

# Past History and Future Challenges of Human Work Interaction Design (HWID)

## Generating Cross-domain Knowledge About Connecting Work Analysis and Interaction Design

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Proceedings

***Past History and Future Challenges of  
Human Work Interaction Design (HWID):  
Generating Cross-domain Knowledge  
about Connecting Work Analysis and  
Interaction Design***

Workshop at INTERACT 2013 – 14<sup>th</sup> IFIP TC13  
Conference on Human-Computer Interaction, Cape  
Town, South Africa, September 2013

**Edited by**

Torkil Clemmensen, Bengt Sandblad, Arminda Lopes and Jose Abdelnour-  
Nocera



# INTERACT 2013

designing for diversity

Proceedings

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**This document contains the workshop proceedings, agenda and practical information as to preparations and place of workshop. The document is edited by the organisers, but the copyright of the position papers belongs to the authors.**

## **About IFIP TC13 and TC13.6 Working Group**

### **1. Technical Committee TC13 on Human–Computer Interaction.**

The committees under International Federation for Information Processing (IFIP) include the Technical Committee TC13 on Human – Computer Interaction within which the work of this volume has been conducted. TC 13 on Human-Computer Interaction has as its aim to encourage theoretical and empirical human science research to promote the design and evaluation of human-oriented ICT. Within TC 13 there are different Working Groups concerned with different aspects of Human-Computer Interaction.

The flagship event of TC13 is the bi-annual international conference called INTERACT at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

Publications arising from these TC13 events are published as conference proceedings such as the INTERACT proceedings or as collections of selected and edited papers from working conferences and workshops. See <http://www.ifip.org/> for aims and scopes of TC13 and its associated Working Groups.

### **2. Working Group 13.6 on Human-Work Interaction Design**

This working group was established in September 2005 as the sixth Working Group under the TC13 on Human - Computer Interaction. It focuses on Human-Work Interaction Design (HWID) and it is called WG13.6. A main objective of the Working Group is the analysis of and design for a variety of complex work and life contexts found in different business and application domains. For this purpose it is important to establish relationships between extensive empirical work-domain studies and HCI design. The scope of the Working Group is to provide the basis for an improved cross-disciplinary co-operation and mutual inspiration among researchers from the many disciplines that by nature are involved in a deep analysis of a work domain. Complexity is hence a key notion in the activities of this working group, but it is not a priori defined or limited to any particular domains. The aim of this Working Group on Human-Work Interaction Design (HWID) is to initiate new research initiatives and developments, as well as an increased awareness of HWID in existing and future HCI educations. See <http://hwid.cbs.dk/>

## **Introduction to workshop proceedings.**

The IFIP 13.6 Human Work Interaction Design (HWID) working group aims at establishing relationships between extensive empirical work-domain studies and interaction design. Today, generic designs are applied to use-situations with very different purposes, as the same social software or games are used for both work and leisure situations. Thus, design shifts from design of a technology to design of various use-situations encompassing the same technological design. We find that there is a need to conceptualize, in HWID models, the relationship between work analysis and design for these new digital realities. The scope of this workshop is to exemplify how HWID approaches translate work analysis to interaction design (and vice versa), and discuss how such understanding can help practitioners and researchers to develop and design digital use situations and digital content. That may entail that we touch upon how theoretical ideas about socio-materiality and socio-technical environments.

In this one-day workshop we aim to make status on the work done within in the IFIP 13.6 Human Work Interaction Design (HWID) approach, and point to future challenges. We invite participants from industry and academia with an interest on empirical work analysis, HCI, interaction design and usability and user experience in work situations and in the workplace. Topics that participants may explore include: Techniques and methods for mapping the relations between work analysis and interaction design; How work analysis can feed into interaction design evaluation; Design cases and case studies of work analysis and in medical and safety critical ICT, enterprise-level systems, e-government services, or mobile devices. The workshop will consolidate - in theoretical HWID models – experiences from empirical case studies of human work analysis and interaction design, and reflect on how these has benefited in enhancing the user experience of a diversity of HWID systems, and provide a set of effective methods and techniques for this purpose. The outcome will be an enhanced HWID framework for studying new digital use situations and digital content.

The workshop will be conducted in an inviting, open and social atmosphere. We aim to provide time for reflection and discussion around each of the accepted papers and cases. For more information, see the workshop web-site <https://sites.google.com/site/interact2013workshophwid/>.



**Past History and Future Challenges of Human Work Interaction Design (HWID): Generating Cross-domain Knowledge about Connecting Work Analysis and Interaction Design - INTERACT2013 one day workshop, Monday 2 September 2013**

<b>Schedule</b>		
<b>9:30 – 10:00</b>	<b>Introduction to the workshop by Torkil Clemmensen and Bengt Sandblad</b>	
<b>10:00 – 11:30</b>	<b>ICT Design and evaluation for trans-mediated workplaces: towards a common framework in human work interaction design</b>	José Abdelnour-Nocera, Barbara Rita Barricelli, Torkil Clemmensen
	<b>Designing a Health-care Worker-Centred System for a Chronic Mental Care Hospital</b>	Rodrigo Silvestre, Junia Anacleto, Sidney Fels
	<b>Supporting Human Collaborative Works by Monitoring Everyday Conversations</b>	Tetsuro Chino, Kentaro Torii, Naoshi Uchihira, Yuji Hirabayashi
<b>11:30 – 12:30</b>	<b>Panel Discussion moderated by Torkil Clemmensen</b>	
<b>12:30 – 13:30</b>	<b>Lunch</b>	
<b>13:30 – 15:00</b>	<b>Mind the Gap - Towards a Framework for Analysing the Deployment of IT Systems from a Sociotechnical Perspective</b>	Thomas Lind and Åsa Cajander
	<b>Challenges in Applying a Participatory Approach in a Nation-wide Project -The Case of 'Usability of Swedish eHealth Systems 2013'</b>	Isabella Scandurra, Rose-Mharie Ahlfeldt, Anne Persson, Maria Hägglund
	<b>Collegial Collaboration for Safety: Assessing Situation Awareness by Exploring Cognitive Strategies</b>	Anders Jansson, Mikael Erlandsson, Camilla Fröjd & Marcus Arvidsson
<b>15:00 – 16:00</b>	<b>Panel Discussion moderated by Jose Abdelnour-Nocera</b>	
<b>16:00 – 17:00</b>	<b>Identifying user experience goals for interactive climate management business systems</b>	Torkil Clemmensen, Stephanie Barlow
	<b>Using a vision seminar process to evaluate the work environment of future work.</b>	Bengt Sandblad
<b>17:00 – 17:30</b>	<b>Panel Discussion moderated by Jose Abdelnour-Nocera &amp; Torkil Clemmensen</b>	

# ICT Design and evaluation for trans-mediated workplaces: towards a common framework in human work interaction design

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**Abstract.** This paper outlines the rationale for a EU COST Action on human-work interaction design for trans-mediated workplaces. Such a network would strengthen the HWID discipline by paying attention to the peculiarities of the different work domains and examining the potential and ability to transfer HWID knowledge from one work-domain to others. This would be the first formal initiative at European level to harmonize HWID as a substantive discipline supporting the interaction of workers through technology at a time in which the concepts of workers and workplace are changing significantly. The Action would focus on three working groups: critical review of ICT design and evaluation methods combining work analysis and interaction design across different work domains; Socio-technical understanding and classification of trans-mediated workplaces as object of HWID; and Producing a HWID framework for trans-mediated workplaces.

**Keywords:** human-work interaction design, trans-mediated workplace, cross-domain learning, design and evaluation.

## 1 Background

Human work analysis is traditionally focused on user goals, user requirements, tasks and procedures, human factors, cognitive and physical processes, and contexts (organizational, social, cultural). End-user tasks performed within a work domain are typically observed and studied with particular attention to user's experience of tasks (pro-

cedures) and the environment (constraints in the work domain). For instance, Hierarchical Task Analysis [1] and Work Domain Analysis [2] are used to study goal-directed tasks and to map the work environmental constraints and opportunities for behaviour.

The discipline of human-computer interaction (HCI) has historically adapted work analysis methods such as hierarchical task analysis to design computer artefacts. In addition, there is a strong tradition of applying ethnographic methods [3] and with a socio-technical perspective [4] in HCI. These approaches focus on work as end-user actions performed together with other people in a field setting: the worker activity is seen as a social and organisational experience. In this context, human work analysis and interpretation are strongly linked with user experience, usability, and interaction design and they influence each other.

Human work interaction design (HWID) is the study of how to understand, conceptualize, and design for the complex and emergent contexts in which HCI and work are entangled. HWID aims to increase the benefit derived from elements from both fields of knowledge, such as work analysis, prototyping, organizational change, computer supported cooperative work, human-computer interaction, and participatory design, by interrelating them and capitalizing on their individual concepts and empirical instruments.

Several aspects influence the way humans work and the work itself [5,6]: for humans, language and culture, nationality, on one side, and education, skills, knowledge, background, emotions and cognitive abilities, on the other side, contribute to define the profile of the users and their approach to individual and collaborative work; for the work, its goals, functions, available tools and content contribute to delineate its characteristics and challenges. All these aspects directly affect the work analysis practice and the processes of interaction and information and communication technology (ICT) design and their evaluation.

Supported by the continuous advances in pervasive technology, workplace configuration is pushed beyond linear logic and physical boundaries. This means that workers' experience is becoming more trans-mediated: new forms of work and collaboration emerge where synchronous and asynchronous interactions occur at different physical and digital levels. This increasingly trans-mediated character of workplaces put on a trial well-known and proven work analysis methods as well as the design of the work processes and their interactive tools. Through the proposed COST Action network we hope to learn how effective HWID has been at supporting new forms of work; and how HWID has changed and has to change to improve the quality of workers' experience and outputs.

Three main challenges are identified in HWID research. The first is addressing the sociotechnical gap in work analysis and interaction design, specifically the gap between social requirements and affordances of technical design. The second is designing simple interactions for complex domains. These two challenges are partially investigated by the ICT COST Action IC0904 "Towards the Integration of Transectorial IT Design and Evaluation" ([http://www.cost.eu/domains\\_actions/ict/Actions/IC0904](http://www.cost.eu/domains_actions/ict/Actions/IC0904)). IC0904 Action's goal is to enable effective cross-sectorial transfer of design and

evaluation methods for computing artefacts that improve life quality, but does not provide an exclusive focus to work analysis and interaction design.

The third and last challenge faced by HWID is bridging the gap between ICT development and organisational change. This means being able to specify in the ICT development phase the purpose of the system in terms of desired effects for the workplace, rather than specifying just technical and user requirements as separate dimensions.

Therefore, in the light of these challenges our COST Action would complement Action IC904 by providing a more specialised ICT design and evaluation framework with a clear focus on human work in trans-mediated workplaces useful to different domains, e.g. health, air traffic control, naval operations, archeology, crisis management and production lines, among many others. Despite this specialization, this Action also included concepts and tools from other domains such as work analysis and organizational psychology not strongly present in IC904.

### **1.1 Benefits**

The main benefit of this COST Action is to place human work at the centre of ICT design in trans-mediated workplaces. This implies recognition of workers' requirements from usability and user experience perspectives. There will be clear benefits in terms of improvements to the quality of work outputs and the welfare of workers.

The COST Action will contribute to new definitions of the concepts of worker and workplace and the implications of ICT design and evaluation for these, which can inform creation of new European policy and laws.

## **2 COST Action Objectives and Deliverables**

In order to address the above challenges, the proposed COST Action will pursue the following objectives:

- Learning from partners' experiences in different work domains when applying work analysis to support the interaction design of trans-mediated workplaces;
- Exploring how work analysis and interaction design have changed and have to change to support workers in trans-mediated workplaces.
- Identify novel ideas for how interaction design for trans-mediated workplaces can ensure high quality usability and user experience for workers, especially in workplaces where high domain expertise is required.

The main deliverables from these actions are:

- A renewed and harmonized HWID framework specifying best practice in the design and evaluation of technology for trans-mediated workplace.
- An integrated body of findings at European level illustrating through different case studies the combination of interaction design and work analysis in trans-mediated workplaces.

- A report of the evaluation of the implementation of the proposed HWID framework in partners' local research activities and projects taking place during the duration of the Action.

In terms of scientific impact, the action will provide the HCI discipline with sound tools and procedures for designing human-centred technologies for the workplace across different domains.

### 3 Scientific Programme and Innovation

The scientific activity within this Action will be exploited as starting point within a network of experts who have collaborated on these research topics for many years. The duration of this COST Action is four years. The network is open to institutions interested in collaboration within the emerging field of work analysis strategies applied to interaction design methods in trans-mediated workplaces.

The networking, the information exchange and the ability to build collaborations among researchers will be coordinated through COST and will be implemented by schools, short-term scientific missions, workshops, a dedicated website, conferences, publications and new project proposals.

The key innovation of this network is developing a meta-analysis of HWID research and implementation projects in different work domains with a view to integrate different findings and experiences into a harmonized body of useful and practical knowledge. Rather than just exchange and dissemination, the Action will involve different partners in the process of analysis and integration.

Different types of activities will be implemented under the Action:

- Short-Term Scientific Missions (STSMs) will be organised to support the partners in visits aimed at exchanging knowledge and supporting the collaboration between different working groups (WG), including the meta-analysis discussed above. The results of the STSMs will be published as internal reports and disseminated to the public.
- One yearly workshop will be organized. The first one will present and disseminate the WG outcomes and to gather new inputs from the participants. The last workshop will present the results of the Action as an integrated body of findings of European experiences in HWID, to disseminate them in the practitioners and academic communities, and to discuss about the future of the network.
- Summer and winter schools will be organised to disseminate knowledge in the area to young researchers.
- A password-protected groupware platform, accessible via Web, will be made available to the partners for sharing documents and papers and to support the collaboration among the WGs.
- A website will be published online to make available the information about the Action, its objectives and outcomes. The action will use social media, Twitter, Facebook, LinkedIn, and research repositories such as Academia, Mendeley and ResearchGate to reach out to researchers, practitioners and students in this area.

- Participation to conferences in the form of special interest groups and scientific publications will be planned through the 4 years of the duration of the Action. This will include the support of the IFIP TC 13.6 working group in HWID

## 4 Organisation

The COST Action will be a framework open to institutions interested in collaboration within the emerging field of work analysis strategies applied to interaction design methods.

The Action will consist of activities, like described in section “Scientific Programme”, carried out by different WGs. Since the activities are not completely independent but interconnected, the WGs will be asked to collaborate with each to reach the common Action’s goals. Every WG will be managed by a coordinator.

A Management Committee (MC) will be selected and will act according to COST Rules and Procedures. The MC will meet twice per year in occasion of the WGs meetings. To guarantee an effective and efficient management structure, the MC will consist of a Chair, a Vice-Chair, a Scientific Coordinator and a Dissemination Coordinator. The partners who will assume these roles will be elected during the kick-off meeting.

The network will be composed by computing and human factors scientists and practitioners, including domain experts of universities and institutions to provide an interdisciplinary forum to exchange their interests, needs, capabilities and constraints. The organization of the network will be focused on members who can provide cross-domain fertilization for HWID.

Four Working Groups (WGs) will be formed, each of them focused on specific scientific activities:

### **WG 1: Critical review of ICT design and evaluation methods combining work analysis and interaction design across different work domains:**

This activity will assess the effectiveness and transferability of recent and current application of HWID methods for meeting work, usability and user experience goals. The potential and ability to transfer HWID knowledge from one work-domain to others is a key component of this assessment.

### **WG 2: Socio-technical understanding and classification of trans-mediated workplaces as object of HWID:**

The goals of this activity are to arrive at a comprehensive socio-technical understanding and to provide a classification of trans-mediated workplaces to facilitate the design and evaluation of ICT for workers. The first goal will consider the cultural, political, economic, policy, health and safety contexts shaping trans-mediated workplaces and associated ICTs. The second goal will provide a classification of the different types of workplaces based on findings from the first goal.

**WG 3: Producing a HWID framework for trans-mediated workplaces:**

This activity will develop a framework usable in different work domains that will facilitate the combination of work analysis and interaction design methods to support the design of ICT in trans-mediated workplaces. Suggestions for the development and improvement of these methods in the context of trans-mediated workplaces.

**WG 4: Implementing and evaluating a HWID framework for trans-mediated workplaces through the partners' projects:**

This activity will focus on identifying suitable projects in the network of partners where the HWID framework could be implemented and tested. Once a first version of the framework is ready the WG will use and evaluate it in the selected projects.

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# Designing a Health-care Worker-Centred System for a Chronic Mental Care Hospital

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**Abstract.** We report on our research on natural ICT solutions for integration into a non-ICT based workflow at a Brazilian chronic care hospital. Our health-care worker centred approach for continuous life-care contrasts from the more typical acute care situations where systems are geared towards a combination of patient-centred or administrator-centred designs. These systems are necessary in acute settings as patients spend a relatively short period of time in the hospital with imminent risk of death. On the other hand, chronic mental care focuses on improving a patient's life quality. Thus, the therapeutic processes are towards preparing patients to be able to establish a routine for what is defined as an independent normal life. We report on one of our prototypes around personal schedules, games and personal digital artifact management. The prototype investigates this different way of looking at long-term health care based on multiple user-centred design iterations with the hospital staff. Through our participatory design and user-centred design evaluation processes to date, we have established that this approach is promising for improving overall care for the residents in long-term care. The approach we suggest may apply to other long-term assistant scenarios such as nursing homes, care for people with disabilities and teaching and parenting contexts.

**Keywords:** Worker-centred design, chronic care system design, mobile computing, user centred design, natural workflow design, natural user interfaces.

## 1 Introduction

Long-term care in contexts of mental health, disabilities and aging are emerging as a fact of life for many of the world's countries. In these contexts, often the person being cared for only receives a quality of care that depends upon the quality of treatment and procedures of the care worker. Our research is looking at these health-care workers by focusing on their complex workflows to design applications and systems to integrate into their existing natural practices [2,3].

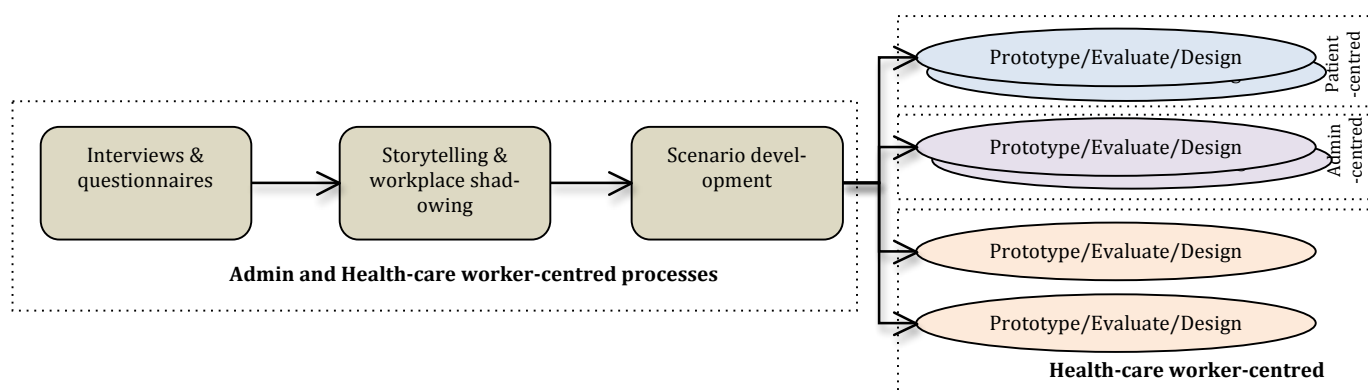


At the moment, we have partnered with the Brazilian Hospital CAIS Clemente Ferreira [4]. This is a special chronic care hospital for individuals with neurological and brain disorders. While the primary objective of the Hospital is for professional health staff to facilitate patients' transitioning from the hospital back into normal society, in reality, most patients live until they die at the institution. The hospital has 3 floors with 6 wings with 800 patients and 600 professionals distributed throughout. The hospital has four distinct professional roles: administration, health professionals, nurse assistants and maintenance. Currently CAIS has essentially no Wi-Fi or cell phone coverage due to architectural issues (at least 70 cm thick concrete walls) and minimal IT budget (no funds to install Wi-Fi service for professionals). They use voice and a paper-based system for their primary workflow mechanisms. While there are rooms for the health care workers to work in and write notes, i.e. nursing stations, most of their time is spent moving around CAIS attending to daily routines. In this paper, we describe the research targeted towards the health professionals and not the patients or administrators. We believe that working with these professionals is an opportunity to design information technology based workflow that avoids a Windows, Icons, Menus and Pointers (WIMP) oriented strategy [3]. Likewise, we can use their workflow as a starting point in deciding what *natural* is, given that their workflow has evolved over more than two decades of practice [2].

## 2 Related Work

In general, e-Health has been oriented around the use of the internet and other information and communication technologies (ICT) in the health sector to improve access, efficiency, effectiveness and quality of clinical processes used by health organizations, patients and consumers in an attempt to improve the health of patients [5]. Much of the work for e-Health has targeted acute care situation, as proper functioning can be the matter of life and death. These systems tend to be either patient-oriented (electronic health records, aids for professional decision making) or administrator oriented (better tracking of costs and care systems for decision making). For example, in the works of [9][6][1][17], work focuses on aspects of the patient experience, providing better feedback to patients, helping with patient motivation or improving a therapeutic process. Likewise, there are a plethora of hospital information systems with a long history [18] as the promise of ICT technology to improve hospital workflows, patient record management and patient outcomes has yet to be fully realized. However, these are more oriented towards the administration and management of information flow, including patient data, throughout a hospital. We differentiate our approach from these *acute* health-care systems that tend to be centred on either patients or administration of the hospital.

Our research approach follows the path of many studies [14,7,1] that have been carried out in the application of ICT within hospital settings with many different objectives, like: improving communication processes among hospital staff, providing more accurate diagnostic tools and treatments, assist in therapy processes, increase patient's medication adherence, and others. Typically, a user design processes (UCD)

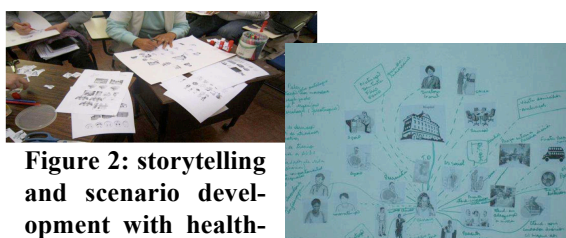


**Figure 1: Diagram of our User-centred Design Process; we observed that for chronic care, the health-care worker centred designs were critical for introducing technology.**

approach [11] is adapted from human computer interaction and software engineering approaches including: interviews as a starting point [12,15] and considering end-user participation in the design process [12,15,10,13], creation and validation of scenarios [12,15,13] added to storyboarding [15,8,16] and a short development cycle of prototypes from low to high fidelity [13,15,10] being evaluated and redesigned.

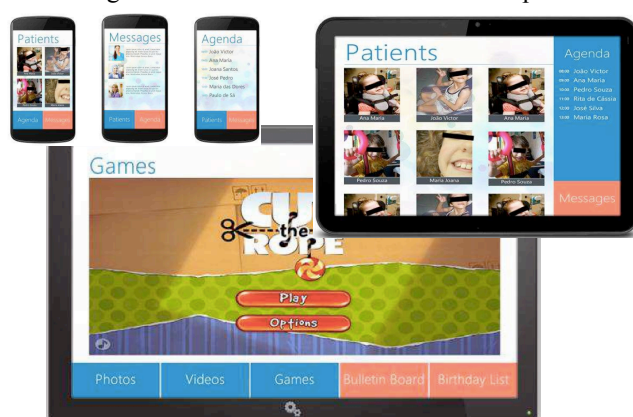
### 3 A Health-Care Worker-Centred Design

Our UCD process has been ongoing since June 15, 2011 to now. We have had 9 half-day or full day meetings with healthcare staff, documented and validated their workflow, established 4 scenarios, and created 3 prototypes for testing, including a long term study that is ongoing. As well, we have applied a survey and a one week workplace shadowing activity. The UCD has focused on all three main aspects of the hospital, administrator requirements, health-care worker requirements and patient requirements. Figure 1 illustrates how our research activities progressed. As we progressed through the patient and administrator centred prototypes (blue and purple), we discovered that many of the activities in the hospital that help to maintain the well-being of the patients have very little to do with direct patient intervention or administrative duties. Instead, they are concerned with maintaining a copacetic workplace with an easy flow of dialogue and social interaction. In this context, the hospital runs more like a family home where the routine of daily life is accentuated by regular stimulating events that are created coupled to pharmaceutical interventions for the residents to mitigate behavioral difficulties that either endanger a resident or disrupt the daily flow of the residents. It is from this observation that we created a prototype to focus on how the health-care workers establish a reasonable quality of life for the residents. The prototype, *CareHub*, is oriented towards personal daily routine and digital asset management.



**Figure 2: storytelling and scenario development with health-care workers.**

During our storyboarding processes during scenario development, we developed an understanding about the various routine activities that the health-care worker does. Figure 2 shows an image from one of the exercises we did during the storytelling activities. Some of the activities include checking on residents, giving medication, taking residents to social activities, washing, feeding and making notes about the residents. During the workplace shadowing, we also noted that they do many “favors” for each other and that forms a particularly important part of how jobs gets done on a regular basis. These favors transcend the official hierarchy of duties at CAIS. As well, much time is spent talking to each other about residents and activities. Finally, we also noticed on our regular visits that essentially every week there is some “special” event organized for the residence to meet and spend time together in a social setting.



**Figure 3: Upper right corner shows smartphone displays, upper left is tablet display and lower image is of CareHub content on the large display. Of particular note is that the smartphone show private information, but not intended for editing; the tablet is the primary means for data organization and entry while the large displays are for public information and content for the residents.**

Based on our observations and the participatory design, we developed a prototype that we call CareHub. The CareHub design distributes content between workers’ smartphones and tablets and large screen displays intended to be distributed throughout CAIS. The details of content distribution is based on the discussion with the staff. Specifically, the smartphones are for referencing private information with minimal editing, including checking agenda, looking at patient information and messages. The tablets are designed to support management of digital assets such as photos and videos, agendas, patient files and notes, game configurations and activation menus, a general bulleting board and a birthday/event list. In contrast to the smartphone, the tablet is intended to be the primary place for data editing and entry. The mobile platforms link to the large displays. The large displays show content that we determined from discussions that would be appropriate for public viewing. In particular, full screen view of photos, videos and video games for residents to play, birthday announcements and a bulletin board. Figure 3 shows examples of the content of the CareHub for the different platforms.

At this stage, we have deployed the prototype using an intranet that we installed and are collecting data about its usage. Preliminary indications are promising. Initially, we started with five tablets that we supplied and one large display. After 3 weeks

of deployment, there were already requests two personal cellphones to have the prototype installed and one additional tablet for using the system. The system is also designed with a web interface so that any smart device with a browser can use the messaging capabilities. We do not know yet how many people are using this feature. One other incident that indicate that staff is adopting the prototype was one of our students who maintains the equipment got a call at 6am from a staff member indicating something was wrong with the large display (the computer had crashed so was showing the blue-screen of death). The student indicated how to restart the computer over the phone and eventually the system was back to normal, much to the expressed relief of the staff member. This suggests that they are already depending upon some of the functionality. Finally, we recorded 250 messages over a four week period from 20 staff demonstrating they have been using it without intervention from us. This has also occurred during a strike at the hospital, so there is a reduced staff count as well as a substantial additional workload on them, yet they are still using it.

## **4 Conclusions and Future Work**

Initial results are quite promising for our approach to develop tools and systems oriented towards the health-care worker to aid them in managing their personal work activities and assets. We are continuing to evaluate the effectiveness of our approach and will be taking the feedback from the health care workers to design the next iteration of prototype that will more closely match their routine. The staff have been very enthusiastic about this direction even though it has very little administrative mechanisms, such as meeting organization tools, patient health record access, or location services. This is in contrast to the common logbooks at the nursing stations that they are supposed to use to track patient health. These are intended to both keep a log of the patients as well as communicate between staff shift changes any important information. These tend not to be used, but instead, during shifts, just a verbal discussion passes the information around. We believe that ultimately, the personal nature of the approach we are developing for the workers can open the door to include some administrative elements as well as supporting adoption of patient-centred technology that coordinates with the CareHub approach.

We are optimistic that our approach is effective for designing ICT solutions for long-term care environments such as mental care and nursing homes. In these situations, patients are essentially residents and the staff have routine activities managing the residents' quality of life more than dealing with acute care or threats to life. The design principles we are establishing in this environment lead to ICT solutions that integrate mobile technologies with large, pervasive displays based on personal information management oriented towards a worker's routine. In our context the solutions do not look at WIMP based interfaces as these are not suited very well to the CAIS environment. We suggest that this is a more natural fit for these technologies in general. Thus, our results suggest a pathway to shift ICT globally for long-term care away from WIMP based, stationary ICT systems.

## 5 Acknowledgements

We thank our funding agencies: FAPESP, Microsoft, Boeing, MITACS, NCE GRAND, CAPES/DFAIT and for the generous contributions from the CAIS Clemente Ferreira. We thank our collaborators, Sara Diamond, Derek Reilly and the teams at OCADU and Dalhousie, for the discussions and ongoing activities on administrator, patient and worker-centred design.

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## Supporting Human Collaborative Works by Monitoring Everyday Conversations

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**Abstract.** In this paper, an application model for supporting human collaborative works is proposed. This model can be regarded as an “ambient intelligence” system [1,2] with following characteristics. (1) This model itself has own function as a voice communication system, (2) that is designed based on analysis of human works in a real field [2] and a virtual field. (3) It interacts with human workers in both of implicit and explicit manners, (4) to help record keeping and workers’ collaborations. (5) The data accumulated in the system can be used in further **human work** analysis to improve the **interaction design** among the system and the human workers.

**Keywords:** voice communication, cooperative work, ambient intelligence, care

### 1 Introduction

Japan’s increasingly aging population is an important issue, one urgent aspect of which is caring for elderly persons with disabilities. Care services are characterized by what we call “action-oriented intellectual services.” Care staff makes many decisions regarding medical care which require specialized knowledge. They also assist elderly persons with disabilities in many activities of daily living. [3] pointed out that medical/care staff spend much time on indirect care, including record keeping and information sharing. But conventional IT systems are fundamentally designed for desk work, however, and do not support the needs for hands-free and eyes-free operations suited to action-oriented intellectual services.

[4,5] proposed a “voice tweet system” to overcome these problems. In that system, “voice tweets” spoken by a staff member are tagged with the staff member’s location and motion, spoken keywords, and associations with background knowledge, and based on these tags, the tweets are automatically delivered to an appropriate staff.

[6] analyzed work and speech interaction among staffs by a real field study at an elderly care facility in Japan, to design a part of the “voice tweet system”. They reported that some part of care records can be obtained semi-automatically, from the everyday conversation of the staffs and residents. But in this real field study, small insights were obtained on remote voice communication among staffs collaborate each other.

## 2 Experiment in a virtual field

We performed 5 trials with 5 subjects for each trial in the virtual field, and got a set of voice tweet data, and records of each subject's behaviors with time stamps. Figure 2 shows the result of analysis of the records on the collaborative works among the subjects in the trial\_4. X-axis is the elapsed time, and Y-axis is the index of the progress of the scenario for each subject (A-E) in upward direction. (a) Dotted vertical lines denote the time of requests for help are sent. (b) Bold solid lines in the diagram denote "collaborative works" performed by corresponding two subjects. (c) Short dotted lines between two subjects' plots denote one subject's interruption, attempt of help for a "collaborative work", and back and resume. (d) Long dotted lines between

two subjects' plots denote partially done (and not completed) “collaborative works”. As shown in the Figure 2, in the trail\_4, 5 requests are sent, 3 “collaborative works” are successfully completed, 2 are partially done. From this diagram, we can also get elapsed time information for (e) waiting someone’s help, (f) interrupting own scenario to help other subjects, and (g) performing “collaborative works”.

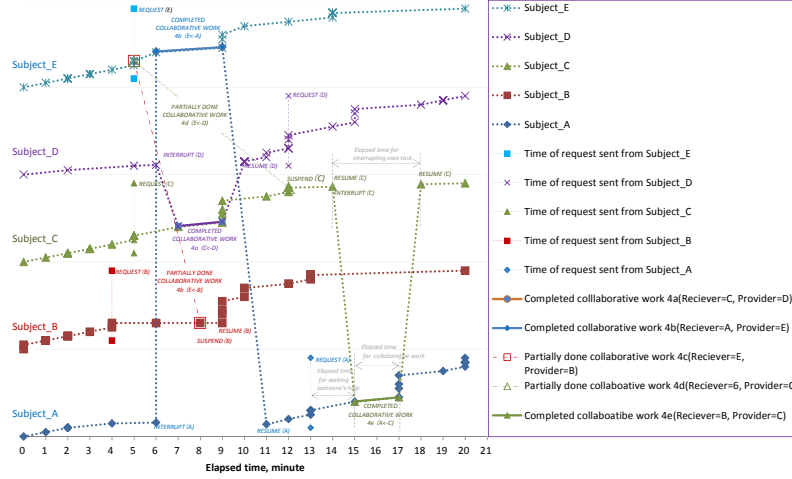


Fig. 2. Collaboration diagram for trial\_4

### 3 Evaluation criteria for collaborative works

Given the counts of requested, attempted and completed “collaborative works”, we defined the success rates as follows. We defined the final success rate (1) as the harmonic mean of the receivers’ success rate (2) and the providers’ success rate (3).

$$P_{collaborative\_works} = \frac{2 * P_{receiver} * P_{provider}}{(P_{receiver} + P_{provider})} \quad (1)$$

$$P_{receiver} = \frac{C(completed\_collaborative\_works)}{C(requested\_collaborative\_works)} \quad (2)$$

$$P_{provider} = \frac{C(completed\_collaborative\_works)}{C(attempted\_collaborative\_works)} \quad (3)$$

Given the elapsed time for waiting someone’s help, interrupting own scenario, and performing “collaborative works” with others, we defined the time efficiencies as follows. Same as the final success rate (1) described above, we defined the final time efficiency (4) as the harmonic mean of the receivers’ time efficiency (5) and the providers’ time efficiency (6).

$$E_{collaborative\_works} = \frac{2 * E_{receiver} * E_{provider}}{(E_{receiver} + E_{provider})} \quad (4)$$



$$E_{receiver} = \frac{ElapsedTime_{collaborative\_works}}{ElapsedTime_{wait} + ElapsedTime_{collaborative\_works}} \quad (5)$$

$$E_{provider} = \frac{ElapsedTime_{collaborative\_works}}{ElapsedTime_{interrupted}} \quad (6)$$

#### 4 Estimated results of collaborative works

Table 1 shows the estimated results for each trial of the experiment described in section 2. In the first trial\_1, some criteria are not available, because no “collaborative works” were attempted nor completed. Over whole performance was estimated as success rate **0.581** and time efficiency **0.564**. The trial\_2 was estimated as the most succeed trail, and the trial\_3 was estimated as the most time efficient trial.

**Table 1.** Estimated evaluation results for each trial

Table 1. Estimated success rates and time efficiencies of receiver(R), provider(P), and collaborative works(CW) for each trial.						
Trial ID	R	P	CW	R	P	CW
	Success rate			Time efficiency		
trial_1	0.000	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)
trial_2	<b>0.600</b>	<b>1.000</b>	<b>0.750</b>	0.600	0.500	0.385
trial_3	0.400	<b>1.000</b>	0.571	<b>0.667</b>	<b>1.000</b>	<b>0.800</b>
trial_4	<b>0.600</b>	0.600	0.600	0.583	0.438	0.500
trial_5	0.200	1.000	0.333	<b>0.667</b>	0.500	0.571
trial_1-5	0.360	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)
trial_2-5	0.450	0.818	<b>0.581</b>	0.613	0.528	<b>0.564</b>

Table 2 shows the estimated results for each subject. All values are available for all subjects by the nature of the definition, while some collaborative works were not attempted nor completed. Over whole performance was estimated as success rate **0.581** and time efficiency **0.507**. The subject\_B and subject\_C are the most succeed contributors and the subject\_E is the most time efficient contributor over the all trials in this virtual field study. But please note that no one can achieve collaborative works alone, and the chances to take part in some “collaborative works” are highly situation dependent, so all evaluations should be done for whole teams or whole trials.

**Table 2.** Estimated evaluation results for each subject

Table 2. Estimated success rates and time efficiencies of receiver(R), provider(P), and collaborative works(CW) for each subject.						
Subject ID	R	P	CW	R	P	CW
	Success rate			Time efficiency		
subject_A	0.250	<b>1.000</b>	0.400	0.417	<b>0.600</b>	0.492
subject_B	<b>0.750</b>	0.750	<b>0.750</b>	0.250	0.455	0.323
subject_C	<b>0.750</b>	0.750	<b>0.750</b>	<b>0.714</b>	0.417	0.526
subject_D	0.250	<b>1.000</b>	0.400	0.667	0.500	0.571
subject_E	0.250	<b>1.000</b>	0.400	<b>0.714</b>	0.500	<b>0.588</b>
all subjects	0.450	0.818	<b>0.581</b>	0.545	0.474	<b>0.507</b>

While these criteria can be estimated only after the events, accumulation of a set of pairs of estimated criteria and log data can be the source of knowledge for future control of the situations.

## 5 Proposal of an application model

Based on the results of our analysis described in the previous sections, we have designed an application model of voice communication system with a “collaborative works” supporting function, shown in Figure 3.

The system behaves as followings. (i) The system monitors and analyses everyday conversations among the members in both of face-to-face and remote communication. (ii) The system generates assumptions on occupational records or current status of human collaborations in the field. (iii) The system asks to the responsible person to uncertain assumptions if necessary. (iv) The person may confirm, deny, correct or just ignore the query from the system. (v) The system updates the assumptions, if necessary and possible. (vi) The system maintains the database of occupational records or current status of human collaborations. (vii) The database is referred by human to get necessary occupational records or to analyze “collaborative works” performed in the work field by human operation. As an advanced function, (viii) the system provide advisory information to support or coordinate ongoing human workers’ “collaborative works” on the fly.

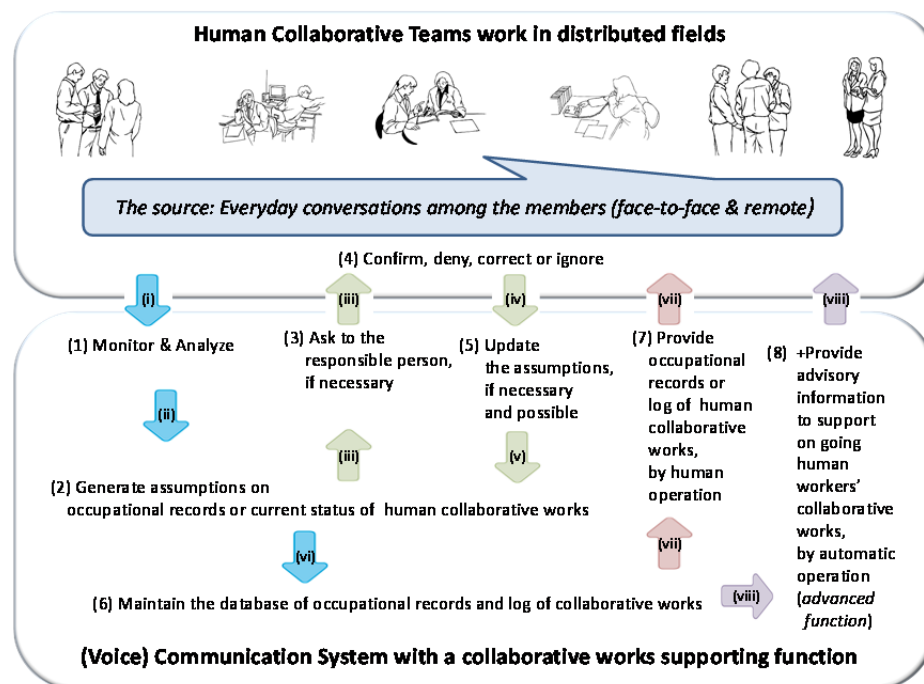


Fig. 3. An application model for supporting human collaborative works

This model can be regarded as an “ambient intelligence” system [1,2] with following characteristics. (1) This model itself has own function as a voice communication system, (2) that is designed based on analysis of human works in a real field [2] and a

virtual field. (3) It interacts with human workers in both of implicit and explicit manners, (4) to help record keeping and workers' collaborative works. (5) The data accumulated in the system can be used in further **human work** analysis to improve the **interaction design** among the system and the human workers.

## 6 Conclusions and future works

An application model to support human collaborative works is proposed. This model can be regarded as an “ambient intelligence” [3,7] system that interacts with the human workers by both of explicit and implicit manner. This model is designed based on a real field study at an elderly care facility in Japan [2], and a virtual field experiment on the “collaborative works” utilizing the “voice tweet system” [9,10] that is a voice communication system for human workers of what we call “action oriented intellectual services” works in distributed work fields.

We are now preparing same experiment of the “collaborative works” at the real study field (the elderly care facility in Japan). Comparison of the results from the virtual field and the real field is one of the future works.

## Acknowledgements

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# Mind the Gap - Towards a Framework for Analysing the Deployment of IT Systems from a Sociotechnical Perspective

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**Abstract.** Deployment of IT is little discussed in research literature, despite the fact that a successful deployment encompasses complexities and difficulties well worth investigating. The deployment phase of IT systems can be a make-or-break moment for usefulness of the system due to sociotechnical factors. We argue that there is a gap between the technological artefact produced and the social requirements that govern how well the system will fit in the organisation. Hence, in this work in progress paper we present a framework (the SOT framework) for analysing deployment of IT from a sociotechnical perspective.

**Keywords:** Sociotechnical systems, the SOT framework, Deployment, Implementation, Organisational change.

## 1 Introduction

Even though there is no lack of general studies in management and organisational science on the subject of organisational change (e.g. Wischnevsky and Damanpour [14] and Tsoukas and Chia [13]), and no lack of studies specifically grounded in an IT perspective on organisational change (e.g. Keen [6] and Markus [9]), we have found very few case studies on the planning and execution of IT systems deployment. Even though such research studies have proven hard to find, we argue that no matter the perceived usability of an IT system, sociotechnical factors make the deployment phase a make-or-break moment for many systems. We believe that there often is a discrepancy, a gap, between the technological artefact produced when an organisation decides to develop or procure a new IT system and the social requirements that govern how well this new system will fit in the organisation. In this context the social requirements denote the expectations, beliefs and wishes that the users may have in the widest sense. Examples of social requirements are people's values and attitudes, the organisational culture, social norms and ethical frameworks as well as preferences

and expectations regarding usability and technical issues etc. This gap can turn the deployment phase of IT projects into something similar to forcing a square peg through a round hole.

Critical Success Factors are quite common phenomena within the research literature on how to successfully deploy information systems in organisations (see e.g. Cain and Mittman [3] and Leonard [7] for examples from health care). These factors are predominantly addressing social aspects of the deployment process. This is not surprising since the general view on systems development and deployment is that it is clearly divided into these two parts, where the former is concerned with creating a new technical artefact that satisfies a set of requirements and the latter is concerned with moving this artefact from its dry-dock of development into the organisation to test the system's seaworthiness. But what is being tested here is not only the technological seaworthiness of the artefact; it is also the social and organisational seaworthiness of the artefact. From our perspective, sociotechnical change and the sociotechnical gap can be divided into three different aspects: the social, the technological, and the organisational. The technological aspect we believe warrants no further explanation, but as the social and the organisational aspects both stem from the social requirements concept presented earlier in this paper they are in need of some distinguishing traits: The social aspect is concerned with elements such as e.g. social norms, ethics, traditions, and workplace culture; whereas the organisational aspect concerns e.g. formal hierarchies, business processes, and policies. Using these three aspects and inspiration from Keen's [6] concept of social inertia we would like to propose a framework consisting of social, technological and organisational inertia. In this context, inertia reflects the relative and varying ability of either of these aspects to adjust with respect to the other two. We believe that the sociotechnical gap presented here is a result of the collective inability of these aspects to reach a middle ground within an organisation. Regardless of what aspect is being inflexible, the result will be a corresponding increase in the sociotechnical gap and the suboptimal performance of the sociotechnical system.

This workshop paper will present work in progress regarding a framework (the SOT framework) that can be used to analyse the gap between social requirements, organisational matters and technology. The aim of this workshop paper is to generate a discussion regarding deployments in general, and the work in progress framework in particular.

## **2 Background**

Abdelnour-Nocera et al. [1] illustrate how deploying a system in different social contexts renders different experiences of the system's level of usability, and also how the interpretation of usefulness differs between users and developers. This is an example of the sociotechnical gap in practice, and through the authors' use of technological frames a case is presented that further underlines the need for the fundamental understanding of social aspects stressed by Ackerman [2]. In their investigation, Abdelnour-Nocera et al. embarks from the assumption that "usefulness is not inherent in

a piece of software but is socially constructed in situ,” which is directly compatible with the view on technical and social interdependence present within the concept of sociotechnical systems presented by Cooper and Foster [4]. Similarly, in their study of Alpha Corp., Orlikowski and Gash [10] exemplify how technological frames can be used within an organisation. The difference in assumptions, expectations, and knowledge identified within different parts of the organisation is a telling illustration of the complexities involved and how easy it is to inadvertently widen the sociotechnical gap.

A perspective on development of information systems in close relation to the deployment phase is the learning process perspective used by Hertzum et al. [5]. Through the use of pilot implementations the developers receive improved feedback that informs further development more efficiently than the use of prototypes or mock-ups, which are separated from a real work situation and thus harder for users to relate to. However, the use of pilot implementations is also a method for preparing the organisation for the coming change, and for the users (or at least a subset) to experience first hand how their daily work will change. As described by Ackerman [2], the increased interaction between users and developers will improve both the developers’ understanding of the users’ work to be supported by the information system, as well as the users’ understanding of what requirements the technology can satisfy. Though the use of pilot implementations will result in a costlier development process and is not always feasible for practical reasons (e.g. in some applications in health care, process control, and other situations where system reliability is critical), we believe that it is an underestimated approach in regards to both deployment and development benefits.

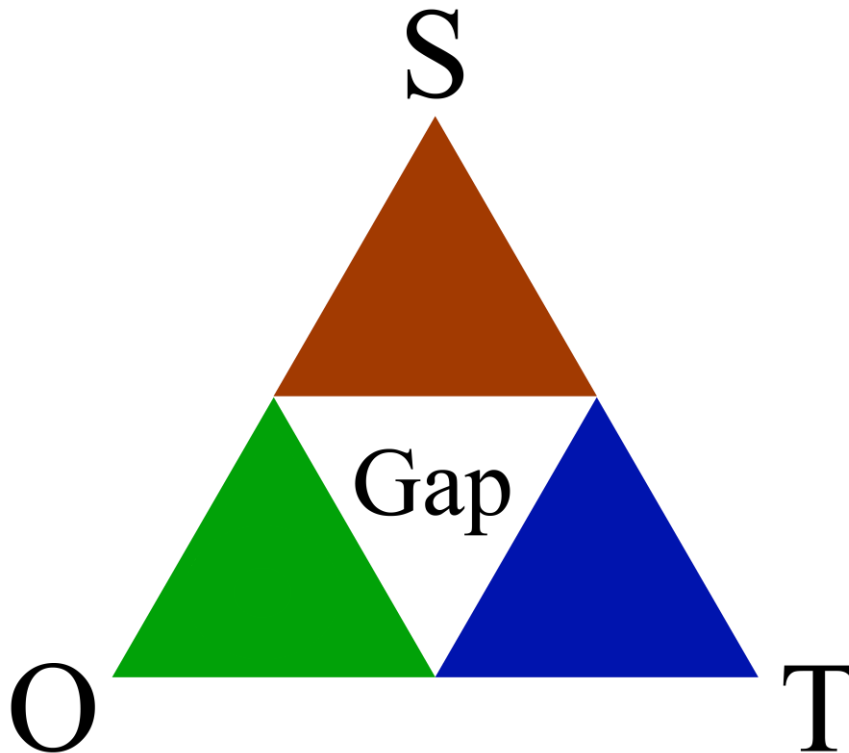
Using Suchman’s [12] metaphor of European and Trukese navigators, Orlikowski and Hofman [11] propose an improvisational model for change management. The point of the metaphor in relation to change management is that we think we need to plan rigorously and then relate our every action to that plan, like European navigators, but in reality we set out with a loosely defined objective and respond to changing conditions in an ad hoc fashion, like the Trukese. The authors argue that perhaps traditional technological change models, based on the works of Lewin [8], are insufficient to handle the organisational and environmental conditions of the present. Instead, they propose a change management model that embraces the Trukese way of handling uncertainty, regarding “change management more as an ongoing improvisation than a staged event”[11]. We agree with their view on traditional technological change models as outdated, and believe that one of the keys to successful change management is to adapt to the fact that there will always be unknowns, no matter how much you plan, and to always plan for uncertainty.

The improvisational model described by Orlikowski and Hofman [11] is mainly suitable for innovations, where the technological development is still rapidly progressing, open to new feedback, and adapting to user requests. However, when regarding well-established technology, or “black box” technology (designed to work without the need for adaptations), the authors concede that this approach might not be suitable. Although we agree with the authors, we believe that the level of flexibility championed by the improvisational model needs to be adopted for this kind of technological

change as well. As flexibility and managing uncertainty is an integral part of technological change also in rigid, bureaucratic organisations, models must be found that can handle this paradox.

### 3 The SOT framework

A goal of the SOT framework is to balance on the fine edge where it is simple enough to be communicated and understood easily by researchers and practitioners while also being powerful enough to be useful. One step towards this is the visualization of the framework illustrated by figure 1 below.



**Figure 1. The SOT framework**

The figure illustrates how the sociotechnical gap is located in the middle of the social (S), organisational (O) and technical (T) aspects we associate with organisational change. In this context we propose the concept of inertia to reflect the relative and varying ability of either of these aspects to adjust with respect to the other two. We believe that the sociotechnical gap is a result of the collective inability of these as-

pects to reach a middle ground within an organisation. Regardless of what aspect is being inflexible, the result will be a corresponding increase in the sociotechnical gap and the suboptimal performance of the sociotechnical system. After further expanding on this framework we believe that it can be used within change management projects to improve the process of planning and executing organisational change, and by researchers to study and analyse organisational change processes.

## 4 Conclusions

The SOT framework has the potential to become a useful tool to analyse deployments of IT systems. However, the framework needs further development in several regards. First and foremost we need to better relate the framework to sociotechnical theory and also to related theories such as diffusion of innovation and the technology acceptance model.

## 5 Acknowledgements

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# Challenges in Applying a Participatory Approach in a Nation-wide Project

## -The Case of ‘Usability of Swedish eHealth Systems 2013’

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**Abstract.** Many healthcare organizations are currently committed to organizational change and quality improvement projects. Unfortunately, little effort is put into health information system development according to usability requirements and methodology, leading to bottlenecks in the eHealth systems when implemented into daily practice. This paper presents the experiences of applying a participatory approach in a nation-wide project. The aim of this national initiative was to build usability of eHealth systems into the Swedish national eHealth strategy and its action plan to ensure impact on practice. Action researchers within the health informatics domain collaborated with representatives of different care professions to propose high-priority changes necessary to improve the usability of health information systems. Reflections from the first phase of this initiative are further explored in terms of methodological challenges and recommendations, whereof one recommendation is to increase the use of HI-U specialists – health informaticians with usability and human work interaction design expertise within national and local eHealth development.

**Keywords:** Participatory design; human-computer interaction; nation-wide deployment; eHealth strategy; future workshop; user representatives.

## 1 Introduction

Currently extensive resources are invested in eHealth development at local, regional and national levels of society. Many healthcare organizations are committed to local organizational change and quality improvement projects, where clinical personnel participate in identifying organizational bottlenecks and subsequently suggest and implement solutions. However, local initiatives seldom connect to national ICT strategies. And where there is a national eHealth strategy, the opposite occurs; the national

strategies seldom connect to the local needs. This presents challenges for local level managers and practitioners and national initiatives are requested.

Further, lack of usability in eHealth systems is identified a major obstacle for care professionals to provide good and secure health and social care [1,2]. National eHealth strategies are being developed [3], but today there is a lack of practical action plans to improve usability in current and future eHealth systems.

The Swedish ministry of health and social affairs acknowledged the need to address usability issues in eHealth from a national perspective [4] and initiated a study to assess the current state of affairs. This study, Usability of Swedish eHealth Systems 2013 (USeHS), is the basis of the findings presented in this paper. The aim of the paper is to analyze the participatory approach used during the first phase of the study. The methodological challenges are explored and some recommendations based on the study are also put forward.

## **2 Approach and Methodological Framework**

An important requirement for USeHS was that “results should be grounded in real practice and not only research”. A team of leading action researchers in eHealth was recruited to design the detailed method and to participate in the work. They all have extensive experience of participatory action research and usability work in healthcare, including evaluating usability [5], developing health information systems using user-centered and participatory methods [6,7], and focusing on supporting patient-centered care processes through eHealth systems [8,9]. The methodological framework of this work is based on three principles;

1. the importance of adopting a user-centered development process that supports active end-user involvement and focuses on usability issues [10]
2. the importance of supporting cross-organizational health and social care processes involving different care professions that have to collaborate to provide high quality care for the patient, and
3. the importance of providing both involved care providers and patients with an overview of the patient care process as well as appropriate and usable support for active collaboration between various care actors.

These principles are well-recognized in research, yet not reflected in national, nor local, policy documents, which may partially explain the lack of usability.

## **3 The USeHS case - method and results in short**

Previous experiences of the researchers from other eHealth development projects [6,7] are that it is crucial to involve real users when designing for daily care routines, but in this case the participatory approach needed to be adapted for eliciting requirements and prioritizing actions at a national level. It was important to address the major Swedish care profession organizations (e.g. unions) as a driving force and to involve their members (actual end-users) from the start. A steering group consisting of representatives from different care profession organizations worked together with the

researchers to determine focus and objectives, and recruited participants for the workshop series that was carried out. In short; during seven workshops action researchers within the health informatics domain collaborated with representatives of different care professions to propose high-priority changes necessary to improve the usability of health information systems. The participatory workshop series was designed to:

1. ground the national action plan in concrete experiences of end-users and
2. make this new participatory approach acceptable to the health and social care domain as a means to ensure that eHealth issues are continuously integrated in business development of the care organizations.

To cover a spectrum of patients' care processes and situations, professionals from social care, primary and hospital care, both private and public care providers were recruited from different municipalities and county councils in Sweden. The method is further described in [11].

The results were e.g. important actions to perform on local and regional levels, as well as suggestions of how to operationalize usability improvement work from a national perspective. Further, examples of eHealth systems and services with high usability for care professionals were gathered, as well as descriptions of problems users are experiencing today. Solutions were proposed and prioritized also by other national researchers with experience of usability issues and human work interaction design (HWID) in eHealth and by representatives from eHealth system vendors. The final report was recently handed over to the responsible ministry for further activities towards the Swedish eHealth action plan [4].

## 4 Challenges and lessons learnt

From the case presented above, some lessons learnt have been drawn. These are consistent with experiences from using a participatory, group-based approach to requirements gathering [12,13]:

**Skilled and experienced group leaders are essential.** Participants tend to focus on their personal experiences rather than integrating other views into their own thinking. The approach, therefore, requires experienced group facilitators in order to capture and visualize the essence of the discussion and the joint view of the real problems/barriers [12]. In addition, specific skills and abilities of the group leader are needed to guide the discussion forward in order to identify future needs. An essential task for the group leader is to compose the group.

**Composing the group to facilitate participation.** It is essential to capture the views and experiences of the actual users. At the same time it is important that these views and experiences are put into a broader context. Therefore, it is essential that the composition of the group is considered, both in terms of stakeholder roles and personalities because all necessary views should be heard within a workshop. The selected individuals should, ideally, be able to represent both their own experiences and the broader context. However, when selecting participants you often have to rely on the leaders of involved organizations to help in the selection. In this project, for practical

reasons, the care profession organizations made the selection and it is debatable whether this is the best approach. Rather, the group facilitators should be involved in the selection of participants. Ideally, the group leaders should also interview the individuals in the group before the workshop series starts in order to avoid unnecessary tension and uncertainty. In this project this was not possible due to time constraints, which resulted in some unplanned actions during the workshops.

**Techniques to ensure participation on equal terms.** In the workshops the impact of different participants needs to be balanced, e.g. in terms of time to speak and influence on the joint view of the group results. This is particularly important when the group consists of people who represent different professions, which traditionally have different power bases in the organization. One example is physicians vs. nurses. In the workshops, the technique used allowed the participants to first write down their personal ideas, then put them up on the common documentation board, then discuss and compare every idea in the group, and finally make a joint decision. Sometimes voting was used.

**Problem focus or solution focus?** A common way to start analysis is to begin with “current state” including problems and barriers and then move on to “future state” designing solutions [14] Starting with problems may cause people to get stuck in current state, particularly in organizations where the staff feel overwhelmed with problems and feel they have little power to change their situation. Our lesson is that if people are allowed to discuss their problems and challenges during an initial section of the workshops, it is easier to proceed to future solutions. Furthermore, this approach with a section dedicated to identifying problems helps the group facilitator to keep the group focused when discussing solutions.

**Double expertise by the group facilitators is required.** To enhance the group work and the acceptance of the group leaders by involved health and social care professionals, double expertise is required when working in this domain. In this case, the group facilitators had extensive experience of health and social care informatics and also knowledge of work process modeling, interaction design and other usability issues, here referred to as Health Informatics and Usability (HI-U) specialists [7] The HI-U specialists played an important role by mediating between different stakeholders and converting clinical and organizational needs into future system requirements (figure 1). The HI-U specialists also worked with the users and the steering group to validate the resulting requirements against the original user needs. More specifically, this means that the HI-U specialists iteratively explored the mutual impact on work environment and the proposed design solutions and vice versa.



**Fig. 1.** Health Informatics and Usability specialists as mediators between clinical and technical domains [7].

## 5 Future challenges

The goal of this project was to deliver usability perspectives to the national eHealth strategy and to enrich the subsequent action plan with users' experiences from practice. The designed method involving participants from care profession organizations, clinical and social care practice, vendors and researchers received high acceptance in workshop evaluations. This is never the less only a first step towards a paradigm shift in health and social care. The challenge is not only to start implementing the results of this project, on national, regional and local levels, but also to start involving the end-users in a more systematic and intertwined business and eHealth development, using methods from e.g. the domains of human-computer interaction (HCI) and participatory design.

Future challenges for research is to evolve and scale the participatory method in order to make the user contributions influential also in nation-wide projects. Important questions remains: Can participatory methods be used to create national action plans? What kinds of users are required and how to make the best benefit out of their contribution related to invested time? Other challenges to explore relate to which future effects this user-centered and participatory approach will have on national eHealth development.

eHealth development is a challenging and complex activity; best-practice methods from HCI, related to e.g. human work interaction design (HWID), are needed to support the business development within health and social care. Future work for HI-U specialists and researchers is e.g. to further examine which HCI methods, and to what extent HCI methods, can support the process of empowering users and making them more involved in the development of their eHealth system environment. This is equally important for national, regional and local eHealth development.

## Acknowledgment

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## Collegial Collaboration for Safety: Assessing Situation Awareness by Exploring Cognitive Strategies

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**Abstract.** Results from cognitive field studies using a method developed for knowledge elicitation in applied contexts are reviewed. A model for verbal probing procedures is presented. The model is used to assess situation awareness in dynamic decision making contexts – colleagues explore each other's cognitive strategies. The objective is to promote a discussion on whether collegial collaboration based on verbal probing procedures for knowledge elicitation of cognitive strategies is a good way to achieve resilience in socio-technical systems. The design of a study to be carried out in an intensive care unit is presented. The domain of interest, the tasks carried out, and the strategies employed by the nurses seem to be available for further analyses. It is suggested that analyses must only be carried out by the personnel themselves, in teams of experienced colleagues, as a way to achieve a safety culture that promotes reporting of incidents in intensive care.

**Keywords:** Verbal reports, cognitive ergonomics, decision making, knowledge elicitation, human factors, cognitive strategies, verbal probing procedures

### 1 Introduction

Research in cognitive ergonomics and human-machine interaction often aim for a detailed understanding of how users think and act in specific work contexts and situations. For the purpose of knowledge elicitation in work contexts where the users are highly experienced, there are several methodologies available. The purpose here is to describe the development of a new method, Collegial Verbalization (CV), and how it was used in different applied contexts. We then present a model for verbal probing procedures that can be used to assess situation awareness and cognitive strategies. The objective is to promote a discussion on whether collegial collaboration based on verbal probing procedures for knowledge elicitation of cognitive strategies is a good way to achieve resilience in socio-technical systems.



### **1.1 Development of a new method: A field-study of train drivers**

The CV-method was developed and first used in studies of train-drivers. We first tried with concurrent verbalizations, that is, we asked them to think-aloud while they were driving. We did not prompt them for explanations or descriptions of the driving task, just asking them to think-aloud what came into their mind while they were driving. We soon ran into problems, since the train-drivers quite soon went on driving without thinking aloud. Despite us hinting on this, they very often became silent. This was particularly evident when they were riding out on the route, between two stations. We learned from the interviews that the drivers were balancing different goals in these situations; they had to keep up with the time-table, and at the same time they tried to avoid exceeding the speed limit (Jansson, et.al., 2006). They tried to drive as gentle as possible, with reduced energy consumption and increased comfort. Unfortunately, we were not able to use the same drivers once again in this project, that is, to have them to verbalize retrospectively on their own driving. But since we recorded them driving with three different cameras in the cabin, we had the opportunity to show their driving to some of their colleagues in hindsight. We asked the colleagues to comment on the driving of the target driver, that is, we asked them to comment their driving in the same way we had asked the target drivers to do while driving. First, this seemed to be a good idea because we would get an independent observers opinion about each target drivers' actions. Later, we realized that the target drivers and the colleagues were very close in familiarity with the routes and the train cabs. We started to analyse how close they were in understanding, the strategies they used and the goals they aimed for. It was concluded that the collegial verbalization method served as a valuable complement to other information acquisition methods in three ways. First, it gave a lot more of information than the concurrent verbalization procedures did. Second, it specifically allowed the researchers to scrutinize the hypotheses on non-observable actions with the help of additional participants. Finally, we assumed it gave less subjective data than retrospective verbalizations would have done since the colleagues were not confronted with their own way of driving, they did not need to rationalize their behavior.

### **1.2 The next step: A case-study of operators on a high-speed ferry**

Inspired by the positive results of using colleagues as informants, we decided to further develop the method. After all, it was developed ad hoc as a response to the inability of the train-drivers to think aloud while driving. We now tried to formalize the method further, to allow for reuse as well as scientific examination of the method. The purpose of this study was to better understand what kind of information the method could provide. One of the objectives of this project was to analyse whether there were differences within the crew in terms of understanding the manoeuvring of the ship. This understanding was related to the dynamics of the ship, as well as the surrounding environment in terms of a pre-defined route. Given the opportunity to study a high-speed ferry crew running a vessel between the mainland of Sweden and the island of Gotland, we decided to video-tape the actions and communications of the bridge crew during an entire 4 hour journey. The studies of the high-speed ferry

officers showed that the method we had developed contributed with a new kind of verbal report data which was different from retrospective and concurrent verbalization data. With the ability to compare statements, we acquired inter-subjective data, which is a completely different kind of data source compared to the situation when there is only a single narrator available, which is the case for both retrospective and concurrent verbalization. We also found that there was an overall agreement between the colleagues and their descriptions. The study showed a high correlation on the main series of events. But each colleague also contributed with additional details. A more detailed comparison also revealed that some details stood in conflict between the protocols, indicating misconceptions of at least one of the narrators. Paradoxical as it may seem, however, it is only with the introduction of the CV method that it is possible to discriminate between different forms of understandings, something which can be critical in many domains. Erlandsson and Jansson (2007) concluded that the most controversial issue with the new method is the idea of having other subjects than the target operators performing the verbalizations. With this approach, the colleagues have not been part of the target actions, and are therefore left with some form of interpretation of what they see when they verbalize. It is important to bear in mind, however, that we are investigating operators who are highly familiar with the tasks we study, and that they all have long experiences from the same tasks and systems. The collegial verbalisation method means a shift away from analysing working memory structures to long-term memories. This also means different theoretical assumptions compared to other forms of verbalisation tasks.

### **1.3 A systematic comparison: A quasi-experimental study of train dispatchers in a train control centre**

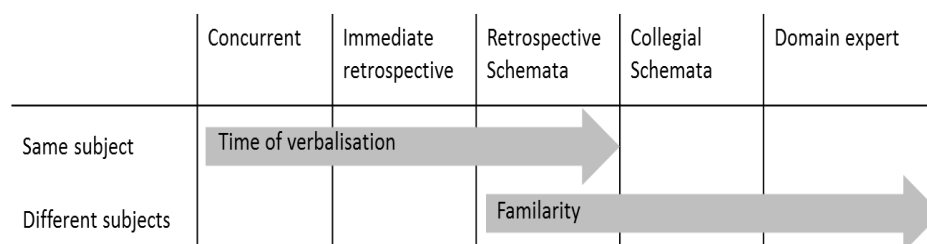
In the first two studies, the CV-method was used as a substitute for the concurrent verbalization procedure, since we were unable to use this procedure in the field studies. The collegial verbalization method comes to a prize though – the colleagues who make the verbalization have not been part of the activities, and as a consequence, cannot be assumed to have any information from the specific target situation in working memory. However, if we are interested in analysing domain knowledge structures that have been developed over a long period of time, and have been used on a regular basis as responses to the demands that the specific environmental constraints impose on the operators in these situations, it may be interesting to compare the cognitive strategies within a crew or team where all members are highly familiar with the same tasks. We had so far assumed that the collegial verbalization procedure results in less subjective data than one usually gets from using a retrospective verbalization procedure. Switching from target operator to colleague means also switching from information held in working memory to information recalled from long-term memory. Regarding the rationalization and privacy problem, the CV-method contributes with independent data from which the degree of rationalization can be controlled. Having multiple independent observers verbalizing on the same content means we need to focus more on how well the verbalizations of these narrators and the target operators are correlated. We decided to make a systematic comparison between CV and retro-

spective verbalization (RV). The CV-method had so far only been tested on operators of vehicles and vessels. Even though these domains are very different, they share some important characteristics. In both domains, the decisions made and the actions taken are based on direct perception and action, or recognition-based decisions, situations where dynamic properties are evident and apparently important. In order to investigate decisions more based on analytical problem-solving, we turned to the task of supervision and control of train traffic. In the final study, where it was possible to systematically study and compare the CV method with RV, we produced quantitative data showing that the relation between a train dispatcher who verbalized on his or her own video and a train dispatcher who verbalized on the colleague's video is quite close. Comparing the total amount of protocol data from each verbalization showed that both CV and RV resulted in protocols of rather equal size, suggesting that colleagues are able to produce as much data as the person who were part of the studied events (Erlandsson & Jansson, 2013a). This is without considering any qualitative differences. Both the target operator and the colleague are producing verbal protocols of the same intensity as a response to the actions taking place. The relation between shared and non-shared topics for each verbal protocol showed that the amount of shared topics between the retrospective and collegial protocols is quite high. However, the narrators did not necessarily interpret the actions in the same way. On the contrary, they sometimes have different explanations for these actions, indicating differences in understanding, either of what is going on in the video, or of whether the actions exhibited by the target operator are relevant actions and behaviour in this situation or not. This information is may be as important as any information showing the similarity between colleagues and target operators. It casts light over the fact that the method of collegial verbalisation may have its most interesting area of application in the domain of human factors, looking for different understandings of situations.

## **2 A model for verbal probing procedures in applied contexts**

The use of the collegial verbalization method shows that, if colleagues are close enough in familiarity with a specific task and system, they can verbalize strategies and other non-observable behaviours to the extent that it is possible, not only to use these report data for the purpose of general discovery of psychological processes, but also for the purpose of verification of the result of the those processes. This is perhaps the main contribution of the collegial verbalization method. This fact makes it necessary to discuss the degree of familiarity and expertise when specifying the underlying theoretical model of the verbal report generation. Here we propose that the report generation model suggested by Ericsson and Simon (1980; 1984) is augmented to cover different degrees of expertise and familiarity with the task under investigation. Thus, we propose a division in terms of concurrent probing, immediate retrospective probing, long-term memory (schemata) retrospective probing, long-term memory (schemata) collegial probing, and finally domain expert probing (Erlandsson & Jansson, 2013b). A model based on this division will make it possible to have explicit predictions and hypotheses regarding verbal reporting, including degree of familiarity

with the task. Figure 1 below shows a model for predictions and hypotheses. The combination of having a target operator that can be probed concurrently (working memory) and in retrospect (working memory and long-term memory), and a colleague that can be probed based only on his long-term memory will make it possible to combine different sorts of investigations.



**Fig. 1** Verbal probing procedures in relation to time and familiarity

### 3 Collegial collaboration for safety

Practitioners and their colleagues develop expertise in close relation to their work tasks. This effect not only what they do in specific situations and contexts, but also how they do it, i.e. their cognitive strategies. Some of these strategies are non-observable and knowledge elicitation in the form of collegial verbalizations has the potential of conveying information between colleagues on how to approach specific situations. By having close colleagues sharing each other's cognitive strategies, we believe there is a possibility that the team start develop proactive thinking in order to avoid non-safe interactions with technical equipment and suboptimal working procedures due to organizational demands. In a new project we plan to develop the method of collegial verbalization into collegial collaboration. The purpose is to evaluate whether this knowledge elicitation procedure can be used as a basis for exploring how colleagues can learn from each other. The studies will take place at an intensive care unit (ICU) at Uppsala university hospital. The ICU environment and organization will be thoroughly examined and a standard criterion for the ICU care bedside, with regard to the 5 care tasks and 6 safety threats described below will be established by interviewing the ICU management. We will use this criterion as a benchmark against which we will analyse our results. Fifteen nurses and 15 assistant nurses will be consecutively included in filming and verbalization. Five typical ICU situations where nurses perform patient care tasks will be studied: Nursing the ICU patient; Nursing interventions; Taking patient's vitals; Medication administration; and Preparing patient for/returning from intra-hospital transportations. These tasks are chosen because they are the most common situations in the ICU and the same safety threats occur repeatedly in these situations.

There is little likelihood that we would capture an adverse event on film. Therefore we will analyse the care tasks in relation to risks for 6 common safety threats. The safety threats are chosen based on a review of incidents reported at the ICU 2008-2012, ICU safety literature (Garrouste-Orgeas et al., 2010) and indicators from the Swedish ICU register (SIR): Tube dysfunction, errors administering medications, accidental removal of lines/drains/tubes, failure to correctly handle ventilators, suction devices, and monitors, and non-compliance to hygiene-, and ventilator associated pneumonia (VAP) guidelines. The material will be analysed by the research team to understand the safety threats (the staff misinterpreting and misjudging situations that have the potential to develop into mistakes and errors on different levels) and to identify possible solutions in terms of monitoring and evaluating safety and minimize / eliminate risks. The peer review verbalization method means that both the staff filmed, and their colleagues, will be used as informants in order to validate and create independent assessments of the actions and behaviours that can be identified through the films. We will film each of the 5 situations 3 times, with different nurses/assistant nurses, a total of 15 film sequences with 15 nurses and 15 assistant nurses. Each film sequence will be 15-40 minutes long. Preliminary analyses show that the domain of interest, the tasks carried out, and the strategies employed by the nurses seem to be available for further analyses. It is suggested that analyses must only be carried out by the personnel themselves, in teams of experienced colleagues, as a way to achieve a safety culture that promotes reporting of incidents in intensive care.

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# Identifying user experience goals for interactive climate management business systems

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**Abstract.** This paper presents findings from interpretative phenomenological interviews about the user experience of interactive climate management with six growers and crop consultants. The focus of user experience research has been on quantitative studies of consumers' initial usage experiences, for example of mobile phones or e-commerce websites. In contrast, this empirical paper provides an example of how to capture user experience in work contexts and with a qualitative methodology. We present a model of the essence of the emotional user experience of interactive climate management. Then we suggest interpretations of these experiences in the forms of nomological networks of emotions by expanding the model for each of three main factors. In conclusion, the findings for two main stakeholder groups are reported in a user experience target table, which can be the basis for future research on user experience of interactive climate management in this and other domains. The overall aim with the paper is to take the concept of user experience into the IS community and to describe and understand what are individual workers' positive emotional use experiences when interacting with workplace systems.

**Keywords:** Climate management, interpretative phenomenological analysis, usability, user experience.

## 1 INTRODUCTION

The concept of user experience describes the individuals' subjective experience of using interactive systems. User experience has been studied in the research area of Human-computer Interaction as the positive emotions related to the voluntary use of computers in non-work contexts [1]. The focus has been on consumers' initial usage experiences of mobile phones [2] and e-commerce websites [3]. Frequently the method used to capture user experience has been quantitative in the form of a survey or a scale [4]. In contrast to the many quantitative papers about consumer product user experience, this empirical paper provides an example of how to capture user experience in work contexts, and with a qualitative methodology.

User experience is defined as a "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" [5, p. 9], which is influenced by user, system and context. To me, this definition appears to suggest that there is there a single measure „u“ of usability, that is, there is a single, unified concept of

usability/user experience that can capture the relation between the human and the computer across the different social, cultural, technical and organizational contexts of one or more information systems. However, we believe that this is a question that cannot be answered alone on theoretical grounds, but need to be answered also by empirical studies of user experience in different contexts.

In this paper we focus on what user experience is in a particular organisational work context - that of growers doing climate management in green houses using climate control systems. One reason why this is a good choice for studying user experience in work contexts is that there is much exact knowledge about how to control the climate in green houses using climate control computers. However, greenhouses are mostly open systems, plants may exhibit a kind of cognition [6], and green house production is important in many countries in the world [7]. Hence, what is described as crop consultants and growers' experience of doing climate management with interactive systems may vary, depending of which of the professional perspectives or parts of the world, which the story is told from. The question that we raise in this paper is: What is a positive user experience of interactive climate management systems? Related to the question about the nature of the user experience of interactive climate management, we ask: Is there a single unifying meaning of the user experience of interactive climate management? and What diversity is there in terms of different organizational stakeholders' user experience of interactive climate management?

## 2 METHOD

To answer the research question about what is a positive user experience of interactive climate management systems, we used an interpretative phenomenological analysis approach (IPA) [13]. With this idiographic mode of inquiry, the aim is to explore in detail how individuals perceive the particular situation they are facing. Interviews (11 in total) were conducted with greenhouse growers, consultants, researchers, software vendors and greenhouse assemblers, all involved in climate management. This sample was carefully chosen to offer multiple perspectives on a shared experience for them, climate management in green houses. Thus climate management phenomena would be experiences of some personal significance to all of the interviewees.

Regarding data collection, the interviews were approached from a position of flexible and open-ended inquiry, and the interviewer (the first author) attempted to adopt a stance that was curious and facilitative (rather than, say, challenging and interrogative). IPA usually requires personally-salient accounts of some richness and depth, and so the research had to capture the interviewees' accounts in a way that permitted the researchers to work with a detailed verbatim transcript after the interview. The interviews were semi-structured in order to enter as far as possible into the world of the participant. Follow-up questions were posed, in order to validate the answers that the participants gave. The data were transcribed by a third-party, a native speaker of Danish, who was instructed to do a meaning transcription (leaving out hmms, oehmms, repeated words, etc). The transcribed interviews consisted of more than 300 pages.

Regarding data analysis, after transcribing the data, the second author worked closely and intensively with the text, annotating it closely ('coding') for insights into the participants' experience and perspective on their world. The analysis of the data was conducted as IPA, supported by the use of Atlas.ti, a qualitative data analysis and research software. The analysis was at every step shared and discussed with the first author. By applying a collective IPA, the researchers attempted to grasp how the participants perceived and made sense of their own world, but at the same time the researchers were also trying to make sense of the participants trying to make sense of their world. Each interview-transcript was read several times, before actual coding. Each was treated as a single case, as we are focusing on the individual experience of each participant. As the analysis developed, the researchers catalogued the emerging codes, and subsequently began to look for themes in the codes. Coding themes were chosen carefully, as the aim was to make sense of what the participants were saying, but at the same time constantly checking one's own sense-making, against what the person actually said. Themes were recurring patterns of meaning (ideas, thoughts, feelings) throughout the text. We aimed at finding themes that both identified aspects of climate management that mattered to the interviewees, and also carried something of the meaning of that climate management. Themes were eventually grouped under much broader superordinate themes, see figure 1. The final set of themes were then summarised for each individual participants and as a group. The aim was to capture the essence of interactive climate management, both for each group of participants, and across all participants. Thus the final part of the analysis was the narrative account of the meanings inherent in all the participants' experience, illustrating the findings. In this paper, we present only parts of our data, namely findings from interviews three growers and three consultants.

Regarding data reflection, we tried to balance the descriptive phenomenology with some model-based insightful interpretation, in a way that anchored – through quotations - these interpretations in the participants' accounts. We held the idiographic focus and considered each participant closely in order not to lose variations. We kept our focus on meaning, and only considered causal relations on the highest level of abstractions. Of course, we wanted to achieve transparency by giving contextual detail about our sample (see table 1), and a clear account of our process. We illustrated key points by verbatim quotes to allow readers to estimate the plausibility and transferability of our study. In later research we will cross validate with other studies of interactive climate management.

### **3 ANALYSIS AND DISCUSSION**

The interview participants that we report findings for in this paper were three consultants and three growers, see table 1. One of the growers was a novice to climate computers, but had plenty of experience with climate control. The other two growers were very experienced both in terms of climate control and in the use of climate control



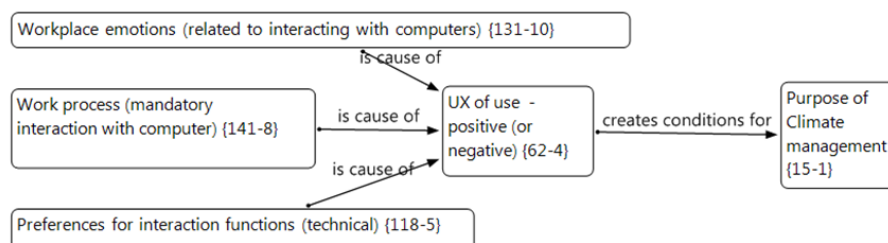
computers. The consultants were a bit different in terms of their professional perspective, one had focus on plants and their growth, and the other two had focus on the economy and production.

**Table 1.** Interview participants

Job position	Age	Gender	Years of education	Years of IT experience	Years of climate management experience
Consultant	54	M	17	33	30
Consultant	58	M	17	26	29
Consultant	54	F	17	30	20
Grower	48	M	15	24	24
Grower	53	M	17	34	31
Grower	49	M	16	13	25

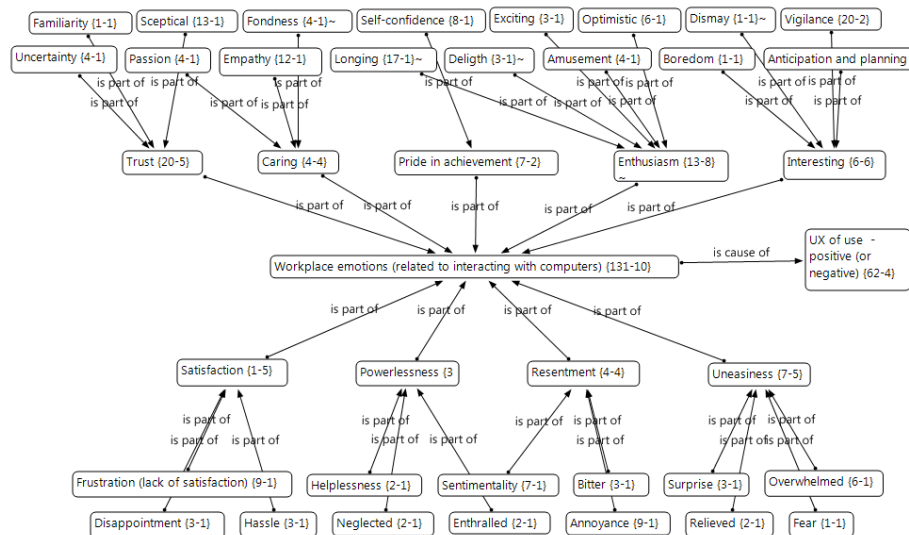
### 3.1 The essence of the interactive climate management experience

If we take an interpretative approach to the essence of the interactive climate management experience, and build on our literature, we see the user experience being influenced by workplace emotions, work processes, and the workers' personal preferences for interaction styles and functions, see figure 1. In this and the following figures, the first number after the text in the box refers to the number of associated quotations from the interviews, and the second number refer to the number of links from the textbox (the "code") to other boxes. In figure 1 we see that user experience itself is described in the interviews (the first number in the user experience textbox show that we were able to identify 62 statements in the interviews where participants speaks as to user experience directly, and the second number, 4, tells us that that the descriptions of user experience could linked to three antecedents (the boxes to the left) and one consequence (the box on the right). This paper is not about the relation between user experience and the business purpose of doing climate management (this could include many topics, like how an improved user experience may lower the total cost of ownership, and more). In the following we will explain the interpretation of the user experience given by Figure 1. We will begin with the feelings that generally can be expressed in a nursery in the user experience of climate control, according to our interviews, see Figure 2.

**Fig. 1.** Model of user experience (UX) of interactive climate management

In Figure 2 in the third row from the top it can be seen that positive emotions using interactive climate control systems include that they are interesting, you can as a grower or consultant be enthusiastic about using them, be proud of what you can do with them, caring for the plants through climate control and have trust in the systems. To experience trust is to trust the sensors (sensors) that are part of the climate control system. Trust is associated with the technology is known, for example, windows interface, or Apple's iPad. Lack of confidence is associated with uncertainties about the quality of data from sensors, and more broadly on uncertainty about the relationship between the models and assumptions inherent in the interactive climate management system and so the grower's or officer's own experience. Caring for plants is to show respect for the grower's green fingers, including the climate control system is really useful for the grower in everyday life, and improves the relationship and thus the quality of the plants. Caring is associated with a requirement passion of those who use climate computer that they really would be watching plants grow. For consultants are caring also associated with empathy for growers situation, and especially their great focus and ability to see the plants out of the greenhouses. Care can also be associated with the growers and consultants simply like to use climate computers. Pride in what you as a consultant or an experienced grower can achieve with the interactive climate management system, even when it is a little difficult and new to use. It is something that it is the last touches like a seasoned growers can berth. It is also proud to be able to use the climate control system in its business that sells something. Enthusiasm, goodwill towards the interactive climate management system, is a clear feeling. It is consistent with the consul States' pleasure and joy in what they themselves and others, such as younger growers who want to use climate computers can see with the system. It expressed a certain technology longing of experienced consultants as well as by growers. Interest is attached to it that you can follow closely the progress of the plants and production, and also the ability to plan and predict what happens.

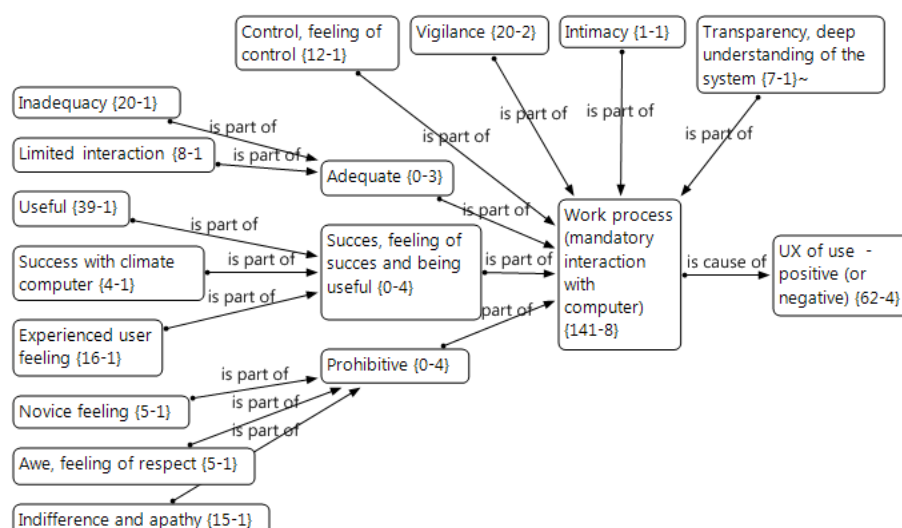
**Fig. 2.** The workplace emotions when interacting with climate management systems.



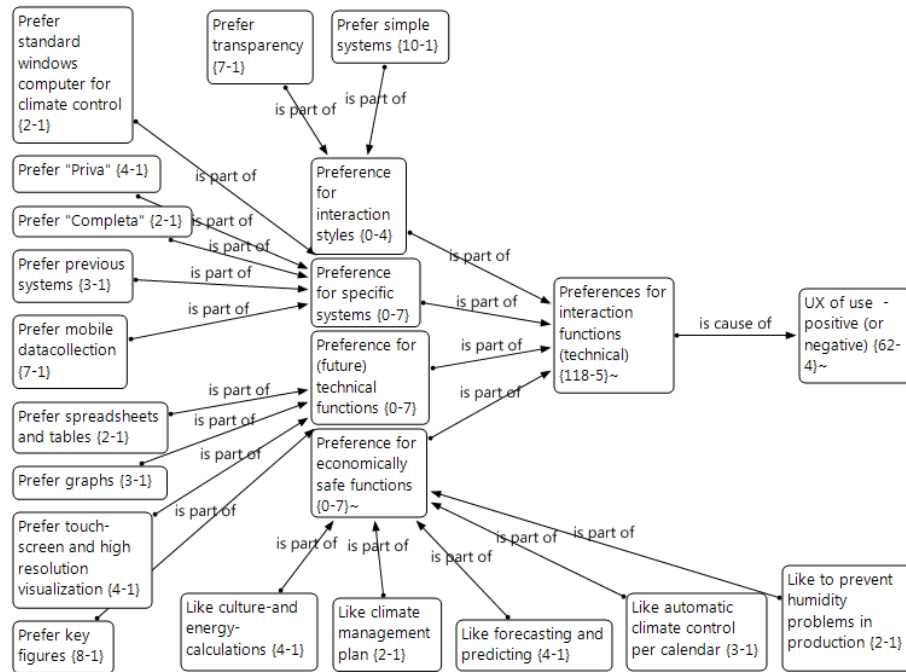
The third row from the bottom of Figure 2 indicates that there are also negative emotions when using interactive climate control systems. These include that you may be dissatisfied with the system, feel powerless, perhaps even resent the interactive climate management system, or have an uneasy feeling about it. The grower is satisfied when the interactive climate management system is running without any major problems. For growers and consultants dissatisfaction disappears when the system is perceived as difficult and frustrating. Satisfaction may also disappear when the new interactive climate management system cannot be the grower as expected or that it is too expensive. The feeling of being powerless is when consultants or growers do not understand why the system does what it does and stop asking questions. The powerless-emotion may be associated with being enthralled by the importance of the system, helpless in face of how hard the system is to use, and the feeling of being neglected simply because one's nursery is too small for the manufacturer to care. Feeling resentment over the use of the interactive climate management system may come when it is established that there are things that do not work. It may be associated with sentimentality about how well the systems worked in the old days, and bitterness over that they do not work better today. Resentment can also come from the displeasure of too many false alarms to be reset, improper placement of components to be maintained or incomprehensible design of connectivity options, or unstable and inaccurate sensors. Experiencing uneasiness when using the interactive climate management system includes the consultants' fear of making a mistake out in the nursery, and to be overwhelmed by the large amount of data in the system. There may also be so many settings to be made in the system that it is a relief to get over with it. Both consultants and growers may be worried about surprises from poor or malfunctioning equipment. Feelings often associated with consumer products, such as elegance, joy, cool, etc., were not found appropriate by our interviewees.

In this section, we have not written much about the feelings and experiences associated with the mandatory aspect of interacting with climate control systems in the workplace, Figure 3. These emotions include the emotional evaluation of the interaction as adequate or successful, but also the negative experience of the mandatory interaction to be prohibitive towards the user-worker. The experience of having to do climate control with the computer can vary from a feeling of control, to being vigilant about what is current happening in the green house, even intimate with the plants, to having a feeling that the climate management system is transparent. Figure 4 illustrates the third factor in the model of the user experience of interactive climate management. The third factor was the experiences related to what the users prefer of interactions with the climate management system. The preference-experiences were about preferred interaction styles, computer system paradigms, specific functionalities and hardware attributes, and also experiencing preferences for economically safe and economically important functions.

**Fig. 3.** The emotional experience related to mandatory interactions with workplace computers.



**Fig. 4.** The emotional experiences of preferences for interactions with climate management systems.



## 4 CONCLUSION

This study has illustrated an interpretative phenomenological approach to finding user experience goals in complex work systems. Two stakeholder groups' user experience of interacting climate management has been described. The differences in interpretations of how growers and consultants experience interactive climate management can be summarized in a user experience target table, see table 2. The common user experience goal is that using interactive climate management systems should be interesting and useful. The growers need to feel like being on the floor of the green house, and that the interactions are easy to explain to colleagues. In contrast, the consultants focus on the plants and on saving money.

**Table 2.** User experience target table

Work role	User experience Goals examples	User experience measure
Grower(s) interacting with climate computers	Interesting, easy to explain to others, simple,	Performance in specific scenarios

	useful, safe, to the point, feeling of “being-on-the-floor”	Outcome over time meet company needs
Consultant(s) using the computer to analyze and give advice	Interesting, exciting, useful, challenging, save money, focused on plants	Used by crop consultant in their work

We suggest that future research may aim to develop context sensitive user experience scales that can be used to measure the identified emotions in other contexts than climate management, or other climate management situations than greenhouses.

## 4 Acknowledgments

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## Using a vision seminar process to evaluate the work environment of future work.

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**Abstract.** Based on a vision seminar process, scenarios of future work can be produced. In order to prevent possible negative work environment consequences, a checklist has been developed for analysis of the proposed new work situation. The work environment analysis is partly based on the Demand-Control-Support model. The checklist is divided into aspects analyzing physical, psychosocial and cognitive work environment problems.

### 1 Introduction

Introducing a new or modified IT-system into a workplace will always have a number of different consequences (Greenbaum and Kyng 1991). Work organisation, work processes as well as the work environment are affected. We can sometimes see very positive effects after the introduction of new technology, such as improved efficiency and safety. But there are also numerous examples of new technology producing the opposite effect. In many cases the new IT systems cause disturbances, inefficiency, frustration and stress (Åborg 2002). To achieve positive effects from the new IT-systems, it is necessary to simultaneously develop the organisation itself and its work practices. In other words, it is not enough to simply introduce IT-systems that support the organisation's current work practice - the focus must be on future practices. It is also important to use the full potential of the new technology to improve the organisation, work practices and work environment. If not, the introduction of the new systems will only "pave the cow paths" and in worst cases introduce a number of problems. If technology is introduced without considering the new emerging organisation and the way work will be carried out, the future work will merely be what remains when the technological changes have been implemented. Good, efficient and sustainable work requires conscious, detailed design and a user-centred process. It is the purpose of this paper to describe our research approach, with a focus on the work environment aspects. The work environment checklist that has been developed is partly based on the Demand-Control-Support model (Karasek and Theorell, 1990).



## 2 Background

### 2.1 Human work interaction design

(Kensing and Madsen, 1991) suggested Future Workshops and metaphorical design as examples of new approaches to stimulate creative visions of future use in organizations. Future Workshops was a technique developed by (Jungk and Müllert, 1987). The general idea was that the three phases Critique, Fantasy, and Implementation should evoke criticism of current work, visions of future work and finally identify the resources needed to realize the visions. The metaphors would be used to stimulate new perspectives, in particular when people were unable to see beyond their own personal horizon. Our approach is similar to the Future Workshops, although the implementation is less formal. The main problem addressed is how we can understand, conceptualize and design for future work environments. Here existing approaches that focus on Human-Work Interaction Design can help us.

The analysis of the current HWID activities has been discussed by e.g. (Orngreen et al, 2008). Here the following properties were identified:

Within design process:

- Encouraging the dialogue between users and designers in the design process
- Bridging the HCI and Software Engineering gap by working with user requirements and collaboration in software development processes
- Supporting communication and design exploration through sketching

Within Work and User analysis:

- Bridging the work analysis and interaction design gap through detailed case and field studies and action research projects empirical field studies.
- Rich contextual user descriptions, including methods to study unpredictable and opportunistic tasks
- Broadening the scope to Social, Organizational and Cultural aspects

### 2.2 A work environment model

The relationship between work environment problems and health in Visual Display Unit work has been studied extensively (Aronsson et.al. 1994, Punnett and Bergqvist 1997, Hagberg et.al. 2002) and various significant risks that affect health in a computer-supported work environment have been recognised:

- Confinement and sedentary work
- A sense of being controlled without any influence or power over how one's work is to be planned and carried out.
- Stress – the feeling that the work's demands exceed available resources and personal capacity.

Different stress-related symptoms can arise or be exacerbated by large amounts of work and lack of support. Such stress occurs when demands exceed what the worker/user feels is manageable. This can cause health problems if continued over a long period of time without effective recovery periods. Symptoms can be quite varied and

include psychological reactions, irritation, fatigue, sleeping problems and physical reactions such as muscular tension or stomach problems. Other common symptoms are eye strain, load strains and headaches. A separate class of occupational health problem is cognitive work environment problems. Such problems occur when something in the work environment hinders people from using their knowledge and skills. This is described by (Åborg 2002) who observed how poorly designed IT systems are one source of such problems.

A model describing health aspects has been developed by (Karasek and Theorell 1990). It describes stress-related problems in relation to work demands, self control and social support at work. Work demands refer to the perceived work-load, the qualities and the requirements. Self control is the worker's perception of his/her ability to plan and control the work situation. Social support refers to the overall levels of social interactions experienced from co-workers, supervisors and other individuals. Karasek and Theorell's most important conclusion is that high demands are not a problem if they are matched by a high degree of self control and strong social support. The most significant risk factor is when workers perceive a lack of control over their work situation. Consequently, high demands can be handled if they are combined with a high degree of worker control and strong social support. But, if the perceived demands become too high, and there is a low level of self control and low degree of social support, this will lead to high stress and an increased risk for health problems. The most favourable situation is one characterized by reasonably high demands, high control latitude and strong social support.

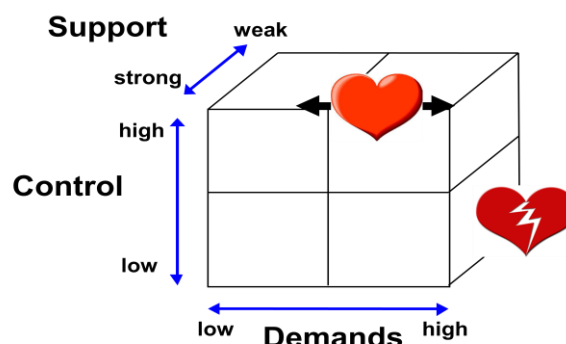


Figure 1. The Demand-Control-Support model for stress and health in work.

### 3 A vision seminar process

Our vision seminar process (VSP) has been developed to transform the perspectives described above into a practical method. In accordance with the fundamental ideas about action research, the VSP has been developed interchangeably with the perspectives. Theories about the perspectives have inspired practice and practice has inspired and refined theory in a mutual process that has been carried out over a long

period of time and in several projects. The overriding goal in all projects has been to support development of workers' current work organization and propose new, future work practices supported by new IT-systems. A more detailed specification of the process and its history is further described by (Johansson et.al. 2007).

The VSP is built up as a series of seminar meetings. During these meetings, a work group of user representatives meets together with designers who act as process leaders. The process must be allowed to extend over a longer period when extensive time is required to gain a new perspective on one's daily work practices and to be able to reflect upon these practices. Moreover, it takes time for all participants to be comfortable enough to be constructive and able to shape their future organisation and work practices. Preliminary ideas must be allowed to mature and be revised.

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

The VSP is a mutual process where participants and process leaders are jointly learning and reflecting (Schön 1995). During the seminars participants are triggered to reflect upon their work practice. They explain, provide details and discuss with the process leaders as well as with each other.

### 3.1 Results of the process

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

- Documenting general prerequisites for the organization's future development. Descriptions of higher level plans for the organization constitute a base for proposed future solutions. Such organizational plans are usually available at different management levels.
- Documenting aspects of future work. A description of the proposed future work in terms of characterizing aspects.
- Documenting scenarios describing future work, based on the aspects of future work. They are practical descriptions of daily work situations illustrating the proposed future work.
- Documenting future work tasks and activities. Work described in the scenarios is analyzed and categorized.

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

## **4 Work environment evaluation**

The purpose of the method presented here is to analyze some important work environment aspects of the future work, specified in the results from a vision seminar process as described above. If important work environment problems can be identified already at this stage, these can be prevented by redesign of the future work scenarios.

Work environment problems can be seen as consisting of physical, psychosocial and cognitive problems. A checklist has been developed based on existing knowledge and experiences. It is not possible to describe this checklist in detail here, but the following structure and headlines illustrate its contents.

### **Physical work environment**

- Immobile by the computer
- Mobility
- Work place design
- Technique at the workplace
- Computer screens
- Special requirements

### **Psychosocial work environment**

- Changes in work environment
- Social relations at work
- Management and leadership
- Competence support
- Mobility and distant work places
- Balance in workload
- Self control at work
- Challenges and rewards
- Development possibilities

### **Cognitive work environment**

- Focus on the work tasks
- IT that requires unnecessary work load
- Automation and repeated work tasks
- Understanding of the work processes
- Perceived good work results

### **User interface aspects**

- Disposition of the screen area
- Menu structure

Orientation and navigation  
 Control of the interface  
 Efficient visualization  
 Feed-back  
 Data input functions  
 Form, font, lay-out  
 Use of colours  
 Understandable icons

## 5 Conclusions

The proposed checklist has been applied in a number of applications and has helped in identification of possible work environment problems. By redesign of the future work, as described by the vision seminar process, these have been able to eliminate or reduce.

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