these organisations as regards to:

General Issues
- What factors and changes control organisational development?
- How do these changes affect civil servants and their work?

Occupational Health Problems
- How are occupational health problems addressed in the organisation and who is responsible?
- What types of measures are introduced to eliminate or reduce risk factors?
- In what ways are occupational health issues and risk factors addressed in the design, development and implementation of new IT systems?

Design, development and implementation of new IT systems
- What factors control IT development?
- In what ways are usability issues addressed in the IT development process?
- Who is responsible for usability in the development process?
- Are users involved in the IT development process, and how?
- How are new IT systems (or modifications to existing systems) introduced in the organisation?

The interviews were based on interview guides. We used slightly different interview guides in different organisations. However, the interview guides were in essence variations on the same themes. They all covered the questions listed above and some additional questions about the role and background of the informant, as well as their own responsibility with regards to usability and occupational health issues. Moreover, the questions were adapted in accordance with the organisational role of each informant. Participants spanned all hierarchic levels and the informants were identified by the different organisations themselves. The roles of the informants include for instance:

- Management, people working on strategic level with e.g. business goals, HR people
- Civil servants, clerks, administrators
- System owners, system administrators, system coordinators
- Helpdesk people
- Project managers, usability specialists, IT architects
- Union representatives

Each interview lasted for about one hour and was conducted on site, except for a few complementing interviews over the phone. Informants were promised anonymity, but in some cases the informant had such a role that it would be possible for someone knowing the organisation to trace the source of certain information. Most interviews were conducted by one researcher interviewing one person, as in Figure 1. In some cases two researchers were present, and in a few interviews two persons were interviewed at the same time. We took notes on paper, and when two researchers conducted interviews one of the researchers documented them directly on a laptop. A few interviews were transcribed, and in some cases notes were transcribed. About half of the interviews were taped in order to provide for citations or checking results against interviews and as a reference and justification for the reports giving feedback to the organisations. Data from different interviews were compiled and analysed by two or three researchers per organisation.

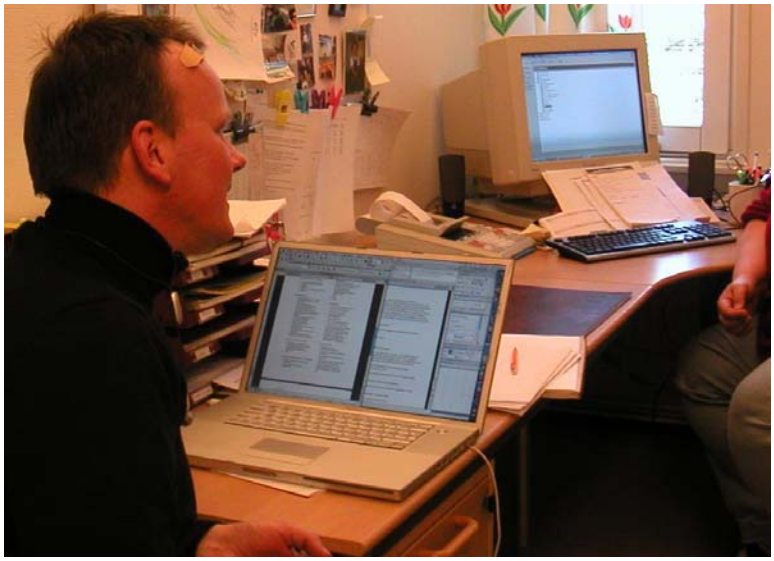

Fig. 1. Most interviews were conducted by one researcher interviewing one person.

Case Study

Data was also collected in a case study of an ongoing implementation and evaluation project in one organisation. This project comprises the second and third phases of the action research cycle, i.e. the action and evaluation phases. We work together with people within the organisation, helping them identify actions and measures to address problems identified in the first phase (the interview study). We also follow the organisation during the action phase when measures are implemented, providing support and observing the outcome. Finally, we evaluate the outcome of the measures and provide feedback to the organisation.

Data has been and will be collected throughout these phases, primarily by means of participatory observations and interviews with key informants. We have followed the organisation for well over a year by now participating in various activities, for instance, project meetings, office meetings, and various work meetings. We participate actively in the activities (being members of the project group) but also observe certain aspects of the interaction and communication in activities. We have mainly focused on issues regarding attitudes towards users (the civil servants), user par-

ticipation in IT development, and the factors controlling the IT development at large in this organisation.

We have also taken part in an extensive programme for communicating knowledge about occupational health issues in computer-supported work, usability, IT development and user participation throughout the entire organisation. In these sessions, we have taken notes of discussions about these issues.

Results from the case study as well as from the interview study was analysed using mind maps by two of the researchers, see Fig.2.

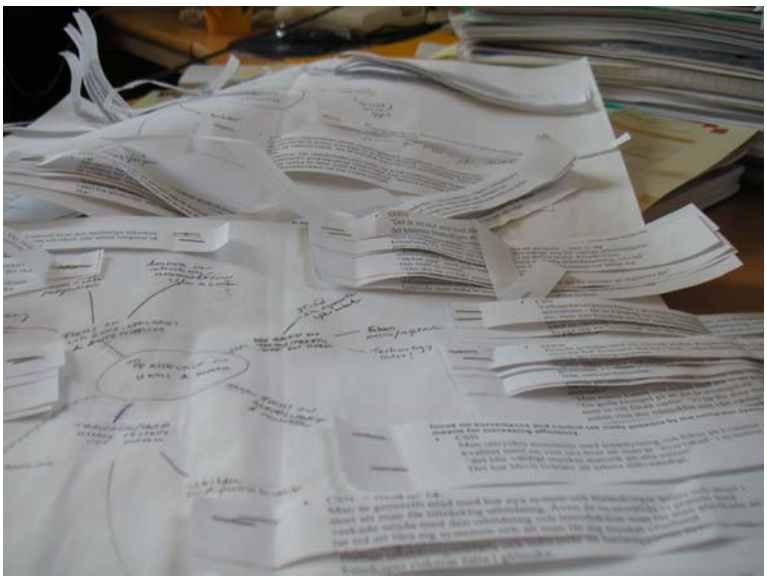

Fig. 2. Mind maps were used to analyse data.

The mind maps were organized according to some of the predefined categories found in the interview guides, but there were also new categories added as data was analysed. Pieces of paper were cut from the different reports made to the organisations and from our research notes to illustrate and illuminate categories. These pieces of paper were joined together and placed under different categories.

Results

This section describes our findings regarding attitudes about, and practices for integrating usability and occupational health matters in systems development processes. We illustrate the results with quotes from the interviews.

Perspective of Users and their Work

The perspective or view of the users and their work was not explicitly brought up in the interviews, but certain ideas and aspects recurred implicitly, and formed a kind of underlying framework, within which the users and their work were discussed. These include a focus on the customers (citizens) and their needs, an equally strong focus on efficiency and automation coupled to surveillance and control of the civil servants. There is also an underlying assumption that the civil servants' work is quite trivial. These underlying assumptions about the civil servants and their work are reflected in the IT development process and the process of implementing new technology.

Focus on Customer, Efficiency and Automation

Customer satisfaction, efficiency and a high degree of automation are the main goals in the organisations, and these factors drive the IT development to a high extent. The work situation of the civil servants has low priority, and is not described in the visions of future organisation – nor are implications for the wellbeing and health of the civil servants explicitly considered.

Customer satisfaction, with for example efficiency and e-services, is important in the authorities, and managers as well as civil servants stress these goals in the interviews. The informants describe that e-services must be "right for the customer", and usability is addressed in the design and development of these services, where the customer is the "end user".

The focus on efficiency is reflected in the IT systems. For example, when working with telephone services, the civil servant automatically receives a new call 5-10 seconds after a phone call has been finished. This may increase efficiency but is perceived as one of the most stressful features of the work situation created through IT. The civil servants in our interviews also pointed to the focus on production in quantitative terms, and that there is little focus on the quality of their work. Management measures work performance in terms of the number of cases being processed and quality aspects are ignored: "You look at the pile of paper, and from the

size you can tell if you've done a good job or not". In several authorities the focus on efficiency has led to an increased workload for the civil servants: "It is very hard for them, and there is much overtime".

Furthermore, increased automation of case processing has top priority, and all of the authorities have implemented electronic case processing at least to some extent. Visions about the future are based on the idea that citizens (customers) fill out and send forms and applications, etc, electronically, the main part of the case processing will be done automatically and computers will "make" the decisions. The role of the civil servants will be to take care of complicated cases and to "support" the computer when it fails to process a case, due to for instance incomplete or incorrect information. Several informants pointed out that there is a high risk for deskilling and routinisation of the civil servants' work, which is in direct contradiction to the goal of creating challenging, healthy and satisfactory work for them.

Focus on Surveillance and Control

In these organisations, IT systems are often used for surveillance and control. Detailed supervision of work, and work performance is made possible by information technology and managers supervise the case handling process and work performance of individual employees through the IT systems. In some cases surveillance of the individual employee is directly connected to their salary. Some informants saw performance statistics as positive in that they helped improve productivity and created an element of positive competition. However, some informants found it stressful that computers were used to monitor work, and their individual performance. They felt that the focus on surveillance implied that management "mistrust that we can take responsibility for our work". Moreover, managers are described as being too focused on statistics and performance measurements "There's lots of statistics at all meetings".

Case Handling is regarded as Trivial

Our studies show that case handling work is regarded as trivial and simple by many informants in these organisations who are not directly involved in case handling, e.g. management and people at the IT departments. Some of the case handlers described the lack of understanding in this way: "This work is much more complex than anyone seems to believe", and another informant said that "You must show great respect for our daily job, it is the centre."

For example, some IT professionals in these organisations claimed that they had a good picture of case handling and of the core business in gen-

eral despite the fact that they had little or no experience and knowledge about the real work situation of the civil servants. Nor had they seen the IT systems being used in real life. Not even the usability experts had studied the context of use and the work situation of the users.

Problems in the IT systems indicated that the understanding of case handling work was limited to an information flow perspective. The systems support the "flow" of one single case from entering the system until completion, i.e. the idea that you work with one case at the time until it is finished. The complex, flexible and situated nature of case handling work is not supported. For example, some systems did not support opening two cases simultaneously, which is necessary when the civil servant works in parallel with handling cases and answering phone calls.

Development of IT Systems Based on Technology and Process Descriptions

In these organisations, the design and development of IT systems are based on abstract information flow models of e.g. the case handling process, or use cases describing interaction as information flow and processing. The work situation of the users, i.e. their situated work practices and problem solving, is not taken into account, and as described above, not fully known. This results in IT systems that do not support the situated nature of work, which is illustrated by this comment: "this is not possible to work with, this is useless!".

Moreover, this perspective may lead to inflexible and rigid IT systems that shape and confine the work situation: "The new computer system forces you to do things in a specific way. Previously we had different alternatives". The interviews indicated that there are several problems with the IT systems, for example; too many windows when working with a specific task, the lack of integration of information between different systems, the number of clicks required for completing a simple task, and workarounds required to solve other tasks. One example of poor fit between the IT system and work was a new mail system that one informant described in the following manner: "If it takes half a minute to answer the email, it takes three minutes to register it in the computer system".

Some of the IT professionals in our interviews were aware that the basic design and structures of the IT systems were inadequate. They described improving the IT systems as: "we put lipstick on the corpse", but they often ascribe the problems to poor requirements analysis and inadequate descriptions of work in the models. Their solution to the problem of poor fit

between systems and work was often to further detail and analyse work in the requirements phase, but using the same methods and representations.

Some civil servants felt that new IT systems had negative effects in regards to stress, comfort and work situation: "We have had an OK situation here, until a few years ago when we introduced two new computer systems". In some cases, problems with the IT systems had direct negative effects on the organisation. For example, one organisation had to close their reception from time to time because one of their IT systems went down, leading to frustration and stress.

In one authority a system development project with a focus on usability and the users' work situation and tasks was often referred to as a good example. In this project the project manager had great interest in usability and user centred design. However, this project met strong resistance from the IT department in, for example, test routines and design methods. The informants described that it was difficult "to force through a new way of thinking about tests, about how to design windows, and to test that they are usable. They just continue the way they always have, just as usual".

Training – Focus on Technology not Work Situation

When new IT systems are introduced, the training often focuses on various features in the interface, e.g. information fields or search engine features. The training seldom introduces and explains new work practices and routines, leaving it to the users/workers to identify new work practices on their own. For example, informants in one organisation described that the trainers had excellent computer skills and knew the new system well, but they did not know how it was going to be used in the organisation. However, informants in another organisation were pleased with the training they received in that it had focused on new work practices, and that it had truly helped them create new routines.

Moreover, many informants claimed that they are not given enough time to practice during training sessions, and that they have to find that time in their daily work after the training. This results in a stressful work situation since managers still focus on performance, e.g. the number of cases being processed, in the new IT system. In one case the system development project had such a short deadline that no formal training was provided and the civil servants had to learn the new system while working with it. This lack of training and time to practice was heavily criticised.

Furthermore, systems development projects often a have a "technical" ending, and the work situation of the users emerges without anyone reflecting on what the work situation will be like. As a consequence some in-

formants felt that they lose control over their work and work situation, which is stressful and strenuous.

IT Department and Users – Two Separate Worlds

There is little contact and communication between IT departments and users. The lack of mutual encouragement among users and developers leads to alienation between the groups and little understanding of the needs of the other group.

Business Development and Systems Development

Informants had very different opinions about business development and IT development, and there were large individual differences in all of the organisations. Most of the IT people, however, maintained that organisational goals control the IT development, but this view was not shared by people in other parts of the organisations. Instead, they claimed that IT development determines and shape organisational development and job design. Some of these informants also pointed to external factors that impact business development, but said that the outcome in terms of IT systems and their design is decided by the IT development department. Moreover, the civil servants in one authority said that the IT people seem more interested in developing new functionality than in maintaining and improving the existing systems. There is a clear tension between the needs of the civil servants and the interests of the IT people: “Well, there are different wills”

In one of the authorities, IT development did not seem connected to business development at all. One informant argued that the development projects simply build systems in accordance with the existing work practices, without any improvements or changes. The new system simply “freezes” existing work practices, preserving them as is.

User Participation

In systems development, user representatives often participate over an extended period of time and on a part-time or full-time basis. Often the same people participate in different development projects, and many of them have not worked with case handling in years. Hence, civil servants become “IT workers” to the extent that this is considered a career path in the organisations, even though they have little power in the projects. Furthermore, the user representatives are often considered more skilled and

knowledgeable in case handling than the average case administrator, and they are often "super users" of specific systems. It seems that it is a combination of personal interest, previous experience and competence that determines who participates in the development projects.

In most of the organisations, involving users in development projects is optional, and decided by the project manager. Since systems development projects often have a tight time schedule, the project manager often chooses to focus exclusively on the essential functionality as specified by requirements specifications. Consequently, there is no time to involve users. When involving users, the project managers prefer people with previous experience from systems development.

The role of the users and their contribution in the projects vary to a large degree, both between the organisations, but also between different projects within the same organisation. However, it seems that the most common task is to test functionality and to review specifications, requirements and system descriptions. Users are seldom involved in prototyping activities or in the system design. Some of the user representatives we interviewed said that their role in the projects was unclear and confusing. They sometimes felt frustrated and uncertain about what they were supposed to do. On the other hand, some of them saw an opportunity to define their own role and areas of responsibility, seeing that this makes it possible to work with parts that interest them, and where their contribution matters the most.

Another problem described by the user representatives was that the language used in system development is different from their own. They cannot use their every day vocabulary when participating in projects: "You speak different languages". This makes it difficult for them to understand and to contribute in discussions in the projects: "You are silent. You don't understand anything that they say." The user representatives said that these language barriers make it difficult to talk to programmers, and that it takes years to learn the programmers' vocabulary and way of speaking.

Moreover, some of the user representatives felt that they are "on lowest rank" in the development projects, and that they have little possibility and power to make changes.

Lack of Communication and Contact

Generally, the people in the IT departments said that they cooperate closely with users and other representatives from the organisations. However, people in the rest of the organisation did not share this view. Our study indicates that there is often a communication gap. For example, the civil servants did not always know where the new systems come from, or

why new IT systems were introduced. The civil servants generally did not have a clear picture of where to send suggestions for improvements of their IT systems. Moreover, if they send suggestions, they seldom receive any feedback, and they are not informed about how the different suggestions are prioritized. The IT people we interviewed were not happy about the situation, since they felt that they never receive any positive feedback from the users. They are only informed when the systems do not work properly.

Generally, people working in the core business do not consider themselves sufficiently involved in systems development: "We from the core business have not taken part in any requirements work. If they would have asked us in a better way then we would have been able to tell them what we really need. "

However, in the studies we also saw examples of good communication and contact, for instance, where systems developers had a close and informal relation to users, as they were located in the same office. Some of the union representatives we interviewed claimed that they take an active part in systems development.

Perspective on Usability

Finally, our studies indicate that there were problems with the attitudes towards usability and usability expertise in these organisations.

There are few usability experts in these organisations and they are primarily involved in development projects that build external web applications for use by customers, i.e. e-services. The usability experts we talked to said that they seldom had enough time in the projects to do all activities needed to produce a usable system. Several of the informants believed that this was due to a lack of understanding of what usability experts do: "No one really understands what I do".

Usability in Systems Development

Generally, there was little usability focus in systems development in these organisations. Usability was seldom an integral part in the requirements process with few usability activities, and there were few usability goals in requirements specifications. As a result, the IT departments did not see the need to include usability expertise when staffing the development projects. Usability activities were often limited to test activities towards the end of the development process, when there are limited possibilities to make any significant changes. One informant illustrated the situation in the following

way: "usability is seen as a shell that you put on, outside the system", and another informant said "You already have finished and ready systems, and then you try to design a little on the surface of them". However, one organisation had specified a usability plug to the Rational Unified Process, and this was believed to contribute to usability to a high degree.

Furthermore, several informants from the IT departments felt that usability is a vague and unclear concept. Other participants in the systems development projects did not fully understand what usability is, and in what way it will improve the IT systems. In one organisation, people from the IT department considered usability not applicable to the particular technical platform that was used.

In one authority, informants claimed that usability receives low priority owing to a previous system development project that was a complete failure. Subsequent projects have focused on functionality and technical problems: "No one dared to have any detailed and extensive requirements after that".

Discussion

Quality in value – i.e. users' wellbeing, productivity and user satisfaction – is related to attitudes and perspectives underpinning discourse about users and their work in the development process (as well as in the organisation at large). These attitudes and perspectives are embodied in methods, models and representations used for analysing and describing users' needs and their work. The models and representations are used as input in the development process, determining design, contents and structure of the IT systems.

In the workplace, one essential aspect of usability is the fit between organisational goals and work practices on one hand and IT systems on the other hand. IT systems should "…fit into the fabrics of everyday life" (Beyer & Holtzblatt, 1998, p. 1). It is therefore essential to understand users' current work practices, and how these practices may be affected and improved by new technology. A fragmentary understanding of the work situation and work practices may result in IT systems that are poorly adapted to the users' needs causing frustration and strain in the work situation. Long-term frustration and strain, in combination with low control and poor social support, is a risk factor for stress related disorders, affecting users' wellbeing, productivity and satisfaction.

Systems development is often based on an engineering-oriented view of problem solving and knowledge. This view is closely related to the sys-

tems theoretical perspective, which places emphasis on technical and formal aspects of the relationship between man and machine (Nurminen, 1987; Kammersgaard, 1990). In an engineering-oriented perspective, users (people) are primarily defined by their relation to a technical system. Their tasks, goals, and needs are described as sets of predefined steps and rules defining the interaction between users and systems (Boivie, 2005). The methods, models and representations used in many systems development processes reflect this view of people and work, e.g. use case models, process models, data flow models.

However, work, is also a highly complex social process, a joint activity based on communication and interaction between people. Work is also purposeful, i.e. driven by goals or intentions. Moreover, work is specific to the context and shaped by circumstances of the situation as it evolves – i.e. it is situated and contextual. This means that work practices cannot be predefined; they emerge in the evolving situation and are constantly generated, shaped and adapted to it (Suchman, 1987). Human beings are adaptive, flexible, and innovative. In short, work cannot be described solely by rules or predefined sets of operations and steps (Winograd & Flores, 1986; Greenbaum & Kyng, 1991).

Thus there is a tension and conflict between an engineering-oriented way of thinking about and representing users' work and work practices in well-defined models, and the "messy" nature of those work practices (figure 3). An engineering-oriented way of thinking favours representations that focus on the formal, and intellectual aspects of work (Nygaard, 1986; Greenbaum, 1990; Harris and Henderson, 1999). They do not accommodate users' practical knowledge about their work, their understanding about "what-to-do" as well as "how-to" in a specific situation (Schön, 1995). As a consequence, there is a tension between how users experience and understand their everyday work situation and representations (models) that are used in systems development. This tension or conflict has two effects. First, it makes it difficult for users to participate in design processes since they do not recognize their work practices in these representations. Secondly, representations can only provide a fragmentary understanding of users' work, undermining the fit between the system under development and the users' work practices.

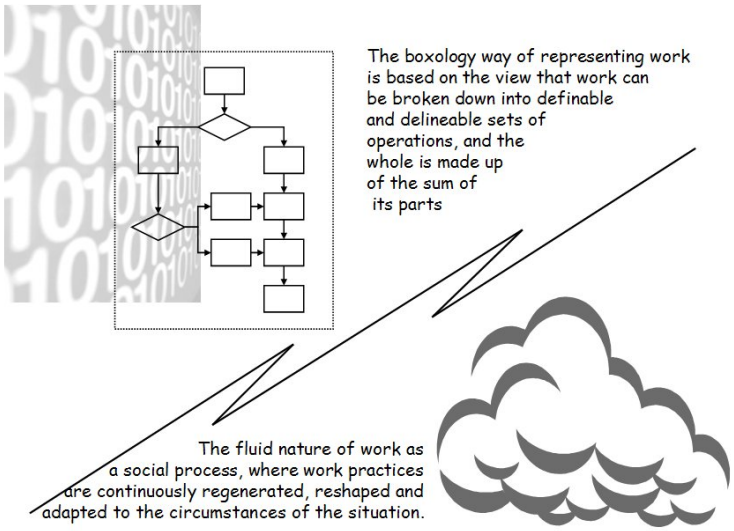

Fig. 3. The engineering oriented way of thinking and the messy nature of work.

Discussions about relations between attitudes and perspectives in systems development processes, and quality in value of the emerging system and ultimately emerging work situation are not new. It is one principle underpinning the Scandinavian school (Greenbaum & Kyng, 1991) and user-centred systems design (UCSD) and has been discussed extensively for at least 20 years. The problem is that little seems to have happened in real-life systems development. Users are still kept at arms' length in development, little attention is paid to their work situation, and health issues and usability issues "get lost" (Boivie, et al, 2003).

This is particularly evident in our case study, where a strong focus on automation, efficiency and legal security control and shape the development of new technology, and ultimately the tasks and work practices of the civil servants. These tasks emerge because of new technology – they are simply what is left over when the computers have done their part. Little attention is being paid to such issues as routinisation and repetitiveness of work tasks, control over work situation, control over pace and order of tasks, social support and deskilling, all of which are well-known risk factors for occupational health complaints. Nevertheless, there is an awareness in the separate IT development projects about these issues. We have interviewed participants in one project, and they pointed to the risk that the system they were building would create work situations where the civil servants become "process operators" instead of specialised and skilled

knowledge workers. The responsibility to make decisions about automation versus manual processing of the various steps in the case handling process rests with the project, primarily with the user representatives, the procurer, and the project manager. They all expressed frustration with having to make these decisions since efficiency and a high degree of automation was top priority, whereas the users' future work situation was not addressed at all.

Furthermore, the studies confirm that there is a gap between users' work and their situation and the discourse underpinning the IT development. The views of users and work expressed in the interviews and in the case study display some characteristics of the systems theoretical perspective of human activity and work discussed above. Not least in the view that the civil servants' works is trivial. Their work was frequently discussed in terms of simple steps and operations, that may be predefined and automated in accordance with clearly defined rules and regulations. It was seen as a problem that civil servants have to make decisions in complex cases where the computer fails to generate a decision and where "human" judgement is required. These "human" decisions were seen as subjective and open to interpretations – which is the very reason that the computer fails to make them in the first place – and the civil servants making the decisions were seen as incompetent.

Another result of the perspective on the civil servants and their work is that the available usability experts were primarily involved in external IT development, i.e. the development of e-services to be used by the general public. Usability was not considered equally important for the internal users, i.e. the civil servants. There seemed to be an underlying assumption that they simply have to use what is installed on their computers, and that usability in this context is unnecessary "luxury" connected to their satisfaction alone, having little to do with their productivity and wellbeing.

User-centred design has been promoted as a way of creating IT systems that are better adapted to the users' needs and work practices. However, user involvement is not sufficient to address the problems, as illustrated in our studies. These organisations all have development processes where users (or other representatives from the organisation) are involved. However, they are typically involved over extended periods of time, on a full-time or part-time basis, and become "IT workers" of a kind, albeit with little power in the projects. User involvement must be complemented with a focus on usability and work situation of users. Focus on information processing and information flow in the systems theoretical perspective must be complemented with other perspectives and methods that focus on and capture the situated and contingent nature of work and work practices, for instance, field studies and contextual interviews (Beyer & Holzblatt, 1998).

We have introduced the idea of field studies in one organization in our case study. However, field studies are often quite extensive and time-consuming, making them impractical in the contexts of these organisations and their IT development. A number of questions regarding how to conduct and document field studies, and how to make use of the results arise. For example, when should field studies be conducted, and who should do them? If field studies are conducted early on in the process, before the start of the actual development project – how should the results from the studies be documented, in order to make sense to somebody else, later on in the process? Moreover, if field studies are part of the commissioning process – how do these field studies relate to the studies conducted by the analysts and designers in the development project? It may be argued that it should be enough to conduct studies early on, and then hand over the documentation to the designers and usability people as input to their design.

In the literature, usability metrics has been suggested as a way of safeguarding usability in the systems development process (for instance, ISO/IS 13407, 1999; Mayhew, 1999). It is argued that usability metrics places usability on the agenda and that if usability is included in the requirements specification it cannot be sidestepped and ignored in the project. Metrics, for example, in terms of productivity statistics and technical performance, are essential in these organisations and metrics for usability and quality in value would fit into their overall focus on metrics. In our case study, an IT user index has been introduced, measuring how the users perceive the usability of their IT systems. The idea is that if usability is measured on a regular basis, the IT department must take usability into account in their development process. The underlying assumption seems to be that expressing usability as numbers will make it visible and that these numbers represent some kind of objective truth about the IT systems. Frequent complaints, suggestions for improvements, frequently reported problems with using the IT systems are seen as subjective and do not seem to represent the same kind of "truth". However, there are problems with metrics. Usability and quality in value comprise many different aspects, some of which cannot be easily turned into metrics. Specifying quality in value or usability as a set of well-defined parameters complies with the need for formal representations in the development project, but obscures the complex and situated aspects of work discussed above. The difficulties with expressing such aspects as numbers make them in no way less important. The question is how to deal with them in a development process that is based on a metrics approach.

To sum up our discussion, we have identified problems with attitudes and perspectives on users and their work in our studies. These attitudes and

perspectives are embedded in the methods, models and representations used in systems development, which in turn shape the IT systems and the emerging work situations of the users. Hence, quality in value, i.e. users' wellbeing, satisfaction and productivity are shaped by attitudes and perspectives held in systems development. User-centred design and field studies are suggested to address the problems and to improve the understanding of the users' needs and work practices in the development projects. However, UCSD field studies come with a number of problems and issues when applied in the contexts of our studies. These problems and issues need to be resolved in the future.

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