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Interactivity and Spatiality – Design of Future IT-enhanced Work Places

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Abstract

In this paper I will discuss interactivity and spatiality, including the relationships between technology-in-use, design and everyday practices. The paper reports some initial experiences from a field study at a technology-intensive control room and of using work-oriented approaches for collaborative design. In several studies a group of multidisciplinary researchers has carried out experiments of collaborative design in full-scale as well as virtual environments. The aim was to investigate how well these methods could support participatory design of work environments. Some important concerns I believe we need to face are how the characteristics of technology-enhanced environments may influence the development of new work practices when emergent technologies give entirely new possibilities for communication and co-ordination over extended distances. Hence, an urgent matter is to create a holistic view on design of future IT-enhanced work places that takes into account the users experiences and everyday practices.

Keywords: interactivity, spatiality, design, work place, interaction technology, communication, co-ordination, human-computer interaction

1. Introduction

Today work conditions are going through substantial changes, not least in questions regarding work organisation and localisation. Distributed work is a term that describes work life which is less dependent of concrete places. Enhanced boundlessness in work could have several advantages but also some drawbacks. This development brings new challenges to designers of work places and information technology systems. There is a need for widened knowledge where experiences and research in a better way can be integrated in a holistic view on work place design.

The area of human-computer interaction (HCI) has contributed to design of better interfaces, even so some systems has an inability to support people in work practices where workers in team need to share and jointly manipulate information. Computer supported co-operative work (CSCW) is a research field involved in exploring a wide range of issues concerning co-operation and its support by information technology (Bannon 1993). It has led to

a richer understanding of work practices and of how to support work processes through technology. Bannon further states that the view has moved towards seeing the office as a social community where work is accomplished through locally situated activities and interactions of employees. There has been an increasingly need for communication between people in different locations. Use of new technologies enable new possibilities for long distance communication and co-ordination through creation of virtual places for co-operation and mutual activities. It is therefore important with an enhanced knowledge about the implications of new interaction technologies in work place settings. Given this focus, field studies are of central importance in research work.

Information technology's connection to social communication is an important aspect to study in relation to the conditions that the surroundings of the work environment imply. Communication between individuals is affected by introducing new technologies and should therefore be in focus (Suchman 1987). Suchman's conclusion is that because an action or event always is dependent of a certain social and physical environment the understanding for and the attention on this environment is important when that action is to be interpreted and understood.

The use of new communication media is changing the work patterns, and thereby put new demands on the work place. These circumstances caused by information technology come to expression in all kinds of work environments. This has been given widespread attention, both in media and within research about work life (Greenbaum 1995). There has also been research with focus on the interaction between information technologies and organisational dimensions such as structure, culture, control mechanisms, work practice, and social cognition (Orlikowski 1992, 1995).

2. Purpose

The local environment of the work place obtains windows towards an increasing number of other, virtual or real, environments. A central aspect of this interaction is its *spatiality* that has to be considered. Spatial relationships and people's interaction between each other will change. Spatiality of work is a necessary perspective for research about the changes in work places today. I also believe that it is a productive perspective for enlightening so far unexplored circumstances of work life. My initial purpose is to obtain an overall picture of today's work practices, as part of my research about design of future IT-enhanced work places. As a first step earlier research were carried out to investigate interaction in different work places (Alexanderson & Rosander 2000). That case study included a field study conducted in a technology-intensive control room from which I will discuss some issues in the following sections. My purpose was to investigate how concrete work conditions have changed for individuals as well as groups with the growth of new interaction technologies. I treated questions about information technology, work practice and work place design. A starting-point consisted of a spatial perspective on questions about communication and interaction in the work place settings.

Spatiality affects how people work and make use of the technology. We should therefore include this aspect when discussing how the work practice is affected by introducing new technologies in a work place setting. It is important to study what role spatiality has in forming the use of technology. This paper develops general principles concerning relationships between interactivity and spatiality, and explores the potential effects of an intensive use of

information technology in different work places. In this I include exploring the relations between technology-in-use, design and everyday practices. I will use the notions of *interactivity* and *spatiality* as these terms could describe interdependent aspects that need closer attention within the field of human-computer interaction. First I introduce approach and then three interrelated themes are presented; a) interactivity and technology-in-use b) spatiality and work practice c) design of future work places. It will include some initial experiences about a changed work practice and also give a general discussion about design possibilities. Finally, I tentatively discuss the consequences of these themes' interdependability and possible implications for the future.

3. Method

To examine the effects of new patterns of interaction I took an ethnographic approach in the case study. Ethnography is a valid approach for developing understanding of everyday activities of particular communities of people. This approach, with its emphasis on employees' point-of-view, holism and natural settings, provides a unique perspective for understanding users' work activities. In my fieldwork I have involved some combinations of observation, informal interviewing and participation in the ongoing events of the community. Through this extensive contact I expected to develop a descriptive understanding of the observed behaviours. (Blomberg et al 1991)

In 1995 a project was conducted in co-operation between Design@Work and Perstorp Chemicals with the purpose to design a new control room as a part of the automation process. The participative design process was conducted through the use of "the envisionment workshop" as a way to tackle the visualisation problems and to enable the generation of possible solutions for the daily work in the control room (Ehn et al 1996). The project resulted in the building of a new control room at Perstorp Chemicals in 1996, and in 1999 I went there to study the results and effects of this (Alexanderson & Rosander 2000).

The methods for collecting data were semi-structured interviews with process operators and management, in total eleven people. We interviewed both experienced and not experienced operators and performed observations during two full shifts. We also conducted two group interviews with different work team which also where observed when performing their daily work routines. The observation took place mostly in the control room with a focus on process work, work organisation and communication. We also observed some work performed in the production area where operators manually manage reactors.

In this paper, I use patterns of interaction as a way for creating some understanding about the impact of information technology on a work practice. The idea of *interaction patterns* implies the different ways in which individuals make use of technology in communicating and co-ordinating their efforts with others to enable carrying out their daily work. I wanted to investigate what the implications were for the work practices and what consequences it could have for creating new patterns of interaction. I argue that this idea offers a useful approach for investigating how technology can be associated with changes of work practices in different work places. In the discussion I will further use the notion of 'ecology of space' (Randall & Rouncefield 1999) as a possible concept to interpret my experiences in the work place.

4. Interactivity

In understanding the use of technology we must study the contexts of its use. Computing is an interactive and distributed activity, we must consider not only the human-computer interaction but also the computer-mediated human-to-human interaction (Sorensen 1999). Accordingly to Blomberg's earlier research, patterns of interaction among users have a major impact on people's experiences of their artefacts and could also have a significant influence on perceptions of machines' reliability (Suchman et al 1999). The artefacts are set in different social contexts and in making sense of the patterns it is necessary to include this context when studying technology-in-use. Relationships between technology and work practice have consequences for how organisations design and use information technologies to support their work.

To understand technologies ethnographically it is required to locate artefacts within a site and the relations of their everyday use (Suchman et al 1999). In the study of a technology-intensive work place, in the control room at a chemical factory, observations suggested that there was a strong interdependability between the artefacts in use and that they needed to be carefully integrated in the everyday activities (Alexanderson & Rosander 2000). This case study lays the basis for my following discussion and includes experiences from the work practice in a control room. The result was partly some initial findings similar to the work of Suchman et al (1999) and to Zuboff's work about the impact of computerisation in work places (1988). I will not give general descriptions of the work here, for further readings see Alexanderson and Rosander (2000).

The field study took place in a chemical factory, Perstorp AB, which consists of four divisions where Perstorp Chemicals is one of them. They manufacture lacquers and resins for many different industrial applications areas. Perstorp Chemicals have responsibility for raw material supply for the laminate floor manufacturing, where most part of the lacquers is used. In a step to develop a higher degree of automation a computer system for processing control of reactors has been invoked into the production unit. The purpose of the study was to examine design and use of a new control room for managing and monitoring chemical processes. The study included design and use of information technology in work processes, and also interaction between humans and machines.

In the study several aspects were explored about interaction patterns in the daily work. This implies a use of interaction in a broad sense, such as the process of interacting with other people or machines for information and social purposes during a work shift. I wanted to investigate some questions concerning co-operation and especially how people made use of different means to co-ordinate their work efforts, including how IT artefacts was used for communication and interaction purposes. Collaboration is a fundamental part of work and the possibilities supplied in a work place setting have great impact on how the collaboration is shaped.

At the chemical factory called Perstorp the operators' work consisted of monitoring and controlling different processes in the reactors, to generate recipes for how the process should be carried out, and to generate status reports for the process in proceeding. In a new computer system that had been invoked the employees could follow a process step by step according to a pre-programmed sequential schedule, and in that way control the process in question. When this program was to be installed they needed education in order to understand what was occurring in the system during the progress of the chemical process. They also controlled some manually managed processes in the production area, since some of the reactors

have not yet been automated. The disadvantage with the automation and the new system is that there is a risk of discrepancy between what is shown on the computer screen and reality. As a supplementary control there were video monitors installed next to the computers that showed the inside of the reactors.

One of the major characteristics of the daily work is that the monitoring of processes is an attention-demanding task, which also often contains lots of idle time. For long time periods, virtually nothing happens in the control room but when a sudden change in the process-state of the reactor occurs, this calls for instant action from the operator. In this way, the operator needs to constantly monitor the processes and always be ready to intervene. Due to the critical nature of the processes taking place, the operators cannot completely trust the computer technology when monitoring the chemical processes, which perhaps could be possible in less critical undertakings. To gain the necessary overview and control, it is not enough merely with virtual interfaces, even automated reactors must to some extent be managed manually through installed valves, just in case. The operators remarked that *“it is so easy to push the wrong button in the batch-program on the computer screen”*. Another problem is that when the system is warning about something it is often too late. An experienced operator will in most cases discover that something is wrong much earlier than the computer system. *“When the computer systems eventually alerts, it is often too late. It is not easy to program the computer – an experienced operator notices problem earlier than the system does. But most often you get a good picture of what’s going on through the video cameras.”*

A fundamental thought with the new quite recently built control room was that it should function as a connection centre where several activities could go on simultaneously. This meant a great difference in work manners compared to earlier, when they foremost worked with controlling reactors out in the production area. As the control room’s function has changed, a line of new possibilities for interaction through information technology has been brought about to the control room and the daily work of an operator. In a way the control room is the place where things happen; it is a natural meeting place where they monitor processes, exchange experiences and socialise. Our impression was that its design enables a wide participation in planning, decision making and knowledge exchange between different shift teams.

The control room worked as a centre of co-ordination where several co-operative activities were carried out in order to achieve the goal of manufacturing the end products. The artefacts in this site comprised a heterogeneous collection of information and communication technologies, including stand-alone computers, a networked computer connected to the local intranet, video monitors, communication radios, telephones, a whiteboard and various kinds of documents. A problem with the integration of these artefacts was that the stand-alone computers for generating recipes, reports and labels were not connected to the network and this prohibited any easy exchange between them. It was not possible to move information in a smooth and unconstrained way, instead it had to be retyped several times.

The artefactual richness of the control room made it a complex environment. Each member of the work group was assigned responsibility for maintaining a chemical process in the production area. They used supplied means to supervise the process mostly from within the control room. In this sense, the work was concerned less with the activities within the room than with the events taking place outside the room. This made it difficult to obtain a basic understanding of the processes, the gap between the artefacts-in-use and the actual, physical operation was especially a problem for newly employed to bridge. According to the employees there is a widespread fear of losing the primary sense and experience of the work practice

when new technologies are introduced.

Technologies are constituted through the specifically situated practices of their use (Suchman et al 1999). One way of understanding the role of information and communication technologies in settings like this control room is to unveil the interactions and interrelations involved in the work practice. The interaction patterns in the control room indicated that there was an extensive adaptation on a personal basis in the matter of how they made use of the available means for interaction. The introduction of new technology has led to changed interaction patterns due to that there are extended possibilities for interaction and communication. Even so, for communications outside the work places telephones were mostly used. The respondents emphasised that they preferred this form of more direct contact and that it is considered to be the most effective way of communicating. Inside communication was often conducted in a face-to-face manner. Several employees expressed a need for efficient channels to enable easier communication. In some cases for simple communication like open questions they found an intranet to be quite useful, but more often they preferred the direct contact of telephones or face-to-face meetings.

The new control room at Perstorp has contributed to a much closer co-operation between the operators and an enhanced teamwork. Now their work is characterised of mutual co-ordination of work tasks. The control room as a connection centre involved several channels for interaction in the work place. This implies that the operators must have ability to control and consciously manage these possibilities if they should be of use and not be a burden. In the control room they worked in shifts and communication between the different teams were crucial. To retain a constant dialogue they used e-mail, intranet as well as whiteboards for messages and information exchange. This created a sort of awareness through closely following each other's activities. A key finding associated with use of e-mail in Graham's work (1996) was the value of "simple awareness", a chance to become familiar with the daily work routines of the collaborators in a way that usually would be reserved for relationships involving close physical nearness.

As shown in the case study, technologies can indeed have great influence on how the work practice develops. We should therefore enhance the understanding of the complex relationships between technology and work practice by keeping technology-in-use at the centre of attention. We need to look into the details of the technology as well as the work practice and interpretations by the social group. Technology is not neutral and different interested parties will affect the development and use of technology. Different interest groups will interpret any given technology in different ways (Orlikowski 1992). Being linked together will not automatically increase the sense of community, improve the ability to collaborate, or improve our chances of understanding each other (Graham 1996).

5. Spatiality

Computers' usefulness depends on the relationships between the person, the work environment, and the computer technology itself (Greenbaum & Kyng 1991). Graham (1996) enlightens that we tend to regard work with computer technology as a technical skill, but she stresses that it is first and foremost a social interaction. Social factors affect the use of technologies in work environments, and must therefore be considered when introducing new technology in order to transform the work practice. She also stresses that technology which change work often

intensifies social interactions. This makes attention to acquired social skills far more important than it traditionally has been regarded.

Places play an important role in our daily work life. Recent development has led to a change in forms of work places, and new combinations of work practices. These changes will further on melt together and engender the establishment of new forms of places. There has been a development of new forms for exchange that bring place into focus again. This aspiration also includes a dimension of networking between several places and realities simultaneously. Multilocality is a concept that can be used in connection with distributed work and it means that the presence is divided between the concrete place and places that can be reached with assistance of information technology (Wikstrom 1998).

The development of electronic media has decreased the significance of physical presence in the interaction between people. Now people can be a part of a communication without being physically present, that is, they can communicate with others without being in the same place. The spatial settings for interaction have a quite different role in human communication today. Physically bounded spaces are less significant as information is available and easy accessible from outside the own environment. Hence, electronic media have altered the significance of place for human interaction. Media can create a sense of sharing and belonging or on the other hand a feeling of exclusion and isolation (Meyrowitz 1985). It is therefore important to consider the aspects involved in communication with regard to media's influence on the interaction patterns.

According to Casey's reflections (1997) our use of technology brings with it an unexpected return to place. A new sense of place emerges from communicating through electronic media, a kind of virtual place. By inhabiting this place people can present themselves to each other in a quasi face-to-face interaction. They become accessible and seem to share the same space independent of location. Wikstrom (1998) calls attention to the fact that the development is headed towards creating virtual places where distributed work can take place. These places are often constructed with spatial characteristics that in the users create a sense of spatial presence. This distributed manner of work makes us more independent of real places, and makes us move quickly in the cyberspace between many different contexts and virtual places. Our environment has great influence on how we can shape and carry out our work to achieve certain predetermined intentions and aims. Wikstrom further states that never before have we physically transported ourselves to such an extent as today, which indicates that we still have a need to be physically present on certain circumstances. Even though communication media's development has changed people's relation to places, the physical room will not lose its importance. This just means that we generate a widened view on the notion of place and learn to handle the concept of changeable spatiality, with several dimensions and signification. (ibid)

New conditions due to technical advances have come that from a placial point of view have engendered major changes in a diversity of work practices today. Now we are connected with places far away and everywhere, this implies a whole new range of possibilities but also changed attitudes in questions about the apprehension of presence. A widespread interaction and co-operation have been made possible by electronic media and former limitations are exceeded with the help of technology, but instead new questions have emerged. The spatial conditions that the new information technology gives rise to have implications for how we perceive our position in relation to others with whom we interact. Technology helps us creating places, both real and virtual in which we can perform. These phenomena have significance for how we can use place as a point of view for understanding and reasoning about human activity.

The notion of place becomes central in a discussion about the design of future work places, and involves the presence of people that make use of it. The use of electronic media has changed people's relations to rooms and gives rise to questions with focus on communication and interaction patterns. To create a deeper understanding of spatial relationships as a consequence of an extended use of electronic media, we need to direct our attention towards how people are collaborating in information technology intensive environments and how they are making room in work place settings. This leads us towards seeing the room as a place for action that takes place, in the same time, in concrete and mediated presence. The presence is divided between several places simultaneously, this multilocality is typical for today's work conditions. The spatial dimensions of the interaction are affecting how the participants apprehend the collaboration and how they respond towards ongoing events.

Recent development of interactive environments makes people's relations to rooms an important aspect to consider in designing these environments. With interactive media new rooms are created, that in a sense have spatial characteristics that give a feeling of presence. In certain aspects these rooms can be seen both as tools and contexts for people's interaction. These rooms can be used in varying ways for different purposes, both as a physical interface and as an interface towards other, virtual places. At the same time they are the environments at present from which the communication gains its coherence and meaning. Technologies like ubiquitous computing (Weiser 1991) can contribute to create enhanced environments where work can be performed in a more effortless way. This possibility may also help us with the important matter of information overload, to overcome this problem it is crucial that the technological environment is able to provide these relieving qualities.

6. Design

Current research has emphasised the need for establishing a deeper understanding of the actual work practice when designing new systems. Using different techniques in the design process compared to traditional software engineering approaches and conducting ethnographic studies enable getting a rich picture of the work practices for the purpose of informing design (Blomberg et al 1991; Greenbaum & Kyng 1991; Suchman et al 1999). Ethnomethodology is becoming a widely used approach to workplace studies and there is a need to make ethnographic studies available to software engineers, designers and users (Blomberg et al 1996; Hughes et al 1994).

Accordingly to Suchman et al (1999) a central problem for design of artefacts is their relation to the environment of their intended use. It is therefore crucial to regard the whole picture to comprise the everyday experiences when designing digital technologies. To enable recognising the situated and contextual aspects, design of computer system should have its basis in the work practice (e.g. Greenbaum & Kyng 1991; Suchman et al 1999). In this section I will draw on recent projects within a research program aimed at developing new forms of work-oriented, co-operative methods for design of work environments.

Many studies in HCI focus on the individual user working on a computer system, this view neglects the importance of co-ordination and co-operation (Bannon 1991). The co-ordinated aspect of work activities has to be supported when designing the system. In my work I am taking part in a group of multidisciplinary researchers which are performing studies with the purpose of gaining some experiences about collaborative design (e.g. Hornyánszky Dalholm

1998; Davies 1999). The context of the studies is the Envisionment Workshop, in which groups of workers use different envisionment techniques in designing work places, including full-scale modelling, pedagogical drama, democratic meetings and VR technology. The Envisionment Workshop is a design methodology based around participatory design through visualisation and user involvement (Ehn et al 1996). It is a collection of techniques aimed at assisting in participatory design in connection to changes of work places and it covers aspects from the physical to the organisational. The techniques are combined in order to visualise and discuss ideas. To enable creative work place changes these techniques are used as means to establish a common language and communicate design ideas among the participants. The goal is to enhance the possibilities for design, visualisation and communication within a group.

For example, there has been extended work within testing different ways of using full-scale models in the design process. Hornyánszky Dalholm (1998) describes five different case studies where the affected users were involved in the creation of their dwellings or work environment. Her findings suggest that involving users in participatory design will result in an increased understanding and also that the access to a tool the users can control will have an impact on their ways of reflecting upon the design work. The studies showed that the full-scale models helped them to mobilise their imagination and creativity. In later work this technique has been combined with the other envisionment techniques in design processes, e.g. in the participation of designing the control room at Perstorp.

Another example was a minor pilot study the group of researchers carried out in the fall of 1999 using a virtual reality tool for collaborative modelling in order to investigate how well this technology could support participatory design of work environments. In the experiment the virtual environment seemed to be able to represent a real work place quite satisfactory. The participants apprehended the virtual place as an interaction space for designing and communicating ideas in a smooth and unconstrained way. This experiment was part of the efforts to investigate whether VR technology could complement the other envisionment techniques as a useful tool. Several case studies have earlier been carried out to investigate if a simple and intuitive VR based tool could be built to support participatory design (Davies 1999). There will be further studies carried out in this area.

Suchman's (1987) investigation of the problems with human-machine communication and about the challenge of interactive interface design has changed the view on design and use of digital technologies. The focus is now more on how people actually are trying to make use of the machines in the course of their everyday work. Suchman's analysis reframes the problem of user interface design from creating a self-evident machine to writing a user interface that is readable for the users (Suchman et al 1999). There need to be a shift in focus from product to process in research and design; more attention needs to be paid to the process of design through involving users in all stages of the iterative nature of design (Bannon 1991).

Within the research program efforts are made to focus on the design process and on involving the actual users in the work environments. Through the participatory design there are possibilities for wide collaboration and enhanced communication. The group of multidisciplinary researchers contributes with different perspectives on the work place activities and work together with the employees in supporting visualisations of work place changes. With the techniques and tools, like modelling in full-scale and VR, there is a rich basis for exploring ideas and enabling a creative climate in the design processes.

The aim is a design practice in which representations of work are recognised as part of the fabric of meanings that constitutes the work practice and not independently existent

organisational processes (Suchman 1995). It is therefore necessary to bring forward the unconscious experiences of everyday activities and make the work practice visible to enable designing innovative systems. We need to include both the work environment as well as the interaction technologies as mutual interdependent parts when participating in work place changes. By making the work more visible, designers could create a more intimate view of the work place landscape (Suchman 1995).

7. Discussion

In this section I will discuss how interactivity and spatiality are affecting how people work and make use of technology, and I will also tentatively discuss design of future work places. I believe that these interrelated themes can be used as a way for studying technology-in-use and work practice changes. Their interdependability needs to be explored as work conditions goes through substantial changes today and as people transform their work practices to take advantage of new forms of information technology. It is necessary to explore the possibilities for changing work practices in more coherent ways through making the everyday practice more visible. Some concerns I believe we need to face are how the characteristics of technology-enhanced environments may influence the development of new work practices and what effects this will have on people's attitudes towards interaction technologies as useful tools to interact with each other in an unconscious way. The difficult part is finding ways to bridge the differences between communication face-to-face and through interaction technology.

The introduction of new technology in the control room has led to changed interaction patterns due to that there now are extended possibilities for interaction and communication. This has in some cases led to improved spreading and sharing of knowledge. Interaction technology opens new possibilities, but in order to be successful it demands an ability to control and consciously manage the different possibilities of the technology. There has been a widespread adaptation of the work practice to technology, which has considerably affected the conditions for the employees at the site in the case study. There was a pronounced need for efficient channels for communication. Most often, direct contact means like telephones or face-to-face meetings was preferred to for example e-mail. There seemed to be a desire for possibilities of choice when it comes to communication tools. The employees used different interaction technologies, in which I include telephones in addition to computer technology, for different purposes. There were divided opinions of technology as an effective mean for co-operation in the work places. In some cases interaction technology seemed to be able to create a tendency towards co-ordination.

The notion of 'ecology of space' could be used as a possible concept in order to discuss spatiality, accordingly to Randall and Rouncefield (1999) this concept implies that the use of spaces carries with it a particular economy of time and effort. Introduction of new technologies could change the ecology in that it effects the use of space in terms of demanded attention and constraints. Smooth technologies that could be used in more effective ways will influence the work in creating a new ecology. In the control room the work is carried out in a physically much more concentrated manner, this has led to better possibilities for getting an overview and keeping the awareness of others activities. The work is characterised of an ongoing dialogue and mutual exchange.

Spatiality provides a space for action where events can take place. It affects how we

form our interaction patterns and how we claim the physical room. This leads towards a requirement for a wider consciousness about how we use electronic media and what effects different tools for communication bring with them. It is also important to enable making conscious choices of different tools for different purposes, depending on the situation and what we want to achieve for the moment being. We should seek an understanding of the deeper impact a particular interaction technology can have on the work practice in overall. In the field study there was an expressed concern about fear of losing the original sense for the work practice. The employees stressed that a developed sense for the chemical process is of crucial importance to maintain the genuine knowledge preserved, and experience is necessary to create this sense for the everyday practice.

Design of future IT-enhanced work places is an exciting matter as new possibilities are brought about with the growth of new interaction technologies that enable communication and co-ordination over long distances. We need to embrace every involved perspective in creating a holistic view on work place design. Nowadays people can interact through encounters beyond geographical limitations and different techniques are used to recreate the closeness found in a locally situated group in geographically distributed groups as well. Informal communication and interaction creates a common ground for maintenance of a relationship, the question is how we could support that in remote work places and thus afford collaboration between different located individuals. Through examining the possibilities for supporting collaboration over long distances an enhanced knowledge about peoples preferences and requirements could be gained.

Design of new technologies could benefit through involving knowledge of the actual work practice. Technology-intensive work practices involve complex relations between people, technology and work environment and this call for a work-oriented approach to design of digital technologies. To enable connecting the work practice and technology design we should be looking in detail at how people actually perform their everyday work. A work-oriented approach to design of computer systems includes a genuine understanding of the work practice, that is the foundation when designing new technologies. There have been extended efforts among several researchers to enable developing a co-operative work-oriented design practice. Within our research program a collection of techniques for participatory design provides a basis for innovative design solutions through visualisation and user involvement. The gained experiences indicate that this approach could create a positive climate in the design processes and facilitate creative work place changes.

Through studying design and use of technology in the field of CSCW, a wide range of efforts has been done to gain insights about people, technology and work practice. The collected knowledge within the field has contributed to an intensified focus on how individuals as well groups collaborate in their daily work and an enhanced understanding for how to design computer technologies that better support the work practice. Designing new technologies for different work practices will imply a need to embrace the artefacts' relation to each other as well as to the environment. In the design it is important to consider the contextual quality of the technological artefacts. Improved possibilities for creating artefacts well suited to the work practice could be reached by exploring the context of their intended use. In creating a rich picture of the work practice for the purpose of informing design, more useful interaction technologies could hopefully be developed.

In the pilot study the virtual environment seemed to be able to represent a real place quite satisfactory. The participants apprehended the virtual place as an interaction space for

designing and communicating ideas in a smooth and unconstrained way. The gained experiences of the pilot study indicate that it is possible to collaboratively design a work place over long distance in a beneficial way with the support of a VR tool. The relationships between physical places and virtual places are blurred when we are networking between several places and realities simultaneously. The significance of place has been altered by new possibilities and we need to adapt our behaviour to match these changed conditions. I believe that interactivity and spatiality are important aspects that need to be considered in connection with emerging new technologies. This initial work lays the basis for further research about future work places and use of new information technology, in a context of distributed work and various work environments including virtual places.

8. Conclusions

I believe the interrelated themes of interactivity, spatiality and design can be used as a way for studying technology-in-use and work practice changes. Technology-intensive work practices involve complex relations between people, technology and work environment and this call for a work-oriented approach to design of digital technologies. Within our research program a collection of techniques for participatory design provides a basis for innovative design solutions through visualisation and user involvement. The gained experiences indicate that this approach could create a positive climate in the design processes and facilitate creative work place changes. Some important concerns I believe we need to face are how the characteristics of technology-enhanced environments may influence the development of new work practices when emergent technologies give entirely new possibilities for communication and co-ordination over extended distances. Hence, an urgent matter is to create a holistic view on design of future IT-enhanced work places that takes into account the users experiences and everyday practices.

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