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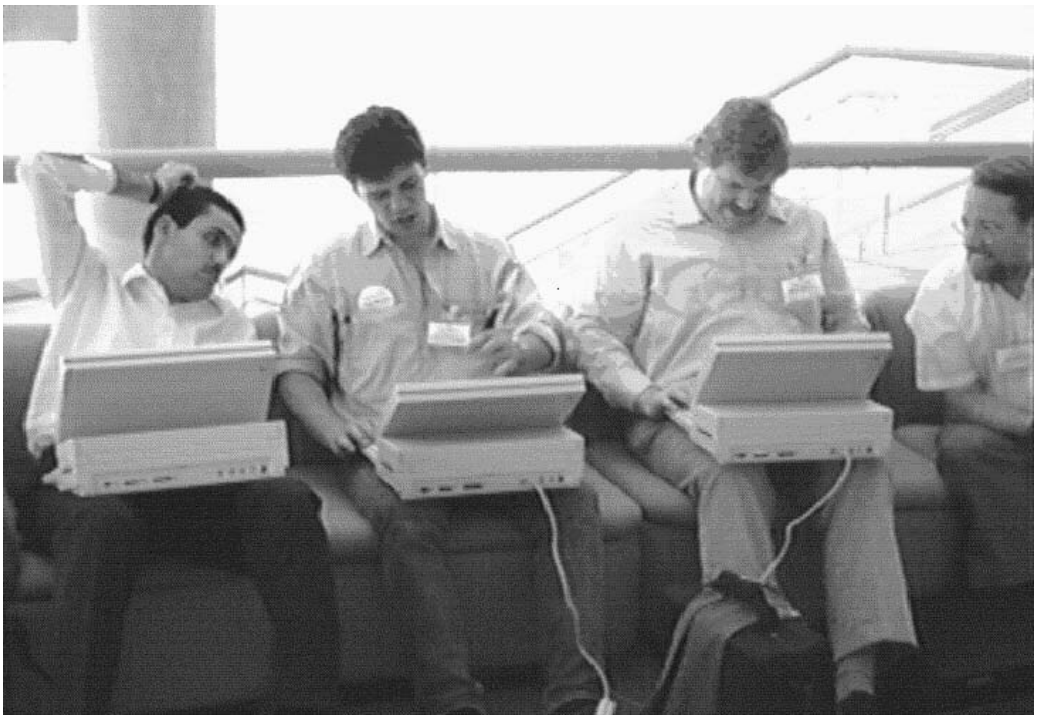
Towards CSCW Design in the Scandinavian Tradition



Konrad Tollmar

Stockholm 2001

Doctoral Dissertation

Stockholm University

Department of Numerical Analysis and Computer Science

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[tomten]

Abstract

This thesis is about how to design Computer Supported Cooperative Work systems (CSCW) on the basis of design practice that is established in the Scandinavian model of System Design.

The approach of the thesis is to develop an understanding of the design of CSCW environments through a series of case studies. These case studies, the CoDesk system, the AtWork system and the VideoCafé system, cover a variety of methods from the Scandinavian tradition in cooperative design.

Studying how these methods have succeeded has been the primary source of inspiration for my thesis. In particular, this thesis will focus on the following issues: Can simulation of realistic work situations be used for cooperative design of CSCW systems by developers and users? And, how can we balance a design based on daily work practice with exploration of innovative CSCW solutions? Furthermore we are also investigating how cooperative design could be integrated in the evolving use and how to combine different design approaches into a coherent design.

Given the complexity of CSCW it will be argued that the design of CSCW system needs to mix design methods with various backgrounds, such as methods that have their roots in workplace practice with methods that transcend common styles of cooperation, to balance different design methods' strengths and weaknesses. It is suggested that a usable approach is to define and use different design orientations in order to deal with this complexity. The use of a design orientation helps in selecting the essential element that is at the heart of the design. This approach seems more usable than working with pure design methods with specific outlines. A design orientation integrates instead a holistic view into the design by leaving the predominant sequential notion in system modeling.

Prelude

The journey of writing my PhD thesis has taken me through an emerging research discipline. The idea behind computer supported cooperative work (CSCW) is to support human collaboration by bringing people closer to each other so that they can share tasks and activities via a computer, even when separated in time or space. CSCW provides support for people, companies and organizations to become more flexible and effective. CSCW is crucial because networked IT is profoundly changing the way we live. Furthermore, it is a complicated field, as it constitutes a complex mixture of advanced technology and the intrinsically social nature of collaboration. Naturally, people from different disciplines have diverging views on how computers can be used to connect people performing shared activities.

The question of whether *any* successful CSCW application is actually in use has been the subject of serious debate. Donald Norman claims that CSCW might even be too complex to ever be deployed, at least in the way that current CSCW research is suggesting (Norman 1991). I do not agree with this completely, but I believe that the design and deployment of CSCW needs to be reconsidered from a more user-centered approach in order to become more widely accepted and used by more people.

CSCW is a deceptively broad area, and my attempt to investigate it further led me to other disciplines, which I had not studied before. This broad perspective also raises a second series of issues. For example, relevance is a complex matter in this field. The pace of progress in the computer industry makes it difficult to reach relevant and valuable conclusions on a small scale in an efficient manner. On the other hand, the speed of technical development and deployment varies. This is relevant to CSCW research, which often must balance between the broad and narrow fields. Most CSCW issues are costly to study, and within the scope of a Ph.D. thesis, it is extremely difficult to avoid research in areas that might become irrelevant before a uncovering a major conclusion that may act as 'a further generator'. However, one way is to apply a holistic research plan – a research plan that maneuvers on more broadly than specifically defined research issues. This method could be considered a paradox, since the more specific hypothesis is not formulated until after completing the

research. Nevertheless, this dual approach seemed necessary, and I believe that this is a place where objectivity and intuition should be blended.

Before I elaborate on the specific details, I would like to touch more generally on the growth and use of IT, in particular networked IT. What are the current drivers, and what generates our need for new forms of communication? There are two ways of analyzing this issue: from a human-augmented perspective and from a market-driven globalization perspective. Both of these analyses draw attention to two important aspects that I have been working with in the thesis. Let us begin with the human-augmented perspectives.

Each one of us is born into the world with different talents and skills. Most of us spend a lifetime trying to hone and develop these innate talents in order to maximize both our own potential and our contribution to society. But few people can maximize their talents working cloistered and alone. In this world of increasing specialization and complexity, rare indeed is the individual who achieves great success by working independently. Collaborative work has mainly focused on business and organizations, and on how new technologies can streamline these activities. But maybe the most interesting group work does not take place at large business meetings, but in small, energetic teams? Long ignored and overlooked, the wonders of collaborative creativity are beginning to be understood and appreciated. In *Shared Minds: The New Technologies of Collaboration*, Michael Schrage (1992) examines the nature of the collaborative process and methods of "fanning the collaborative flame". With frequent reference to legendary creative collaborative teams of the past (Orville & Wilbur Wright, Watson & Crick, Jobs & Wozniak, Lennon & McCartney), Schrage articulates truths that deserve to be emphasized. In his memoirs, Crick sheds light on the nature of his successful teaming with Watson (as quoted by Schrage):

> *Our advantage was that we had evolved an unstated but fruitful method of collaboration.... If either of us suggested a new idea, the other, while taking it seriously, would attempt to demolish it in a candid but non-hostile manner.*

Good collaborative teams, therefore, have a tacit understanding that the individual ego must be subordinated to the greater team goal. There will be a time when human beings rise above the possessive attitude of *'that's an idea I thought of first'* to the greater attitude *'that's an idea I had a part in creating'*. One perceptive observation is that some of the best collaborative work occurs in informal, playful settings. The proverbial doodle, hastily sketched on a cafeteria napkin, serves as a forceful reminder of how creativity can best be unleashed in informal settings. Likewise, brainstorming sessions in a formal conference room seldom yield memorable creative results. This was a new insight to me. The role of playful interaction was not studied by me until my last case where I focused on developing new styles of communication that were driven by pleasure rather than some practical needs.

A clear paradox is revealed as we examine the market-driven globalization view. The impression that work tends to be less constrained and de-regulated is partly a facade. The impression of increased flexibility and a final mature shift into the post-modern office culture only partly hides the fact that new and less visible, but even more complex, work tasks start to take form, for instance, in the back-office procedures. Much of this work has a formal and clear representation – activities that may be flowcharted, measured etc. Because of the extreme specialization and division of the work force, we are radically changing our definitions of work and our way of valuing work.

One aspect of this change is the question of what will happen when invisible work becomes more visible. Nardi and Engeström (1999) provide an overview and some examples of invisible work with informal work procedures that are not actually part of a job description but remain important background processes that are crucial for the collective. Other examples of invisible work are routine jobs that actually require a great deal of experience, knowledge and problem solving, for instance the work of switchboard operators (Muller 1999). Increased awareness at workplaces is the goal of many research projects within CSCW (Rodden 1996). Usually, it has been argued that increased awareness is a mechanism that supports informal work processes. A matter that has been less discussed is the fact that in defining awareness mechanisms, we actually turn invisible work into visible work and hence formalize work representations that had not

been visible (Suchman 1994). We can call it a shift from hard to soft work representations. Nevertheless, awareness mechanisms would still provide opportunities for surveillance and monitoring. When we become outsourced as consultants, and the status of work becomes softer and less visible, e.g. telecommuting and back-office operations, we become, in the words of Bishop, *'widget workers'* (Bishop 1999). Crude implementations of new communication techniques force us to become too explicit in our work. Sometimes we need, as Nardi and Engeström put it (1999), a *"freedom not to be accountable"*.

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Chapter 1
Introduction

Networked IT has a profound impact on society (Castells 1996). The possibility of exchanging and sharing work artifacts and activities unbound to a specific place and/or time within a few seconds is changing the foundations of human life. Just like machines turned the agricultural society into the industrial society, we are now witnessing a shift into the information society (Zubuff 1988, Harasim 1993). In contemporary work situations, we seek to organize the work around integrated activities. In management and information system theory, it is argued that specific activities may very well add value to an organization without necessarily supporting the formal organization (Manheim 1992).

The area of Computer Supported Cooperative Work (CSCW) thus represents a major paradigm shift (Kuhn 1962) in using computers, where the computer facilitates human communication rather than acts as a purely calculative device. This shift is a result of many converging phenomena. It may be noted that a significant role of electronic communication consists in increasing the information and emotional connection of co-workers. To understand the full potential of CSCW, we must emphasize the emotional dimension of work. Kraut (1990) claims that cooperative work mainly consists of an ongoing series of interpersonal dialogues in order to perform tasks and exchange

information. The role of CSCW would be to make it easier for colleagues to communicate with each other and share information, e.g. developments in video-communication point in this direction (Whittaker 1995). Other examples are the development of shared digital memories such as cooperative databases, the worldwide web and workflow systems (Dourish 1997).

The idea of CSCW, as an academic discipline, is to make us *understand* how to support human collaboration and enable interaction between people with the computer as a medium for coordination and communication (COMIC 1995). The issue of what is and what is not academic research within CSCW has been the subject of endless arguments since the first workshop in the area (Greif 1987). Due to the interdisciplinary approach of CSCW, however, it has been hard to distinguish a homogenous research agenda for the field. Bannon and Schmidt (1992) accomplished a great deal when they distinguished some of the core components in order to produce a more precise definition of CSCW as a design-oriented research area focusing on IT-supported cooperative work.

But what, then, is the *design* of CSCW? More broadly speaking software design is becoming an established discipline with the main objective to move from a descriptive experimental theory towards a cross-disciplinary and holistic constructive approach (Winograd 1996). The research agenda for IT design now includes more fundamental issues, such as the relationship between the design of software and software environments. This discussion seems to be lagging behind in the CSCW field. Greenberg (Interviewed in Crow et al. 1997) argues that CSCW is deficient of a more holistic design perspective. The idea of understanding CSCW from a design perspective is still mostly unexplored. Work settings are still mainly understood from a theoretical perspective and are not based on daily practice that is interpreted in a non-Cartesian framework (Flores and Winograd 1986).

One response is to argue for the development of a better grounded sociology of work as a *'workaday world'* (Moran and Anderson, 1990) drawing on the inspiration of ethnomethodology and, as a means, ethnographic studies of the settings of sociality technology and work practice. Another attempt may be found in Bødker and Trigg's (1994) exploration of adapters, or tailors, of software, and how that process

shaped, modified and expanded the practice in their workplaces. Their work was based on '*Scandinavian model of System Design'* (SD), a research movement that pointed out that the design of software is always intertwined with the design of the organizational interactions that surround its use (Bjerknes et al. 1987). The key idea in this design approach is to design better systems by explicitly cooperating with the people that will ultimately use the products. One of the key instrument that has been used in SD is *'Cooperative Design'* (Greenbaum & Kyng 1991). Another term with somewhat different focus, mainly used in North America, is *'Participatory Design'* (Schuler and Namioka 1993). Never-the-less I will collectively label these approaches as *SD*[1]. Unless the source talks more specific about the method applied, I will talk about cooperative and participatory design.

One of the sources of SD was the large degree of dissatisfaction with the fact that computer systems for a very long time have been designed with little sympathy for the end users. From the very beginning of the evolution of cybernetics, it has been perceived that the computer revolution *"is a two-edged sword"*. Norbert Wiener (cited in Tomeski 1975) claimed that *"It may be used for the benefit of humanity. It may be also used to destroy humanity"*. Tomeski writes furthermore in his book People-Oriented Computer System that:

> *"even if about twenty-five years have passed since the modern computer was introduced, a surprising amount of ignorance about computers and their use remains".*

Indeed, even after almost fifty years have now passed, this kind of vocabulary still sounds very familiar. Kapor (1996), for example, in his software manifesto, talks about the shame of the computer industry for intentionally overlooking the usability aspects of software. Tomeski points out the problems with reduced professional skill and states, *"the*

[1] However there is no such thing as *The* Scandinavian model of system design approach. There are not one, but several approaches to systems design using this term. In this chapter will we later on discuss some of the most well-known and influential of these.

enrichment of jobs and organizational environments should be considered when planning systems for the computer". Another early example can be found in (Greenbaum and Kyng 1991) when they cites Robert Boguslaw, who in 1973 claimed that:

> *"[system developers were] concerned with neither souls nor stomachs ... people problems [with computer systems and their implications] are left to the after-the-fact efforts of social scientists".*

SD originally developed out of a workplace democracy movement. Hence, the methods and approaches in SD mainly concern the workplace and the social effects of new technology. Given this SD and CSCW share several fundamental concerns: How do people prepare and carry out cooperative work? How can communication and coordination enhance quality, efficiency or pleasant cooperative arrangements? How can IT support cooperative work? What are the politics concerning the suggested technology? Can the technology be in accordance with good work conditions and labor agreements? Does the law require it? These questions are as important as they are endless. It would be irresponsible and ignorant not to forecast the profound changes in society that CSCW technology will entail. However, many of these questions are outside the scope of this thesis, but in-depth discussions could be found in Kling and Scacchi (1982) and Zuboff's (1988) classical studies of how IT affects the workplace. Marc Berg's thorough analysis of the politics of bringing research in social science into the CSCW field provides a more updated perspective (Berg 1997).

CSCW and SD have co-existed largely within the same research communities for more than 10 years, but the actual use of cooperative design in CSCW design have been surprisingly small. Kensing and Blomberg state (1998) that there is:

> *"considerable overlap in the problems addressed by research in CSCW and participatory design" but there are also "differences in the emphasis placed on the shared concerns of technology design, cooperative work analysis, methods and worker participation, and organizational and political change"*

Encouraged by this reasoning, and by Kyng's (1994) discussion of the relation between Scandinavian Design and CSCW, I developed the key objective in this thesis – '*how to apply the Scandinavian model of system design in the CSCW domain*'. The main focus in my thesis is on the practical application of SD in CSCW, i.e. how could cooperative design be used in CSCW. In particular, this thesis will focus on the following issues:

- *Can simulation of work situations be used for cooperative design of CSCW systems by developers and users?*
- *How can we balance a design based on daily work practice with exploration of innovative CSCW solutions?*

SD has advocated for a long time a broad range of methods that should enable developers to immerse themselves into work situations and practice as well as educate potential users about technical possibilities. In this tradition developers and users cooperatively and gradually develop a design practice for system design. Hence, in order to try out SD methods within the CSCW context our main approaches have been to work with a design-by-doing approach studying what kind of work artifacts can be used as prototype media in the design of CSCW, and exploring how combined design approaches could merge transient work practice with *'workaday world'*.

1.1 Thesis Outline

The main method of the thesis is towards an understanding of SD through description and reflection over a series of case studies, i.e. design-by-doing, and is based on three different CSCW systems, each of which was based on its own SD principles. These case studies are: '*The Collaborative Desktop*' (Marmolin et al. 1992; Tollmar 1993; Tollmar, Marmolin and Sundblad 1994; Tollmar and Sundblad 1995; Tollmar 1995b), '*The AtWork system*' (Tollmar and Sandor 1996; Jönsson, Schomer and Tollmar 1996; Tollmar, Sandor and Schömer 1996; Tollmar 1997) and '*The VideoCafé system*' (Junestrand and Tollmar 1998; Tollmar et al. 2001). Each study provided a unique context that required a specific combination of design approaches. These case studies covered a variety of methods from the SD tradition, and the

study of how these methods have worked out is the primary outcome in my thesis. The reflections and summaries of these case studies have been materialized in a practice that advocate the use of *'design orientations'* that merge different design methods into a coherent design (see Chapter 5.2). In my interpretation, design orientations stands in clear contrast to a design models by being more suggestive and less demanding.

This chapter starts with a description of the chosen research methods and their theoretical grounding in various academic fields. In the basis for the design analysis, that follows, the relations between information technology design, user-centered design and SD are discussed. I will then discuss some current perspectives of CSCW with the aim of formulating a few ideas for re-thinking the development, deployment, and adoption of CSCW technology. One repeating argument is that when it comes to designing workable CSCW systems, the technology must smoothly support and harmonize the shifting needs of the group activities, the actual work practice and anticipated problems. That seems to be one of the big challenges for CSCW design, i.e. how to design for usage that evolves.

Chapter Two provides the first of the case studies, with reflections and conclusions:

- *The Collaborative Desktop, an extension of the traditional desktop model with CSCW support, was developed thro ugh extensive work, use and assessment of different prototypes, paper mock-ups, software, videos and demonstrations of theses prototypes.*

Chapter Three provides the second of the case studies, with reflections and conclusions:

- *The second case study is built on a system called AtWork. The basic idea of the AtWork system was to build a tool that could be used to create and maintain social awareness among groups of working professionals. In the AtWork study we tried to mix cooperative design with ethnographic studies to balance transient and traditional work practices.*

Chapter Four provides the third of the case studies, with reflections and conclusions:

- *In the VideoCafé system, we studied the use of video-communication. Basically, VideoCafé is an installation of a media space between two research groups, one at KTH-CID and the other at Ericsson Media Lab. In the VideoCafé project, in a close loop with the users of the system, we built a number of prototypes of media space installations where different features of the system were tested and re-designed while it was in use.*

Based on the conclusions from the case studies, Chapter Five will work out a general design approach of how to apply SD in CSCW. Given the complexity of CSCW it will be argued that traditional cooperative design is not sufficient in CSCW situations. A multi-design approach is needed that involves a number of disciplines, not just cooperative design but also ethnography and architecture design. The very reason to suggest a multi-design approach is also derived from a non-rigid and open view towards design. We believe that the importance of sharing design practice is not to provide a cookbook with stepwise receipts but rather to discuss our experience of using different approaches.

Figure 1: The CoDesk Environment, The AtWork sign-in board, and The VideoCafé system.

1.2 Past and Current Views of CSCW

Before I start to elaborate on specific case studies and their outcomes I will point out some of the discussions that have had major influence on the CSCW field in general and on my work in particular.

Paul Cashman and Irene Grief coined the term *'Computer-Supported Cooperative Work'* (CSCW) at a workshop at MIT in 1986. The aim of the workshop was to gather people from various disciplines, who shared an interest in how people work, and how technology can support cooperative work (Grief 1987). They used the term CSCW to describe this common interest. This workshop was followed by the first CSCW conference organized by ACM in December 1986 in Austin, Texas. The conference on CSCW has then been held biannually since 1986. Since 1989 it alternates with the European conference on CSCW (ECSCW) which is held every odd numbered year. Ever since 1986, the term CSCW has been the subject of a lively debate. Several researchers have been focusing on the cooperative properties in the field of CSCW area, and they define CSCW in contrast to normal software by assuming that CSCW will make the user explicitly aware that he/she is part of a group, team, organization or community. However, as Bannon and Schmidt argue (1992), it is more important to talk about the implications of the field rather than the core definitions. Hence, I will not get involved with CSCW definitions. Instead, my pragmatic analysis is built upon an understanding of CSCW through a number of exemplary systems and the theory behind these systems.

1.2.1 Basic CSCW: Exemplary Systems

E-mail is probably the most successful form of CSCW tool (Sproull 1991). The tremendous growth of the Internet over the past decade has turned this medium from a purely professional tool to an everyday tool for people in general. This has led to new problems with e-mail, like the overflow of junk mail. Malone and his colleagues developed various mechanisms for filtering e-mails, such as Information Lens and Oval (Malone 1988). Many of these ideas have now been incorporated in today's e-mail applications. These technologies are often also labeled *'Computer Mediated Communication' (*CMC) which is a slightly easier term to define since it avoids the discussion about what is cooperative work. Some would claim that CMC is a broader field than

CSCW while others would argue that it is exactly the opposite since it is the discussion about cooperative work that make CSCW a vibrant, inter-disciplinary field.

Coordination among co-workers through the use of CSCW tools, e.g. Oval's semi-structured messages, is also called a workflow system, and here we can see a close connection between workflow systems and messaging systems. The original idea in a workflow system is that the work can be clearly flowcharted and defined as tasks that should follow a defined path within an organization. Winograd (1988) has suggested a language-action perspective for the design of workflow systems and used the conversation as the basic metaphor in the Coordinator system. But this design approach was not particularly successful. More recently, much more loose definitions of workflow have been designed and used (Dourish 1997). Anyhow the controversial implications of task-oriented systems remain important issues still debated within CSCW research.

Capturing the dual nature of cooperative work, the formal and informal aspects of work, is an important feature in CSCW research. Robinson (1991) elaborates on the need to support a double-language, i.e. a language that is both formal and flexible at the same time. Robinson argues that what most CSCW systems lack is alternative communication channels. He suggests the notion of *'formal'* and *'cultural'* levels of communication. The formal level is essential, as it provides a common reference point for participants. The cultural level defines a different type of world. It is an interweaving of subjectivities, where the counter-factual is as significant as the given. The formal level is meaningless without interpretation, and the cultural level is vacuous without being grounded. He refers to the Grove cooperative text editor (Ellis 1988) as an example of a system that offers this bi-level communication channel. In addition, the on-going textual alternations could use a user's voice annotations to sort out problems that need an alternative form of communication.

Another specific category of CSCW systems is one that assists a group of individuals working together at the same time. These could be used for writing or sketching via some shared application. The first demonstration of such a system was already given 1968 by Engelbart when he and his colleagues presented their NLS / AUGMENT systems

(Engelbart 1973). Engelbart's vision was to enhance human intellectual capabilities and to facilitate group collaboration among workers pursuing common goals by providing tools for *'tough knowledge work'*, e.g. planning, analyzing, and designing in complex problem domains (Engelbart 1988). The work by Ellis, Gibbs and Rein envisioned a decentralized version of a system such as Engelbart's (Ellis et al. 1991). With standard workstations (Xerox) Ellis et al. explored a set of groupware tools that are commonly known as the COLAB system. By utilizing the computer power that persons have on their desk and linking the desktop devices together, it was possible to provide a subtle shift of power from centralized to individualized use of computing. Many of the key ideas in today's desktop conferencing systems and meeting support systems are derived from the COLAB system, e.g. WYSIWIS (What You See Is What I See – compare with WYSIWYG – What You See Is What You Get) and private workspaces.

Also demonstrated by Engelbart was the use of computer-supported video-meditated communication (VMC) for connecting remote meeting environments. Studies of video-communication to support cooperative work has been a part of the field of CSCW ever since. Over almost two decades several experiments questioned the value of video-communication since it was hard to empirically show improvement between meetings performed with and without video-communication (Dourish et al. 1996). However, the presence or absence of a social context deeply influences how conversations proceed and their results. Kraut's (1990) study of teamwork showed that informal communication is an essential form of human communication and suggested that this might be the major contribution with video-communication. Tang and Isaac (1993) used a practical case, with the ShowMe application, to show that the major point of video-communication is to provide a rich social context and hence improve the comfort level in remote meetings. In related research in mediaspaces (Bly 1993) we can see a trend towards non-quantitative studies in an attempt to specify users' perceptions and awareness of the presence of others (Bellotti and Dourish 1995). Furthermore, mediaspaces appear to be especially well suited for informal communication (Bly 1993.).

I will now go into more detail and talk about some more specific perspectives on CSCW. I will then elaborate in particular on

customizable properties in Information Lens and Oval, and shared information spaces such as in the COLAB system and the innovative use of video-communication such as Xerox mediaspace and Sun's ShowMe application.

1.2.2 Tailorable CSCW Systems

It has been argued that system designers seek to develop stable systems, but that workgroups in well-functioning teams are constantly changing. CSCW solutions should never be static. They need to evolve as people's work practice evolves over the course of a project. CSCW systems should emphasize these different perspectives. However, this will lead to painstaking and complex design efforts as a result of this diversity.

A number of systems have sought to solve this by giving users more control over the personal computing environment, e.g., Quilt (Leland et al. 1988), Information Lens (Malone et al. 1988) and Oval (Malone et al. 1992). These systems are based on the fundamental assumption that even casual computer users could build their own cooperative work applications if provided with a set of simple, yet powerful, tools. For example, all objects in Oval can be connected to action-based rules, implemented as agents that process the objects with or without active involvement by the user. Users can also link objects into a hypertext structure by combining agents and views using what Halasz (1988) regards as one of the most important features of hypertext systems: the ability to create and use dynamic nodes, e.g. messages and replies.

This could be viewed as extreme user-participatory design. However, field studies by Mackay et al. (1989, 1990) showed a somewhat opposite view, where most people did not find Information Lens especially useful, and many functions were used with great caution. Most obvious examples were that even if agents were easily defined by even novice users, most still found it more secure to use the agent's manually afterwards, e.g. for sorting mail, instead of using autonomous agents a priori.

Tailorability seems however to be a desirable feature especially within the field of CSCW, see e.g. (Bødker and Trigg 1994; Mambrey et al. 1998), but it also generates new questions. What properties make Excel

and similar tailorable environments so powerful and successful? How can we boot-strap a process when people start to build CSCW environments? Is technical knowledge the limit? Do people have the time and knowledge to build their own work environments? CSCW provides here unique opportunities for integrating cooperative tailoring functions but it seems that this process needs to be supported by an active deployment process.

1.2.3 Shared Information Spaces – WWW

In current commercial workflow systems, like Lotus Notes, it seems that the design of shared information spaces tends to provide more flexibility than the language-based models suggested by Winograd (1988) as pointed out by Bannon and Schmidt (1992). From a technical point of view, Notes gained momentum by successfully using replicated database techniques designed for an environment that is only partially connected. These partially connected, shared repositories of information can be used in a highly flexible manner for shared documents and messaging systems, among many other CSCW tools.

Studies from the COMIC project (1995) have also shown that document sharing is intimately tied to social activities and their production is not *'merely'* a mechanical process but also an interpretative one. Consequently sharing also become intimately tied to the design of CSCW systems. However sharing in real work situations is much more than just being able to simultaneously access common information, e.g. a meeting around a document is often about coming to some agreement as to what should be done about a particular case. One of the major problems in designing such a device for CSCW applications is *'representing'* in electronic form some of the subtleties of document use which *'belong'* to current manual systems; subtleties which are often *'invisible'* because of the very familiarity of such systems. Hence King and Hughes (COMIC 1995) suggest that:

> *"it might be useful to envisage 'what if' scenarios based on studies of work activities, to attempt to identify some of the consequences of incorporating CSCW applications with respect to record use".*

Kyng suggests a similar approach that also incorporates cooperative assessments of variously scenarios as a part of the cooperative design activities (Kyng 1994).

A number of different CSCW systems exploit the use of a shared store to support cooperative work. Early examples are mostly derived from multi-user hypertext systems such as KMS (Yoder 1989) or SEPIA (Haake 1992). However, shared hypertext facilities are also exploited within cooperative authoring systems such as Quilt (Fish 1988). However one of the main reasons for the only partial success of such CSCW systems is that only a (very) few cases have obtained a critical mass of use. This is mainly due to the lack of technical standards, i.e. most of these systems are using non-compatible systems and networks.

The Internet and the World Wide Web have changed these shortcomings and maybe the most important factor in its success is that the web gets a critical mass of professional users in a wide range of categories. Today the web is an emerging platform for information systems. Furthermore, the web has developed some new standards, the most important of which is HTTP. In this view, the web becomes a collaborative technology – it allows people to share information. The web is now also regarded as a natural infrastructure for CSCW such as the BSCW system (Bentley et al. 1997) and in a large number of scientific applications (Henline 1998).

The web also contains communication artifacts, usually web pages. Dix argues however (1996) that new feedback and awareness mechanisms are needed to enable more fluid cooperative settings on the web. Improving the web so that it no longer acts merely as an *'Info Space'* but instead becomes a *'Meeting Place'* might change the nature of the medium fundamentally. Manhart makes a similar comment (1999):

> *"…established system architectures for web systems focus mainly on the creation and storage of consistent hypermedia information structures and on the efficient distribution of the resulting documents. The interaction between the information users is seldom supported."*

Reflecting back to the analysis of paper work it is probably wise to develop a richer set of functions for document sharing on the web, such as access handling, authentication, trustability and new types of tools to create relationship. Capturing such subtleties is not only a matter of interface design though this is an important matter that will need to be addressed, particularly in the direction of creating effective and smooth access to interactive document stores.

1.2.4 Mediaspace

As mentioned above, tools that support real-time communication, such as video communication, have been studied for more than two decades. However, the success of videoconferencing systems has yet to materialize, and it has been suggested that the design and deployment of this new medium requires much more care before it can be distributed to a large community of users. In this section, I will briefly describe some well-known systems that try to facilitate social networks by using new approaches in video– and audio-communication for interpersonal communication.

The first example is from Xerox Research Center. In 1984 a new lab at Xerox Research Center was established with one site at the main campus in Palo Alto and the other in a remote office in Portland. The idea of the lab was to expand the idea of personal computing to interpersonal computing (Olson and Bly 1991). For that purpose, they developed tools in three different areas: shared computing infrastructure, design methodology and mediaspace. Mediaspace is the term coined by Robert Stults at Xerox Parc to label electronic media that have the ability to alter and augment physical space (Root 1988). The importance of the Palo Alto – Portland mediaspace was that it provided an opportunity for communication that would not otherwise have been possible, and that the support extended beyond communication regarding the explicit content of work tasks. Bly argues (1993) that this made the mediaspace a way to sustain working relationships.

Another attempt to reformulate the use of video-communication was the subject of research at Bellcore through the *VideoWall* system (Kraut et al. 1990). Kraut describes two significant research issues:

> *"how to design a mechanism for coordinating the social and production roles of people in the workplace"*
>
> *"explore whether video's employment in system for informal communication might be successful because video simultaneously reminds you of a need to talk to someone and provide a communication channel through which to carry on the conversation"*

Kraut et al. focus on informal communication due to an earlier experiment and research by their team where they concluded, by using observational studies, that over 85 % of all interactions, and more than 50 % of the conversations were unplanned (Kraut 1990). They observed that, *"it is clear that much important work in research and development organizations occurs in unscheduled meetings"*.

They also showed the importance of being close physically. It is easy to prove, and intuitively understand that casual interaction is more common if we work in the same office or corridor than if we work apart. Hence, the physical and technical design of the VideoWall system becomes essential. The VideoWall system was hence designed to continuously connect two public lounge areas to support casual interaction between people that worked at two different parts in the lab. The system used also a large wall-projection system, equipped with several audio channels, to even better support social encounters with remote colleagues. The audio channels provide sound localization in a way that the speaker's voice appears to originate from the location of the speaker's image, this enabled several conversations to take place simultaneously. The outcome of the studies of the usage of the VideoWall system was encouraging, and despite several design flaws, it was clear that most of the conversations would not have occurred if the system had not been in place.

Several of the problems that videoconference systems face today are due to ineffective display techniques. Placement of displays and cameras is very important to maintain those social protocols that human interactions rely on. These issues have been tackled in *Clearboard* (later called the Team Workstation) from ITT (Ishii and Kobayashi 1992) and the *MAJIC* system (Okada et al. 1994).

Clearboard allows co-workers in two remote locations to work with drawings and software tools while maintaining direct eye contact and the ability to use natural gestures. The system was designed successfully by using a simple but powerful metaphor while developing the mock-up. The metaphor that Kobayashi and Ishii used was *"looking through and drawing on a big glass board"* – hence the name Clearboard. In studies of prototypes of Clearboard, it has been proven that users of Clearboard can make effective use of the ability to shift the focus, making eye contact and monitoring a partner's direction of gaze. Clearboard has also been used to show its communicative strengths in alternative forms of more playful interaction between a musician and a painter.

The design of the MAJIC videoconferencing system, was concerned with providing a similar kind of context as in face-to-face meetings. The central objectives were to support life-size images, multiple eye contact and gaze awareness. The latter is especially important in multiparty conferencing sessions where the ability to have side conversations is of utmost importance. It speeds up the meeting process and reduces conflicting errors during critical remote meetings.

These four experiments in mediaspace technology show an increasing need for a communication medium that could better support informal communication. Informal communication is of utmost importance and should be one of the design goals for CSCW. Informal communication is spontaneous, interactive and rich in quality and experience. Designing communication media that can support this is demanding. It requires a delicate balance between openness and access that conflicts with privacy restrictions. Therefore, it is essential that this kind of system is sensitive to the social context where it will be used.

In the studies we observed an attempt to incorporate competence from non-traditional CSCW fields, such as interior design and architecture. The creation of places for casual interaction and playful cooperation involve issues that are so far missing from traditional CSCW research.

1.2.5 CSCW – A Solution Looking for a Problem?

But what are the collaborative problems that the field of CSCW is trying to solve? What is the communication problem? Furthermore, is

the chosen problem critical to the organization? One early evaluation was conducted by Orlikowski (1992) using real work situations in a large company that was introducing Lotus Notes. Orlikowski claims that corporate cultures are usually competitive and seldom support cooperation and sharing. Hence, she reasons, it is likely that the introduction of CSCW will generate large difficulties. There are two organizational elements that are of special importance: people's mental model of the technology and the structural properties of the company, such as policies and norms. Orlikowski puts it:

> *"A major promise underlying groupware is the coordination of activities and people across time and space. For many users, such a premise may represent a radically different understanding of technology than they have experienced before. This suggests that a particularly central aspect of implementing groupware is ensuring that prospective users have an appropriate understanding of the technology, that is, that their technological frames reflect a perception of the technology as a collective rather than a personal tool."*

Orlikowski argues that having an '*appropriate understanding of the technology*' would provide the users with a greater understanding and motivation for the system. But what about an '*appropriate organizational understanding*'? We also would like to question whether networked and globalized enterprises and organizations are sufficiently well-understood by people working in these settings to make conclusive and contextualized CSCW case studies. For example, if experience in working in a networked organization is limited, how can it be possible to assess the difference a CSCW system would make? A classic case of the clash between norms in an organization and the new habits imposed by CSCW has been documented by Zuboff (1988). Other studies have also revealed cases where organizational problems make the introduction of CSCW difficult, even if the CSCW technology was appropriate. For example, Bowers & al (1995) came to a similar conclusion when they analyzed the needs and use of CSCW software in a governmental agency. Their study uncovered also organizational obstacles that made the installation and use of CSCW tools problematical.

This raises an important question: Are we looking for answers in the right place? We have networked computers, Internet technology and a broad range of options for creating new communication media, but the problem in adopting these opportunities may reside rather in organizational matters.

1.3 CSCW Design Methods

The construction of information technology has radically changed work tasks and workplaces as well as large work organizations. This socio-technical perspective on CSCW highlights a facet of modern communications that needs further examination. It has become obvious that building CSCW applications is far more complicated than designing single-user systems (Rogers 1994). Bannon and Schmidt argue that if you enter into CSCW issues, you will change a broad range of socio-technical matters – *"enter and you will change"* (Bannon and Schmidt 1992). Consequently, the basic approach of CSCW research should be constructive rather than descriptive. Like an architect, who has to design buildings with a functional form as well as reflect the inhabitants' cultural values, designing a CSCW system is also a complex issue. Given this, the socialization of CSCW design is becoming even more important. CSCW design is not only a process that generates CSCW solutions. It is a key factor in the deployment of CSCW thinking and the development of cooperative work.

1.3.1 CSCW Design Founded in Qualitative Research

Most CSCW design is established within the frame of qualitative research. Qualitative research methods are designed to help researchers understand people and the social and cultural contexts in which they live. Qualitative data sources include observation and participant observation (fieldwork), interviews and questionnaires, documents and texts, and the researcher's impressions and reactions. Orlikowski and Baroudi (1991) suggest that qualitative research could be categorized into three categories, based on the underlying research epistemology: positivist, critical and interpretative. Positivist studies generally attempt to test theory, in an attempt to increase the predictive understanding of phenomena. Critical researchers, on the contrary, assume that social reality is based in history, and that it is produced and reproduced by people. Habermas argue that critical

research focuses on oppositions, conflicts and contradictions in contemporary society, and seeks to be an emancipator to help eliminate the causes of alienation and domination (Habermas 1971). Finally, interpretative researchers start out with the assumption that the only way to get access to reality (a given or socially-constructed reality) is through social constructions such as language, consciousness and shared meanings. Just as there are various philosophical perspectives that can inform qualitative research, there are various qualitative research methods. Examples of qualitative methods are case study research, ethnography and action research.

Case study research is the basis for all studies in the thesis. Case study research is a common qualitative method used in information systems research as well as CSCW research. Yin (1994) describe research based on case study as:

> *"A case study is an empirical inquiry that: investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident"*

A common quality research method within CSCW is ethnographic research. The ethnographer should be immersed in the life of people that is studied and *"seeks to place the phenomena studied in their social and cultural context"* (Gould and Lewis 1985). Depending on the focus of ethnographic research, it can either have a critical or an interpretative center. Early pioneering work includes Suchman (1987) and Zuboff (1988). Lucy Suchman builds her results on ethnomethodological interpretative studies focusing on the design of computer technology. This research is, Suchman claims, best carried out in close proximity to the work of those who use the system.

Ethnography has also been used as a method whereby multiple perspectives can be incorporated in system design, especially the study of the design of CSCW systems for various forms of work practice (Hughes et al. 1992). Work practice is becoming something of a rallying cry in many quarters of CSCW. What counts as work is in this context a matter of definition. Sometimes waiting passively is considered work. For others it involves extreme physical challenges like sports or construction. For some just lending their name to an

enterprise can be a well-respected form of work. Button and Harper argue that the sociological underpinnings of the concept of work practice are *"less well understood"*. The grounding theory of ethnomethodology involves generating descriptions of work based upon sociological theories of social structures (Button and Harper 1996).

In addition there exist many obstacles to transform the outcomes from a workplace study to inform a CSCW design, Plowman et al. (1995) write:

> *"What this reveals is a big discrepancy between accounts of sociality generated by field studies and they way information can be of practical use to system developers".*

Plowman et al. suggest hence to use *"hybrid and tailored"* form of ethnography which could be more usable in design.

1.3.2 User-Centered CSCW Design

Established methods from HCI, for example user-centered design with its base in qualitative research methods, such as described in Gould and Lewis (1985) and Norman and Draper (1986), have often been reused for CSCW design to confirm the social-technical approach in the design.

Marca (1992) expanded the notion of user-centered design by including active collaboration with users in order to achieve a better understanding of the unique context of people's work. His design framework advocates a combination of design methods and social theories. Informal interviews happen when group members share their norms and work practices. Information is made available for continual re-interpretation. Design is a collaborative effort between users and developers, and verification and validation involve rapid prototyping at the actual work site.

The design framework outlined by Marca suggests that CSCW system design and evaluation methodologies are closely related, mainly because both of these activities need to have a very clear picture of the users' work situations. Greenberg (Interviewed in Crow et al. 1997)

also argues that there should exists a close relationship between design methods that work well for CSCW and the evaluation of CSCW usage:

> *"We need to develop low cost ways to uncover the design requirements of existing collaborative situations, as well as low cost methods for evaluating the groupware prototypes and systems we build. We also need good metrics and test situations that we can use to quantify performance changes when CSCW systems are introduced."*

Another example where design and evaluation are closely related is Suchman and Trigg's work (1991) on using video as a way of understanding work practice that can both inform system design and be used for evaluation purposes. The work by Suchman and Trigg suggests here the potential of merging design and ethnography. Button and Harper (1996) take a slightly different approach when they analyze work practice from the ethnomethodological definition of the unfolding contingencies of work and the temporal order of work. However, their conclusion, based on this view of work practice, is that design could neither be based solely on formal work procedures, nor on the narratives in daily work life.

We could interpret the emphasis on design as an active step away from traditional software construction due to numerous failures in the area of software development. On the contrary, the practice of design has a genuine history of understanding actual practice and everyday requirements (Ehn 1993). The role of design in software development has hence become more salient (Bannon 1986, Norman 1988). We could attribute this approach to a new understanding of software design and a general understanding of the everyday use and experience of software. Winograd (1996) suggests studying the use of software even closer, when he uses the metaphor of *"inhabited software"* to describe an intimate relationship between software and use. Software could be seen as a design generator of space, in which the *'users'* operate. Architecture explores this particular experience of using space in a way that very well could act as a guide for software design (Hooper 1986). The idea that the use of network technology leads us to inhabit the net with cooperative activities as described by Harasim (1992) is one possible development of the user-centered model in the CSCW

domain to describe an intimate relationship between the network and the users. To understand this even deeper we suggest a closer connection between the developers of network technology and users.

1.4 Scandinavian (cooperative) Design

The main part of the Scandinavian model of system design tradition focuses on how system developers should and could work with end-users to improve engagement in the development process. The background for this was the early introduction of IT technology, which in many cases automated work at the expense of a de-skilled workforce, a clear division of labor and control over the work process. Bjerknes, Ehn, and Kyng (1987) made a major contribution here with organizing the conference: '*Computers and Democracy: A Scandinavian Challenge*'.

They argued that the most vital factor for obtaining systems that meet users' needs and requirements is user involvement in the design process to create a forum for users to input their thoughts and experiences. The main interest here is not adapting the users to an already existing system development process. On the contrary, the main interest has been to reveal new ways of designing systems where the users' interests and participation is at the top of the agenda. Hence cooperative design has for a long time advocated a broad range of approaches that would enable developers to immerse themselves into work situations and actual practice, as well as educate potential users about technical possibilities. By simulating realistic work situations, the developers and users can create a system design cooperatively and incrementally (Ehn and Sjögren 1991). Direct participation by end-users is seen in this context as a means of enhancing knowledge gathering, as Kyng summarizes:

> *"We adapt the term mutual learning, to describe how a cooperative design effort could be organized"*

Cooperative design can thus be used to emphasize the combination of dissimilar knowledge, i.e. epistemological effectiveness – no single person or discipline has all the knowledge that is needed for system design.

1.4.1 Workplace democracy

SD has a root in Scandinavian workplace democracy. Ideas about workplace democracy were raising questions about the social effects of new technology on the workplace. The Scandinavian approaches to system development have therefore been characterized as user-oriented rather than management oriented, e.g. the '*Collective Resource approach'* (Ehn and Kyng 1987) that suggests using trade unions as a strategy to achieve more influence at the workplace.

The pioneering project was that of the NJMF (Norwegian Iron and Metal Workers' Union) initiated in 1970 (Nygaard and Bergo 1975). Ehn (1993) describes how this evolved from a conventional research project to one in which local unions chose the topics for study and action and were supported by the researchers. A planning and control system, an on-line production information system, and the reorganization of a main assembly line were investigated in this way. A key outcome was a local and subsequently (in 1975) a national *'data agreement'* regulating the design and introduction of computer-based systems.

One of the early projects following this tradition was the Swedish DEMOS project (Ehn & Sandberg 1979). The basic assumptions were that the use of computer technology contributes to rationalizing work and deskilling workers, and that there is a fundamental conflict between workers and employers that cannot be resolved without strict negotiations between workers and management.

The UTOPIA project followed that same strand but focused more specifically on technology development for graphical workers (Bødker et al. 1987). The UTOPIA project had three major goals: to contribute to high-quality graphic products, to improve skilled graphical work and to create a more democratic work process. The basic assumption of the UTOPIA project was that strengthening the labor side would increase the quality of product, the quality of work and democracy. The aim was to increase the graphic workers' power by expanding their knowledge about their work. Computer systems can act as specialized tools that are controlled by workers to give them more control over their work.

The UTOPIA key results were not mainly the developed system, TIPS, but the discussion around experience and methods. Most important was that the UTOPIA project showed that it is possible to design IT-based solutions with user requirements from their work experiences, an idea that was considered unworkable by management and employers at that time. One of the key approaches to worker participation was to establish a relation between designers and users by using mock-ups and simulations, as opposed to using formal requirements that were found to be much less successful as a means of communication between designers and workers (Ehn and Kyng 1991). An outcome was the *'tool perspective'* that was developed at the end of the UTOPIA project. It summarized the basic ideals of the project; that the computer should be a tool for skilled workers and workers should be in control of the tool. Practically, this was demonstrated through the use of low-tech prototypes (mock-ups and simulations) for workers' discussions with designers. It has been suggested that one of the benefits of this approach is that the workers do not have to explicate their work procedures. They can express their job skills by demonstrating and doing their work. Ehn (1989) argues for an understanding of design-by-doing and skill-based participatory design and views this type of understanding as a complement to descriptive ethnographic knowledge:

> *"There is much more knowledge in the practice of the design and the use of computer artifacts than can ever be formally described or reflected as system descriptions"*

These expressions of tacit knowledge make it possible for ordinary users to use their practical skills when participating in the design process. The fundamental principal on which this is built is the power of abstract prototype media. Ehn argues that the strength of prototypes is embedded in the fact that "*they recall earlier experiences to mind*". Ehn refers here to Wittgenstein who argues that to understand and to be able to use is the same thing, i.e. in order to use a vocabulary you need to understand it.

Some commentators suggest that the main rationale for cooperative design has shifted after the Utopia project from democratic participation to effectiveness in design (Procter and Williams, 1992), as

evidenced, for example, in Greenbaum and Kyng (1991). It might be more accurate to say that the concern with effectiveness has always been there, but that its grounds have shifted. In the earlier formulations, the capitalist context and its labor process implications were themselves seen as the main fetters on development, so that a thoroughgoing industrial democracy was the most obvious way to unleash more effective systems. As confidence in this straightforward solution has weakened, more complex partnerships are being sought as a means both to the quality of working life and to effective systems.

A recent account of the experience from UTOPIA and other cooperative design activities by some leading participants is (Bødker et al. 2000), from where I cite:

> *"Our 'political' focus on worker participation and the development of new cooperative design methods have in the 1990s become a 'success' in the USA as 'Scandinavian participatory design'. The reason is simple: participation is not only a political and emancipatory category, it is also a basic epistemological (knowledge theoretical) principle. Participation is a fundamental process, not only for democracy, but also for learning. It would certainly be to overestimate our political impact to confuse the two. Today we are more at home in the academic world, than on the political arena. The researchers are no longer dissidents, but for good and bad pretty main stream socio-technical researchers and designers."*

1.4.2 Design theory

Earlier criticized for being rather ad-hoc and without a firm research basis, current SD research now has an improved theoretical framework. Practical deployment of SD has been inspired by movements in design theory and has shifted the focus from system description to design activities, such as prototype-based hypothesis assessments and mediated workshops (Bødker et al. 1987). However, the evolution of design theory has many concurrent movements and to understand today's issues a short review of design theory might serve well as common ground here.

In the industrial era, it was perceived that the major metaphor for design work was the process. The needs in the post-war era were enormous and pragmatic. Systematic methods, through standardization and specialization, seemed to offer the most rational solutions. Design theory in the 1960s was heavily influenced by these movements, and design methods at the time tried to mimic the evolution of design activity into a process. The basic idea was to deconstruct the design process into a sequence of manageable activities. Analyzed more closely, the demands for logic and rationality could be derived from the goal of decoupling activities in order to create space for collaboration in complex projects. In practice, this led to an increased division of labor and resulted in an increased belief that objective, rational reasons could guide the design process. A counter-reaction to this can be found in the work of Chris Jones (1970). Jones' key argument was that traditional product development has its origin in a craftsman's gradual refinement based on intuition and experience. This approach was obviously not in accordance with the industrial view on standards and specializations, but Jones' suggestion was to combine the two approaches. The suggested *'metamethod'* was a compilation – a cookbook – of various design methods. As such, it became a prominent resource for designers.

Today, designers once again are starting to look for multiple-methods, and compiled methodology books are starting to become common again, e.g. courseware in HCI such as Dix (1990) and Preece (1994). Rogers argues (1999), that the question of which design method to select is misleading. It is not a question of selecting one in favor of another. When deciding on how to proceed with developing a system, it is more useful to consider how to combine different methods to gain maximum usefulness. She continued by suggesting that one of the best *'design methods'* – the knowledge of how to achieve good design – is to read about how others have experienced related design projects and case studies that reflect the contexts in which they are used.

A second counter reaction towards formal requirements was to suggest design representations that are more flexible such as *prototypes* and *mock-ups*. Some design disciplines, such as industrial design, make difference between mock-ups and prototypes to separate the intended audience and use and would only use the label prototype to describe highly finished design work, like an almost functional car. I will also

make a difference between mock-ups and prototypes. However what we here will label as prototypes include also early design work still compiled with some more advanced tools than just pens and paper.

One common prototype media for software design is simple script programming environments such as Director or Visual Basic (Winograd 1996). Using these types of tools to create prototypes makes it possible to quickly create a dynamic visual representation of an idea. As this might not always be sufficient, sometime we need prototypes with much functionality. It is common to categorize software prototypes, in *'horizontal'* and *'vertical'* prototypes. The horizontal prototypes are *'broad'* and deal with the overall look and feel. The vertical prototypes are *'deep'* and concern specific tools. A complement to building software prototypes is to use paper mock-ups with the obvious advantage in the early design phases that with a paper model it is clear that the design is not fixed and could easily been changed. This tends to relax the discussion and makes paper mock-ups a good medium to communicate about design. A very simple form of mock-up is overhead slides. Other forms are:

- *Abstract cards that could be used as a game.*
- *Screen shots (with slips representing icons, menus etc) to perform walk through in the system.*
- *Paper and pen for sketching.*

Yet another traditional prototype medium is video. A strong feature of video is that it enables us to show examples of use of a system in different environments. Scenarios that span over longer periods can be shown. With video a *'polished'* version of a prototype system that resembles of a finalized product can be simulated. One drawback with video production is that it needs considerable planning.

The basic idea in prototype development is a stepwise product development process where great attention is focused on the iterative refinement (Greek Protos = first). The iterative refinement is achieved by a feedback mechanism between the steps, such as Schön's reflective dialog with the student or in a cooperative design workshop, described below.

According to Donald Schön, design is primarily about establishing a dialog between the designer and the design. The key in that dialog is to use the designer's "*repertoire of design contexts*". Schön argues that a designer needs to be able to interplay the 'reflection in action' and the 'dialog' between the designer and the task. In *"The Design Process as reflection-in-action"* (1987) he describes a case in which the studio master teaches his students how to apply reflection as a method for thinking about and pushing the design into new direction. In the first interaction, after the task has been defined, the students present sketches to the studio master. The studio master tries to reframe the problem in a new context and outlines a design solution. He then asks the students to reflect on the work before continuing. In doing so, the students could alter the path from a dead end to a newly reconstructed problem. By means of a reflective conversation about the situation the studio master has altered the student's connection between seeing a familiar situation and using a well-known strategy. Schön refers to Thomas Kuhn's notion of unfamiliar situations which are both similar to and different from familiar ones and argues that the:

> *"whole process of seeing-as and doing-as may proceed without conscious articulation. Hence, design theory should focus on the study of the process that links the proposed artifacts to a usage situation, not on the design process itself."*

This is indeed a shared viewpoint with SD which also advocate prototyping as a way of focusing on the usage situation rather than textual system descriptions.

The Scandinavian model of systems design was also influenced by Herbert Simon's design science, developed in the early sixties. According to Simon (1981), contrary to the natural sciences, the design process aims to define how things '*ought to be*', rather than tell us how things *are*. This discussion is imperative for designing new technology such as CSCW. The root of the discussion is based on the artificial artifacts that are created during the design process. Using prototypes, we can model the fictitious artifacts, give them a clear form and function. This design-oriented approach towards knowledge building provides a mixed view of a situation, and as such, it is a complementary component to experimental theory development. A

key issue in design therefore became conceptualizing those representations in appropriate media, such as sketches, drawings, mock-ups, prototypes, etc. It has been argued that the essential core of design work is more about crafting appropriate solutions gradually rather than seeking innovations.

1.4.3 Cooperative Design Methods

One of the outcomes from the *'Design Theory'* perspective is the focus on design methods as a structure for cooperative design practice and approaches. This has lead to a categorization of cooperative design practice into many different design methods (Greenbaum and Kyng 1991, Schuler & Namioka 1993). Taken toghether there are too many cooperative design methods to be all listed here, therefore will we only in this chapter describe a few of the most well-known and influential of these. For a longer summary of cooperative and participatory design methods I would like to refer to (Muller et al. 1997).

In the UTOPIA project (Bødker et al. 1987), one of the major practical as well as theoretical achievements in the project were the experience-based design methods, developed through the focus on hands-on experiences, emphasizing the need for technical as well as organizational alternatives. In this respect the UTOPIA project influenced a shift in the SD traditions. From a descriptive practice to a design practice that focuses on the cooperative work between users and designers through mock-ups and mediated workshops, e.g. Future Workshops (further described in Chapter 3.3.2).

Paper mock-ups, such as a cardboard computer, have previously been used successfully as a cooperative design method to shape a concept and new metaphors (Ehn & Kyng 1991). As Ehn & Kyng noted, a major benefit of cardboard computers is that they form a common design language: A language that *"resembles other language games"* – games that the participants know how to play. The paper mock-up's main duty is to set the stage and support interaction and reflection. The most obvious advantage with cardboard computers is that a paper model design is not fixed and can be changed easily. This make cardboard computers, i.e. paper mock-ups, an excellent medium to talk about design issues, especially in cooperative design (Ehn and Kyng 1991).

The use of mock-up techniques was taken up in a couple of new approaches of cooperative design, such as the PICTIVE method (Muller 1992). PICTIVE uses low-tech, paper-and-pencil design objects in conjunction with high(er)-tech video recording. The intent is to provide a non-software-based *'rapid prototyping'* environment of common office objects, which can be manipulated on an equal-opportunity basis by all members of a design team – programmers and non-programmers alike. The members of the design team serve as peer co-designers, bringing their various issues to this common design environment. When the technique works well, the session proceeds as a sort of informal group brainstorming session, without any particular party driving or controlling the session.

Another approach, which is very much in the tradition of SD, is the MUST method by Kensing et al. (1996). The approach suggest a variety of techniques for developing an understanding of current work practices, including interviews, observations, etc., but the method also places a strong emphasis on the cooperative development of visions of the future system by both users and developers. Within this process, the use of *"scenarios describing envisioned future work practice supported by the proposed design"* is suggested. Because of its strong organizational focus and its reliance on the PD tradition, the MUST method attempts to explicitly accommodate conflicts of interest between management and workers e.g. in rationalization and downsizing processes. The authors suggest achieving a consensus concerning the objectives of the system design beforehand. Scenarios are here suggested to serve as a tool to make these consequences explicit for everybody involved in the process.

A concrete application of '*scenarios'* in a CSCW project is discussed by Kyng (1995), who describes the use of a variety of scenario types in the context of the EUROCOOP project. It involved the design of four generic, interrelated CSCW applications. Scenarios were used in four different roles: '*work situation descriptions'* were supposed to capture relevant, existing situations which the users find to be important parts of their work, bottlenecks, or generally insufficiently supported. Secondly, they were used in the process of developing mock-up prototypes and accompanying '*use scenarios'* that textually describe the intended future use of the envisioned system. Kyng also describes the project-internal use of more detailed, technically oriented '*exploration*

and requirement scenarios'. They complemented use scenarios by giving details that are relevant for evaluating technical details (e.g. locking mechanisms) of the proposed design. Finally, '*explanation scenarios'* gave a description of the new possibilities offered by the proposed design and the explanation of the rationale behind the design in terms of the working situations; hence these scenarios were more detailed than use scenarios.

In more recent development of cooperative design practice we could observe a strive towards using cooperative design in non-working settings, such as designing tools for children (Druin 1999). The *'consumers movements'* inspire another progress in alternative forms of cooperative design. The successful computer equipment certification by TCO, the Swedish Confederation of professional employees is here a remarkable example (Boivie et al. 1997). This has resulted in that more than 100 million persons now are using TCO *'environmentally labeled'* computers and screens. Other initiatives, described in (Bødker et al.2000) are now taken in Sweden for certification, or at least pushing demand on suppliers, of *'on the floor'* computer support in work places. LO, the Swedish blue collar union confederation, has initiated the ITQ project, *'Quality certification of Information Technology for the developing work'*, with pilot studies at several mechanical industry workplaces and care workplaces with CID at KTH as coordinating research partner. A part of the project is the *'Users award'*, driven by LO, TCO and CID, where users in workplaces nominate computer systems that give good support technically and socially.

1.4.4 Using Scandinavian Design In CSCW Design

Despite the overall positive response that SD has received from the CSCW research community, the actual number of reports where these design techniques have been used are not so many. One reason might be that in cooperative design and CSCW practitioners and participants must attend to numerous constraints if they are to discover productive options. Constraints include technology, tools, knowledge, social and organizational conventions, among others. It seems that managing the constraints of just one of the fields provides work enough, and only a few studies have in practice showed willingness to try to tackle and

balance both of them, i.e. using participatory design methods in CSCW design in practice.

However, a concrete application of using cooperative design in a CSCW project is discussed by Kyng (1994). This project was concerned with designing computer support for cooperation in the Great Belt Link ltd. Company, a state-owned company responsible for the building of a bridge/tunnel between Zealand and Funen in Denmark. It involved the design of four generic, interrelated CSCW applications using cooperative scenarios (described above).

Another Danish project in the cooperative design tradition is the AT project, a project between the local branch of the Danish National Labor Inspection Service and Aarhus University, that along these lines focused on long term strategies to disseminate the collective experience of using IT in organizations (Bødker et al. 1994). In their paper, they analyze an alternative and intermediate form of participatory design by studying how local developers help users tailor and support their software. To what extent these *'tailors'* of software actually carried out and deployed new solutions is the central question here. The normal linear development that starts with analysis, followed by design and lastly implementation does not apply to these tailors. A holistic design with its focus upon practice rather than abstract theories seems to be the appropriate approach. This generative design method means that the design constantly evolves according to its situated use. It is a process, as opposed to the traditional descriptive way of designing systems.

Two more recent examples are the POLITeam project (Mambrey et al. 1998) and Vicki O'Day et al.'s studies of cooperative design in a school-centered network community (Vicki O'Day et al. 1998). Mambrey et al. reported how cooperative design has been used in the development of the GMD POLITeam project. In the POLITeam project the main focus was on developing a system for a particular German ministry. Hence two different strategies were used, one was to adapt an existing groupware system rather than developing a new system, and the other was to use design methods with a focus directed at participatory design. Some controversial issues like privacy and integration with the traditional paperwork seemed likely to be resolved a lot more easily with the combined flexibility of customizable software and the

participatory design approach. Vicki O'Day et al. used a slightly different approach in a study of the development of a MUD system for a school-centered network community (Vicki O'Day et al. 1998). In her work, she tackles important issues, such as how technical design can strive towards social objectives in such a way that technical and social goals could co-evolve and how to deal with the fact that similar technical implementations could have radically different social effects. One important conclusion for complicated design situations is to point out the valuable contributions mediators make when they report on communication failures between a rather disparate group of designers.

In conclusion, to some extent CSCW design is inherently following cooperative design approaches, i.e. in order to take cooperative work tasks seriously designers must study these from a worker-centered approach toward system development where the users' knowledge was taken seriously (Ehn 1989). Hence, one of the basic motivations for using cooperative design in CSCW design would be to clearly highlight that work is fundamentally a social activity involving cooperation and communication. Few work tasks involve working in isolation, and hence working from the cooperative design approach presents a shift in the way group interaction is viewed within complex organizational environments. In the next chapter we will go into more detail about specific research issues that this thesis will work with.

1.5 Research Issues

Earlier in this chapter it was stated that the main purpose of this work is to advocate an understanding of Scandinavian-oriented CSCW design through a design-by-doing approach. Therefore this thesis is neither an attempt to build a wide theoretical bridge between CSCW and SD, nor to build a unified model of Scandinavian design-oriented CSCW. On the contrary, the approach of the thesis is towards an understanding of the design of CSCW environments through a series of case studies. Before these case studies are examined in more detail I would like to present the key research issues that have been investigated in them.

Our interpretation of the CSCW studies that used the SD approach is to view the design process as a process that crafts digital work artifacts to form an understanding the CSCW system. If the design is

successful, it leads to a collection of work artifacts that form, in Wittgenstein's terminology, a family that resemble the cooperative work practice (1953). But these '*digital work artifacts*' also need to suggest how to handle cooperative work through computer support in new forms. Using Ehn's definition of design (1988) but adapting it slightly to CSCW (underlined) I use the following definition of CSCW design:

> *"Design of CSCW is an interplay of understanding daily work practice and the creation of new digital tools and objects that support the cooperative daily work practice."*

The key hypothesis in this thesis is that understanding daily work practice and the creation of new digital tools is well, and efficiently, done when using the Scandinavian-oriented design approach. This will also include investigating if cooperative design of CSCW further empowers the cooperative work practice as well as the character of this design approach.

This chapter has dealt with a number of issues involving the relationship between SD and CSCW design. From this fairly broad view we need to focus our efforts on the most relevant issues and select the most important ones. In particular, the following issues will be discussed in more detail:

- *How to use prototypes in the design of CSCW?*
- *How to balance a design that is based on daily work practice but still explore new innovative CSCW solutions?*
- *How to build a design based on evolving use?*
- *How to combine different design approaches into a coherent design?*

Dialectical design

It has been questioned if the SD approach could bring innovation to work. Ehn (1993) claims that there is a fundamental need for balancing between tradition and transcendence – the "*dialectical foundation for design*". If we base our design mainly on daily work practice, it might inhibit truly innovative CSCW systems from taking form. And on the

contrary – if we design by pure intuition, it is likely to fail due to the lack of connection with daily practice. We need a design process that can balance between these two dimensions, i.e. how to combine understanding by observations and innovations that demands for action and change?

Prototypes

In cooperative design prototypes of artifacts have become a primary vehicle for exploration and communication (Ehn and Kyng 1991). The fundamental principle, upon which the idea of prototype design is built, is the power of abstract prototype media. The prototypes become a medium in which ideas could easily be tested and evaluated. However, prototypes for CSCW generate other demands as well. Some issues in a CSCW system might be tested from a signal-user perspective, but most parts, e.g. group dynamics and the group acceptance cannot be tested in this way. One of the issues that we will further investigate in this thesis is: What kinds of prototypes can be appropriately used in the design of CSCW? We are for example interested in comparing different types of prototype media such as paper mock-ups and semi-functional prototypes to investigate what are the special properties that prototypes of CSCW need.

Design-by-evolving-use

Cooperative design argues for an understanding of practice through practice, and regards this type of understanding as a complement to descriptive knowledge. The very basis for this reasoning is that a great deal of our knowledge cannot be formally described and to enable tacit knowledge, there is a need for alternative approaches, e.g., design-by-doing and skill-based participatory design. Based on our theory of how CSCW evolves, we believe that it is important for CSCW design to use these approaches to understand practice in cooperative settings. Hence, we would like to investigate how to perform the actual design process through evolving-use that makes it possible for ordinary users to use their practical skill when participating in the design process.

Multi-methods

The view that CSCW design is a gradual, craft-like process avoids the struggle to select *the* most appropriate design method. Instead, it

brings in multiple choices. When deciding how to proceed, it is often more useful to consider how to combine different methods to gain maximum usefulness. We are interested to study: How to combine different design methods? How could different cooperative design methods support each other? However this can result in a conflict with the consensus approach that has been typical for cooperative design: What happens if multiple design activities come to different results? Could multiple design solutions co-exist within the same CSCW system?

In the next three chapters we will continue with these investigations by introducing the different case studies.

Chapter 2
The CoDesk Case-Study

The thesis began in 1992 with '*The Collaborative Desktop*' (CoDesk) project. At that time, my PhD had not yet been defined, but over the course of the CoDesk project, I started to become more and more interested in the design mechanism that was used in the CSCW community; or rather in the lack of good design approaches that could generate systems that could both tell something new about the work practice, as well as provide innovative CSCW applications. One area that covered these interrelated issues rather well was the study and implementation of mediaspace systems, but these technologies were not yet commonly available and still fairly exclusive in terms of cost.

CoDesk would become just the opposite – a low-cost work environment that could be integrated into the normal desktop environment. The Collaborative Desktop, an extension of the traditional desktop model with CSCW support, was developed through extensive work, usage and assessment, with different prototypes, paper mock-ups, software, videos and demonstrations of theses prototypes. The basic idea is that CoDesk should not be regarded as a CSCW application, but as an integrated general work environment. The interface to this work environment is designed to support the collaboration in a manner similar to handling documents and applications in a normal desktop interface, with the addition of

some new objects such as communication tools and representations of persons and work settings. The main interest has been focused on: (1) The development of a consistent and understandable model of the CoDesk system using prototype design methods and (2) the development of a technical infrastructure that enables CSCW prototyping, including a communication platform and a framework for shared objects.

In several papers and demonstrations we have presented different aspects of the work with the Collaborative Desktop: the environment in (Tollmar, Sundblad and Marmolin 1994), the use of the space (room) metaphor in (Marmolin in COMIC 1995), the use of shared objects (Sundblad in COMIC 1995) and (Tollmar in COMIC 1995), the graphic interface in (Tollmar and Sundblad 1995). This chapter summarizes my main contribution to the CoDesk project with a special emphasis on the design of the user interface through extensive use of prototype media and cardboard computing. It is mainly a revision and extension of the IEEE Journal of Computer Graphics and Application paper (Tollmar and Sundblad 1995), of which I am the main author and contributor.

2.1 (CSC)Work Environments

We must however start with a general background to describe what we mean by *'a basic environment for CSCW'*. We follow two separate tracks that will merge to a set of requirements for a CSCW environment. In the first track we make an analysis of the collaborative process from some social and technical viewpoints. While in the second track we focus on the information society in general and find that many of its demands are similar to requirements on the collaborative process.

2.1.1 Collaborative processes

An important aspect of collaboration is that it is a social process, controlled by social conventions as Kraut et al. (1986) conclude from their study. They interviewed 50 research teams and concluded that the most important aspect of collaboration was the establishment and maintaining of personal relationships. These are the glue that holds together the pieces of collaborative efforts, but also the source of many

problems in collaboration. Kraut et al. point at the importance of geographical proximity for the development of personal relations in general and especially for the development of trust, which is crucial for collaborative work. Also Harrison et al. (1990) emphasize that social processes constitute the basis for all the negotiations, commitments and responsibilities that control the work process. In the view of work as a social process the need for support of informal personal networks become clear, especially in work environments where the boundaries between work, knowledge achievement, information gathering and pleasure are not very distinct.

Another important aspect of collaboration is that it is a communicative process. For example, Johnson (1989) views collaboration as a communication process and argues that the characteristics of human collaboration can be abstracted from examinations of conversations, especially from breakdowns in conversations. In a distributed environment collaboration has to be accomplished by communication.

As found by Kedziersky (1988) questions to other designers are an important way of sharing information. However, as pointed out by Curtis et al. (1988), documentation is not enough and a useful knowledge base also has to contain information about *'who knows what'*, that could be used, e.g., to suggest who to communicate with. Collaboration could also be viewed as a process of knowledge integration. Integration of knowledge and experience among team members is obtained by collaborative idea generation through discussions and brain storming, by reviewing, annotating and critiquing work etc. In an ordinary environment, new ideas are created, developed and tested in mainly informal situations.

Kraut et al.´s study (1986) points however to that the preferred work strategy in collaborative work is to avoid working together unless absolutely needed, i.e. to keep what we call the '*collaboration load'* as low as possible. Collaborative aspects of work seldom concern work execution. However, a lot of groupware, as tools for co-authoring, co-editing, co-drawing (see e.g. Beaudouin-Lafon 1990) are built on the assumption that people really want to accomplish tasks together. A more plausible assumption could be that information sharing is at least as important for collaboration as to work together on the same task. This could at least be true for professional routine tasks such as

authoring, coding, drawing etc., however it may not hold for highly creative tasks such as problem solving. A strategy of division of labor for keeping the collaboration load low leads naturally to consideration of collaboration as a management activity including planning, monitoring, negotiation, scheduling and decision making. Planning is concerned with the coordination of the activities to be performed, which often involves negotiations about commitments. Monitoring concerns decisions about how to achieve the goals.

Another important component of a collaborative process, e.g. identified in several papers from the Esprit COMIC project (1995) is the awareness of the actions of and changes in activity status of other members of the collaboration team and of changes in the shared work material. Mechanisms for supporting awareness are thus very important in CSCW systems.

2.1.2 Information society

One important need in modern work life is efficient handling of information in a society that produces so much information that traditional text-based and TV-based media are insufficient. The need to handle the *'information overflow'* has been characterized as a change in the social paradigm of society (Kumon 1992) and different visionary computer based solutions have been suggested (Bullen and Bennett 1990) and (Engelbart 1990). These solutions are all focused on the management of published information in global and open but personalised libraries.

Different forms of *'free work'*, knowledge work, design and software engineering, become more and more common in several work settings (Kling & Iacono 1985). Another way to interpret Kedziersky (1988) is that rather than by excessive reading of documents the information overload is often handled by using other people as references.

According to Morgan (1986) people in organizations always form informal networks. These *'occupational communities'* cut through the organization and may provide the members with opportunities for identification and forming of reference groups, not only within the organization but also outside (Gregory 1983). In teamwork a member

both improves his or her professional skills and gets an opportunity to extend the personal networks.

New friends are often made by chance, for example two persons sit near each other during a meeting. But these informal networks will develop not only by chance but also through the abilities of the people involved, they could include people from e.g. the work-team, friends from school and the company's basketball-club.

Garsten's doctoral thesis, based on a field work at three different Apple sites shows that the Apple employee is encouraged to work on the personal networks explicitly as well as implicitly (Garsten 1994). Explicit encouragement is given in the introduction course for newcomers. They are told to search for the information they need to manage their work tasks by themselves and doing it by networking since the apparently not bureaucratic organization has limited routines to distribute important information. The implicit encouragement comes from the general insight that big informal networks are the best start on a good career. The company president asks an employee about the importance of a wide personal network (Sculley 1987) and gets the answer *"Because that is the natural course of how ideas flow"*.

2.1.3 Environments for CSCW

Our discussion can be summarized in terms of a set of general requirements that a CSCW environment should support:

- Integration of today's work and tools
- Division of tasks
- Informal personal networks
- Communication in different media
- Sharing and record keeping of information
- Strategies for sharing of background knowledge
- Awareness of interesting changes

Before we in more detail describe the Collaborative Desktop environment we introduce some basic models and metaphors that can be used to support the requirements above. These models and metaphors are the basic work environment, the KnowledgeNet and the tool approach.

Here we first examine earlier work that has tried to capture the *'nature of work'* and argue why we think that many of those models lack realism and are more or less useless in real work situations, and then give as an alternative our approach.

Many models for CSCW tend to be goal oriented. Most include some conception of an activity that has some goal. The more specific the support, the more specialized and narrow the goals. Trevor, Rodden and Blair (1993) have classified the different models for cooperation into three classes: procedural models, activity models and frameworks. With procedural models one tries to model and capture procedures that are intended to happen while performing a certain task in, e.g., an office environment. Examples of these kind of system are the Coordinator (Medina-Mora et al. 1992) and DOMINO (Kreifelts et al. 1991). To give more flexibility activity models have been introduced, for example the Amigo Activity Model (Danielson 1986). Activity models focus on what and how the work is done to describe cooperative work more effectively and non-statically. Trevor (1993) argue that Frameworks are *"the most general form of cooperative environment"* and are intended to go one step further than activity models by focusing on the coordination of activities in groups or teams without a specific application or domain in mind.

In reality, work is not well structured or defined. People do the unexpected more often than the planned (Suchman 1983) to achieve a task. Robinson (1993) has in his research argued the importance of use common artifacts to understand and be able to support a multidimensional world of activities. Several systems focus on coordination, while cooperation in work is often mediated through the material, the documents or the notes. A model of cooperation based on messages seems too one-sided and unbalanced; cooperation based on sharing seems equally important.

We therefore wish to add another class of CSCW models to the previous list, basic work environments. In such an environment, users could in a mundane way find support for CSCW within different mechanisms and tools used today. One natural part of this environment is the building blocks that are needed to be able to *'live'* in the environment, to extend and rebuild it. Another natural part is to

provide some basic mechanisms to enable the integration of different communication mediums like mail and video-conference tools.

2.1.4 The KnowledgeNet Vision

In '*The KnowledgeNet*' we view collaboration as the sharing and integration of knowledge and regard many other collaborative activities as means of accomplishing this aim. With KnowledgeNet we aim at supporting this process by shared knowledge bases of experts accessible by CSCW tools. From a visionary perspective KnowledgeNet is an attempt to make undocumented knowledge public in the same way as libraries make documented knowledge public. The KnowledgeNet could thus be viewed as a distributed *'library'* of documented and undocumented knowledge that is made accessible by CSCW technology.

According to Schmidt and Bannon (1992) CSCW should be conceived as an endeavour to understand the nature and requirements of cooperative work and contribute to the conceptualisation of work with the objective of designing computer based technologies for cooperative work arrangements. The KnowledgeNet could be defined as the infrastructure of personal relations that knowledge workers develop in order to get access to information of importance for their work. It serves as a common information space that fulfils the requirements of a cooperative work arrangement specified by Schmidt and Bannon (1992).

Multiple nets

People often belong to more than one net, both larger nets distributed geographically and small nets located in the same work place, sometimes embedded into the larger nets. These nets are characterized by some kind of social rules that define identifiable groups and secure the exchange of information. Although the groups are rather persistent, they are dynamic and memberships and objectives will change with the needs and constraints of the situation. cooperation in these groups is often informal, controlled by social conventions rather than formal rules. Members are mutually dependent and they are active as long as they have some benefits or as long as the net supports the job to be done. However, the job to be done is often an individual job, as writing an article, solving a design problem or finding some

facts to be taught, and cooperative work is combined with individual work in an indistinguishable way. Collaboration in such nets is both synchronous and asynchronous and there is both face-to-face cooperation and cooperation mediated by different tools.

Peopled information space.

Schmidt and Bannon (1992) point out that a common understanding of the meaning of the information is as fundamental as the sharing of information objects. For efficient collaboration a common information space has to be jointly constructed and negotiated by the actors involved. The information space has to be *'peopled'*. A common information space must be *'peopled by actors'* who are responsible for the information in the system. Schmidt and Bannon raise the issues of supporting the identifying of the originator of the information, the context of information and the politics of information. Thus, KnowledgeNet should support access to and communication with the one responsible for the information as well as the sharing of information objects. Support for the construction of a conceptual reference of frame for interpretation of the knowledge and the political goals of distributing the information are other important requirements.

Social awareness.

With social awareness we mean awareness about the social situation of the members, i.e. awareness about what they are doing, who they are talking with, and if they can be disturbed by questions etc. Many researchers have pointed out the fundamental importance of social awareness. Gaver (1992) uses the term affordance to characterize the physical properties of media space that provide such information. Moran & Anderson (1990) and Gaver et al. (1992) discuss these problems in terms of peripheral awareness. They point out the importance of signaling the availability of information and people in a way that uses the human capability to peripherally process not-attended parts. Dourish and Bellotti (1992) point at the danger of introducing awareness mechanisms that are not controlled by the users and argue for passive mechanisms. Robinson (1993) discusses the importance of the multifunctional character of artifacts for collaboration and points out that they among other things should help people see at a glance what others are doing. Many researchers (see e.g. Johansen 1989) have found that informal collaboration is a

fundamental aspect of any CSCW environment, and awareness of the social situation is needed for such collaboration. Kraut et al. (1986) have showed that geographical proximity is fundamental for the development of personal relations and communication and geographical proximity provides much better social awareness. All these results indicate that social awareness is a fundamental feature of effective collaboration in a network.

The KnowledgeNet has to provide such social awareness. The KnowledgeNet should not only facilitate task accomplishment but also support communication of social behavior patterns, establishment and development of personal relations and spontaneous drop-in meetings (Marmolin et al. 1991). That is, The KnowledgeNet should be multifunctional and support both social goals and job related goals, both informal and more formal collaboration. To meet this requirement The KnowledgeNet should support the users perceiving other users as close to themselves and provide information about the activities and status of other users.

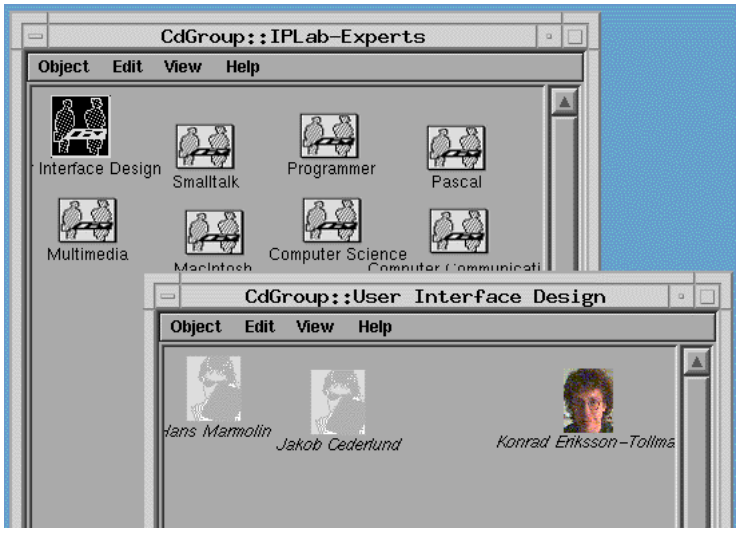

Figure 2: Users knowledge forms competence groups

Our environment strives to support the KnowledgeNet vision by providing all users with tools for a seamless integration of synchronous and asynchronous modes of interaction, for example by enabling social ad-hoc communication and allowing the user to toggle between activities as in real life.

2.1.5 Tool Approach

Instead of designing groupware based on analysis of a specific design task or collaboration task to be fulfilled, we propose, like other researchers e.g. Moran and Anderson (1990), Bannon and Robinson (1991), the design of generic collaborative tools. The user chooses in the *'tool-box'* and applies single tools or combination of tools in the order and manner she or he finds appropriate to perform the task at hand.

The tool-oriented approach aims at designing a user controlled environment that makes it easier for the users to do what they want, without limitations and assumptions imposed by the system. As other researchers suggest (Greenberg 1991) user control is a key factor for usability, and this is certainly also true for our work environment. An obvious advantage with the tool-approach are that it enables the use of most of today's single-user tools for cooperative tasks.

Usually the tool perspective focuses on individual use that one might find contradictory to cooperative work. With a tool-oriented approach the users can apply and develop individual and original skills that will form the core as the basic resource in cooperative work teams.

2.2 CoDesk as an Environment for CSCW

The Collaborative Desktop (CoDesk) is an attempt to make collaboration a natural part of the daily use of a computer. Our way to achieve this is to put the user in the center of the computing in a similar way that applications and documents are defined and visualized in the desktop metaphor.

We have developed CoDesk from something that we know works: the desktop metaphor that has made daily computing a lot easier and more error tolerant.

FIGURE 3: Drag and drop operations in the GUI.

CoDesk is a basic environment for CSCW where we have extended the traditional desktop metaphor with a few new objects that enable cooperative work. Without limitation to a specific model of cooperation each user could tailor, form, her desktop to the individual need for cooperation and communication. In CoDesk it should be as easy to look for your colleagues as for shared or individual working material. Central in CoDesk is support for groups or teams to form cooperative settings.

Primarily CoDesk provides mechanisms that extend the network from a computer network to also be a user network by integrating the essence in communication and collaboration via different tools and media. Figure 5 gives a view of the CoDesk user interface.

Basic CoDesk Objects

Members, groups and rooms

The most central type of object in CoDesk is the individual person, member, represented both as an icon and as forms (e.g. *'cards'*) with attributes, including name, communication lists and KnowledgeNet who-knows-what information. Groups are simple collections of members.

The room metaphor is used for different interactive settings, early used as an extended desktop for single user work arrangement at Xerox PARC (Henderson and Card 1987) and also for CSCW applications, e.g. in (Borning and Travers 1991). In our metaphor a room is used to represent a collaborating group or a specific action. The rooms are additions to the groups and should been seen as dynamic cooperative

settings. Rooms are familiar environments for cooperation and work. Rooms are where you meet people, do your work, read a paper etc. For movement and navigation in the rooms the desktop metaphor is used through pictorial representation, the graphical user interface, and search-and-retrieve tools. Note that rooms are not only used for sharing but also for individual use like a private mail list.

We also explore the role of rooms in supporting *'social browsing'*, as in Cruiser (Root 1988) by *'group awareness'* mechanisms. The user can set allowed *'disturbance level'* from group members, in the same room or making a "random walk" visiting a couple of rooms. The most common way to communicate with some members will be to install a common room with some tools and working material, e.g. documents, specific for that group. To support temporary connections with other group members a temporary room could (automatically) be installed by, for example, a direct phone call to another user.

Figure 4: Extended user information with KnowledgeNet data and access to direct communication.

Documents, tools and folders

As noted in (Reder and Schwab 1990) work behaviour is characterised by multitasking, and many activities and interactions are structured into communication chains that criss-cross each other. This means that tools for collaboration should allow and support many collaborative activities at the same time. A user can jump from one activity to another, have *'sleeping'* activities that will be continued later on, etc. The ability to adopt different kinds of tools is considered (Grudin 1988)

to be a main feature in a successful CSCW system and has therefore also been one of our major goals. We believe that our architecture makes it possible to integrate and use a large amount of ordinary single user tools into the Collaborative Desktop.

Common tasks for which collaboration through computer is very suitable is writing text, designing graphics, sound or video together. Here the collaboration is mediated through the *'material'*, documents, we work with. As stated in (Bannon and Schmidt 1992) designing CSCW system from the viewpoint of a common information space could be very valuable and useful.

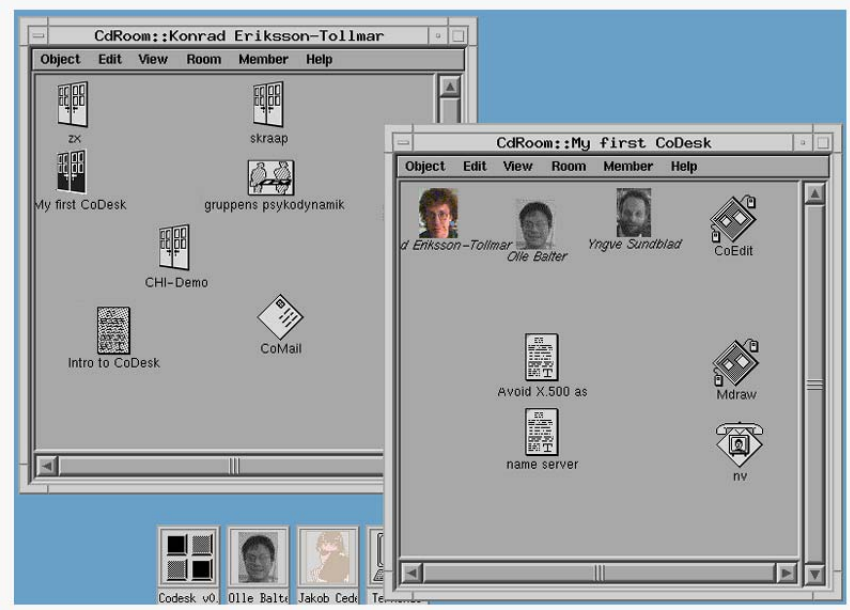

Figure 5: CoDesk – An environment for CSCW.

Building, using and extending CoDesk

CSCW systems based on *'a shared information space'* have gained growing attention. Such systems are attractive as both time and location independent but they need to be augmented by direct user communication.

In an environment like CoDesk is a shared information space built through the use of it. Without being limited to a specific cooperative model, each user of CoDesk should be able to tailor his/her collaborative desktop based on their individual needs in terms of

cooperation and communication. Hence, CoDesk primarily provides a mechanism to transform the computer network into a community network by integrating communication and collaboration via different tools and media. The CoDesk environment, which is '*a shared desktop*', is built as people use it and fill it with information and cooperative activities. There is no feasible way to pre-fabricate such an advanced information space since it will be redesigned while it is being used anyway (Hendersen and Kyng 1991).

However, we argue that this does not decrease the demands on the initial design. On contrary, in order to understand and be able to use an evolving system, such a system needs a very clear and understandable foundation. Close cooperation with plausible end-users was the key to constructing a simple CSCW framework. We decided to mediate a conversation with the users by means of various prototypes of the CoDesk environment. The rest of this chapter will now go into more detail about the prototyping of CoDesk, and describe a cardboard study of the CoDesk environment.

2.3 Using Prototype Media to Design CoDesk

From the very beginning, a strong focus has been on the visual appearance of the interface and of the model in our prototype. This allowed the design to initially focus the attention on creativity rather than get caught up in structuring representations and design methodologies, as in (Myers 1991). In addition to this open-ended approach, we also found it very important to involve potential end-users at a concrete level in the design process. We have consequently applied a multi-method strategy in designing the Collaborative Desktop, including HyperCard prototypes, live demos, videos, paper mock-ups, as well as academic studies of earlier work.

Using HyperCard and similar tools to create prototypes was perhaps one of the easiest decisions in the design process. With HyperCard, it is possible to quickly create a dynamic visual representation of an idea. As argued by Twidale, it is essential to start without any 'hard' theories about CSCW environments, but rather try to determine some of the requirements by observing users (Twidale et al. 1993). Hence, we made two kinds of software prototypes, horizontal and vertical prototypes.

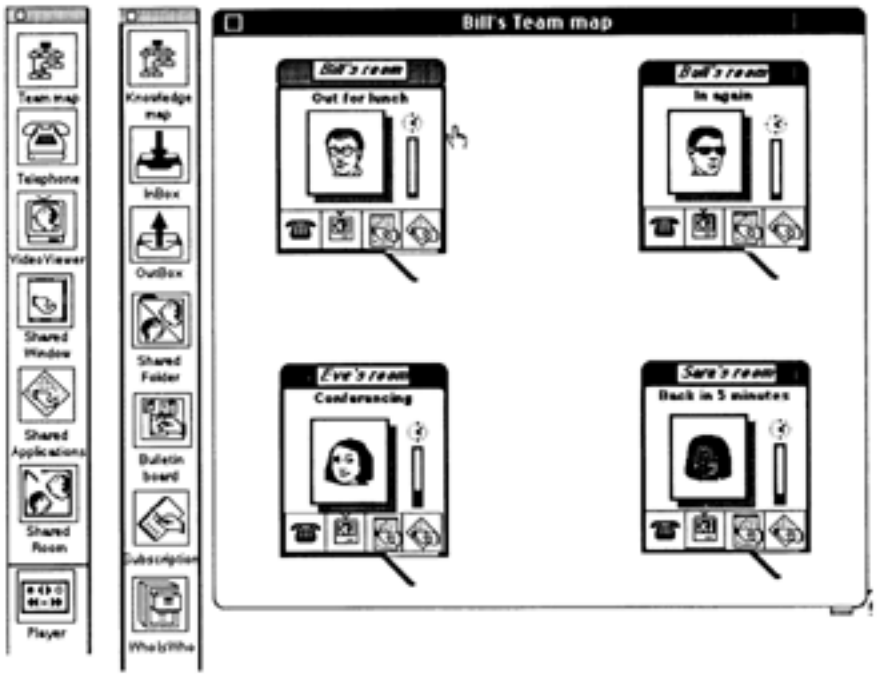

Figure 6: First HyperCard prototype.

Building semi-working prototypes with a limited amount of embedded functionality was a part of testing vertical prototypes. These prototypes were built in a Unix-based environment on multimedia workstations. At that time, these were rather expensive products, but they are now commonly available. Finding the right software tools to build these prototypes was a major task. The interface was developed with the object-oriented *InterViews suite* (Visslides 1992) and prototypes of video and audio communication reused existing freeware on Internet such as *NV* and *VAT* (Jacobson 1992). Other tools, e.g. a collaborative bulletin board, an e-mail application, and a collaborative drawing were developed by my colleagues Bälter (1998) and Avatare (1996) using Smalltalk and InterViews (Linton et al. 1989). Combined with the CoDesk kernel these semi-working prototypes were used to demonstrate how the CoDesk environment could be used for a broad range of plausible users (Tollmar et. al 1994).

Another prototype media that been used in the CoDesk design is video. Video could be an excellent media for showing mock-ups of functionality that has not yet been implemented, as well as showing the context of use. Inspired by this reasoning and some good examples of CSCW videos (e.g. CSCW and CHI Technical Video Program), we created two small video scenarios that exemplified usage situations with CoDesk (Tollmar 1995). From our experience, we would like to highlight some features of video that make it very suitable for CSCW prototypes. Firstly, video allows time and space to be manipulated. This could be used to construct scenarios that span longer periods and come from multiple perspectives. Secondly, these video scenarios have also been very useful as a starting point in the design discussions, such as in the cardboard study.

2.3.1 The Cardboard Computer Study

We have chosen to use *'the room'* as a basic metaphor in CoDesk for cooperative activities. This was initially based on previous research that illustrated the social significance of rooms as evidenced in studies of workplaces (Heath and Luff 1991, Hughes and King 1996). As Moran and Anderson (1990) discuss, one of the primary functions of a room is to act as a place for activity with social conventions. Marmolin (COMIC 1995) summarizes that a room functions as a kind of artifact, using Robinson's (1993) discussion on the importance of multidimensional tools to get the job done, for supporting peripheral awareness, and strengthening implicit communication, and creating organizational awareness.

Figure 7: Using paper mock-ups in the design.

But why the room? Why not shared desks, since the underlying metaphor is the desktop? What is a room? How can we use the room metaphor, and what benefit do rooms have compared to shared desks? To study these issues further, we decided to use paper mock-ups to study how people might potentially use CoDesk, and how to create cooperative settings with the room metaphor.

The study

Based on Carroll's (later described in 1995) methods for analyzing scenarios, Marmolin (COMIC 1995) created four different scenarios: visiting an office for discussion, forming a collaborative team, having a meeting and calling a team member. These scenarios provided the foundation for this study. Based on these scenarios, we prepared paper mock-ups to be used by the participants.

This study attempted to capture several things. We needed to clarify the common understanding of the traditional desktop metaphor. Furthermore, we wanted the users to tell us how they conceptualized the new object on the CoDesk desktop. We asked the participants if they could use the paper mock-up to create an image of their organization using the group object. We also asked if they could use the room object to build a collaborative situation based on their own

experience. Finally, we asked if they could use different tools to search out and contact colleagues with a specific question in mind. Afterwards, we discussed how they experienced the mock-up and asked them for plausible improvements.

The study involved twelve people. The participants represented different kinds of plausible CoDesk users such as students, researchers working with computers and other professionals who use a computer daily. The average participant had been using a computer for several years and used it for a couple of hours per day except for some of the professionals who used computers for 10-12 hours per day.

After the walk-through scenario, we brought up a couple of discussion points to get direct feedback on some usability issues. The discussion focused on three areas: improvement in usability, improvement in the interface and strengthening awareness in the system. The purpose of this discussion was to give them an opportunity to articulate their experience of using the paper mock-ups in words instead of action. Each study took approximately two hours.

Users' experiences of the CoDesk cardboard computer

How do CoDesk users organize and share information?

Several studies of how information on paper is shared have given us a basic understanding of the intrinsic relation between work practice and organizational policies (Blomberg et al. 1996, Malone 1983). Informal communication and sharing ideas seems to be of utmost importance in making work rational and pleasant. Letting the study participants create five fictitious work settings to see how they would organize and share information with the different CoDesk tools and objects was hence of particular interest.

CoDesk provides three new types of objects: members, groups, and rooms. The most central type of object in CoDesk is the individual person, known as a member, represented both as an icon and as a form (e.g. 'cards') with personal attributes. Groups are just simple collections of individual members. The rooms are used to represent a collaborating group or a specific meeting situation. The rooms are additions to the groups and should been seen as dynamic cooperative settings. Initially, we asked them to use the cardboard computer to

perform two simple tasks. The first task was to create a representation of the organization where they work using the group object. While the second task was to select a project from one of those groups and design a collaborative setting with the room object.

Our first finding was that the basic understanding of how direct manipulation works in a desktop interface is not as common as we expected it to be. The participants' strategy for solving a certain task varied in several different ways. Several claimed that they prefer to use menu alternatives rather than drag-and-drop operations. We found that even if the basic functionality in CoDesk is rather common, we still need to provide an orthogonal set of commands that enable several alternatives to perform each operation.

Naming seems also to be an important aspect. The use of common names is a key factor in group cohesion. However, it became evident in the study that naming is difficult and often ambiguous. Hence, we suggest that collaborative environments specify mechanisms for proposing names in the event of a new object or a new user. The first alternative is useful in situations where a user wants to merge an object into a new context and wants to find an appropriate name in that context. The second alternative is relevant for novice users; since objects may have multiple names, it makes sense to offer a list of names to the user for such objects.

How is a network of colleagues handled in CoDesk.

While many researchers have pointed out the need for social networks and social awareness, making them work is still unclear. Gaver (1992) discusses the benefits of using peripheral awareness; the human capacity to process peripheral, not-attended information. Bellotti and Dourish (1992) claim that non-controllable systems are obstructionist and suggest using passive systems. But in order to share any awareness, people must be willing to expose themselves and their activity. Fundamentally, the gains have to outweigh the costs.

Most of the discussion with the participants revolved around the attributes that were needed to be able to locate and contact people in the CoDesk net. In one of the scenarios, the informants were asked to list the attributes they would like to be able to search for. Afterwards,

we reversed the question and asked the informants to provide information about themselves. Name, phone number, address, etc. seemed to be natural items to provide, while there was more discussion about whether organizational affiliation and work description were of common interest.

The unwillingness to provide more personal information was clear and obvious. The vast majority also rejected the idea of providing information about personal interests, e.g., hobbies, however this is common on personal web pages. It was also obvious that many participants were uncomfortable with the idea of defining themselves as some kind of expert. This stands in contrast to the expressed need of finding other people based on specific properties, e.g., an expert within an organization. Due to the reluctance of participants to provide this kind of information, it turned out not to be feasible.

A plausible alternative for providing detailed personal information could be to define areas that the users are interested in. Then, instead of searching for a particular expert, users would look for people who share an interest in learning about a specific subject area. Another suggestion was to use a more open form, similar to a personal web page, in order to provide information about users. This mechanism allows users to leave implicit clues instead of unwanted, explicit personal data.

2.4 Conclusions

From the Collaborative Desktop effort we have learnt that producing a working prototype of a generic CSCW environment is, even with the best generally available tools, a very considerable effort. For gaining better experience and knowledge of the human and social factors of CSCW in real world applications it is crucial to make production of working prototypes much easier and faster.

However, the cardboard study provided us with a surprisingly large amount of relevant design information concerning CSCW issues, e.g. cooperative naming, alternative usages of the room object for interest groups, etc. Given the rich and detailed dialog we argue that prototype techniques such as cardboard computing work well for cooperative design of CSCW systems such as CoDesk. On the other hand, a

majority of the participants in the study referred a lot to their past experience, and sometimes it was hard to maintain focus on the tasks in the study and not start debating the problems with the current desktop model, e.g. the desktop is seldom well-understood and the metaphors are unclear. This scattered slightly the discussion but upon reflection, these findings were probably as important as the specific CSCW discussions, and several of the design suggestions *should* actually be directly implemented into existing desktop systems.

It is also clear that some CSCW features cant be evaluated directly and need to arise in the realm of a group of users. Consequently working with vertical CSCW prototypes is a non-trivial but essential complement to horizontal CSCW prototypes.

Chapter 3
The AtWork Case-Study

The second case-study is based on a project called *AtWork*. The basic idea of AtWork was to build a tool that could be used to create and maintain social awareness in groups of working professionals. Some of the reasoning for this project was derived from the CoDesk research, but also from the dissatisfaction among the groups at KTH and Ericsson in terms of being able to reach colleagues with a highly flexible work style.

The AtWork system is well described by Tollmar, Sandor and Schömer (1996) that cover both design as well as implementation issues, Tollmar and Sandor (1996) describes some early prototypes of the AtWork system, Jonssson, Schömer and Tollmar (1996) describes more generally some different prototypes of awareness system, and finally Tollmar (1997) gives a more theoretical background to the AtWork system. This chapter will however mainly focus on the design process in the AtWork project that has been my main contribution to the AtWork project. It is mainly a revision and extension of the ACM CSCW Conference Paper (Tollmar, Sandor and Schömer 1996), of which I am the main author and contributor.

The AtWork system started off with a *'quick-and-dirty'* ethnographic study that was balanced with a set of design workshops. Rogers and

Bellotti (1997) discuss a similar approach when they suggest how to ground blue-sky research with ethnographic studies. The goal with our design strategy was twofold. Firstly, we were interested in seeing if cooperative design and ethnographic design approaches could complement each other. Secondly, we wanted to study a couple of different cooperative design techniques in CSCW situations.

Based on the outcome of these workshops, we implemented two software prototypes that were then used and studied over the course of a couple of months. We were especially interested in studying how different interfaces were produced in the cooperative design workshops, and how they could be used in different situations.

3.1 Related Work

Recognized within the CSCW community is that one of the most important components of collaborative work is the awareness of the activity within a group. We would like to stress the importance of social awareness. By social awareness we mean awareness about the social situation of the members, i.e., awareness about what they are doing, if they are talking to someone, if they can be disturbed etc. In our everyday work, social awareness is a key element. We gather continuously information about our colleagues and act accordingly. If they listen, we will talk, if they are not here, we might phone them or leave a note. If they are in the right mood, we start a discussion, if not, we postpone it.

A definition that catches the essence of awareness in a broad way is the one suggested by Dourish and Bellotti (1992) where awareness is defined as *"the understanding of the activity of the others, which provides a context of your own activity"*. Moran and Andersson (1990) discuss the problem in terms of *'peripheral awareness'*. They point out the importance of signaling the availability of information and people in a way that uses the human capability to peripherally process non-attended aspects. Kraut et al. (1990) show that geographical proximity is fundamental for the development of personal relations and communication. This includes first of all the knowledge of persons' availability, both physical and emotional. Gaver et al. (1992) uses J. J. Gibson's term *'affordance'* to characterize those physical properties in a media space that provides such information.

3.2 Understanding the Workplace

The subject for the study was an academic research group (A-Lab). The academic world that this research group acts within is organized in networks. The social and knowledge networks are often wide spread. The skilled people in this kind of setting are those that have many external contacts in these networks. This is not true only for academia, e.g. within some corporations, the management values informal networks as a way to improve efficiency and productivity (Garsten 1994). Building, maintaining and keeping these networks are time consuming and not always an easy task. A knowledge worker needs to constantly distinguish whom to keep updated, or not, as well as inform about that person reachability and availability.

Accordingly, the focus of this work has been directed towards observing and understanding mechanisms for supporting social awareness within CSCW systems. Good communication tools will allow *'flexible working environments'* where hierarchy and strict regulated norms will be replaced by human centered and project oriented approaches. Although the flexible work style in a multi-disciplinary research lab like A-lab is somewhat extreme, it has been argued (Kling and Iacono 1985) that this will become a more common work style in many settings. The need to handle *'information overflow'* is characterized as a change in the social paradigm of our society (Kumon 1992). Information overload often seems to be handled by using other people as references rather than by excessive reading of several documents (Kedziersky 1988). One of our informants put it like this:

> *"For my work I'm very dependent on good social relations... If I don't have good social relations I'll work slowly and I neither like my work situation nor myself... A person who is good in his work knows how to use knowledge he got at previous times and has a great net of contacts."*

Notable from earlier experience with CSCW system is the difficulty to envision all dimensions of cooperative work. To explore this further, and in particular study the means and expressions of social awareness, one part of the project has been to try out what we will refer to as *'multi-domain methodology'* that combining different cooperative design

techniques with other design techniques that has been used for CSCW such as variously form of social studies.

3.2.1 Mixing Design Methods

Why do certain systems gain acceptance while others do not? Sharrock (COMIC 1995) argue that most CSCW *"failure [is] often attributed to the inadequacy of existing methods"* since traditional requirement specification pays insufficient attention to the social context of work. It is our belief that a broader perspective on work and environment needs to be considered. The design techniques that we applied are a fusion of different categories of design methods into, what we will call, a *'multi-domain methodology'*. Encouraged by earlier successful use of interactive design and cooperative design techniques (Bødker et al. 1987; Ehn and Sjögren 1991) we tried to blend some existing design methods rather than invent our own from scratch. In a series of design workshops members participated in the project and contributed to the design of the different prototypes that have been developed.

From a PD perspective, work is fundamentally social, involving cooperation and communication. Few work tasks are done in isolation. PD insists on shifting the perspective to group interaction within complex organizational contexts. Bannon (1991) proposes that the design process should be directed towards an:

> *"understanding [of] people as actors in situations, with a set of skills and shared practice based on work experience with others".*

He stresses the importance of going from *"user-centered to user-involved design"* by applying common design techniques such as prototyping and iterative design instead of requirements specification and traditional human factor analysis.

However, as Tom Ericsson (1991) argues in his analysis of design activities, one of the basis for working with iterative design and interface metaphors is understanding *"how the thing works"*. Obviously, cooperation and communication patterns are more complex than physical *'things'*. In order to understand them better, and by this to offer a good basis for the iterative design, we started with what could

be called a *'quick and dirty'* ethnographical study of the communicational patterns within the lab.

During a two month period one of the co-authors made an ethnographical study of A-lab. This kind of study is assumed to provide a general but informed sense of the setting for the designers. It is debated, e.g., by Sharrock et al. (COMIC 1995), that:

> *"field work methods involving ethnography are capable of providing rich material and analyses of the 'real world' character of the social organization of work".*

The use of the design workshops could also be argued for by reflection on ethnographic analyses, which most often are textual stories and therefore provide only partial support for system design. Hence, we found a natural blend of iterative design with user involvement as an intriguing development of ethnographically informed design.

3.2.2 The Situation

A-Lab employs people with many different skills, e.g., computer science, linguistics, psychology, sociology and social anthropology. From time to time graphic designers, industrial designers and artists also work within the lab.

Working in a multi-disciplinary community sets high standards for the members. They are not only obliged to follow the discussion within their own field, but also within the filed of several other laboratory members. In order to find someone in the lab, people use a sign-in board (Figure 8). Placed at one of the two doors accessing the lab, it contains all staff members and blue magnetic stickers that should indicate whether you are *'in'* or *'out'*. But since most of the Ph.D. students enter the other door, they often forget to adjust their sticker. To use the computer to see if a colleague is *'on'* the computer network (e.g., the UNIX finger command) is seen by most as a more reliable way to check whether he/she is present or not. Still such systems offer only information regarding the use of computers, a rather limited concept of a person's *'presence'*.

Figure 8: The A-lab's sign-in board.

The group can also use other communication programs in the UNIX environment that make it possible to chat over the network. Those are mainly used by the master students and by some Ph.D. students, all with a computer science background, and only if they know each other well. A problem reported in the use of chat programs is the fact that these applications remove the normal social hierarchy, which can make users uncomfortable. This also prevents a wider usage since the risk to commit mistakes with a plausible negative social impact is felt to be high.

Many also feel unsure about when it is appropriate to use new media for communication with colleagues. An exaggerated care for a colleague's workload, especially for those who you don't know that well, is common. Meeting face-to-face is often desired for reasons such as the sensitivity of the subject or because you have not seen each other for a while.

The fact that for example working hours are not regulated, clearly creates problems for the lab staff to reach and collaborate with each other. Several different strategies are used to overcome this. The preferred strategy is dependent on the employee's position in the lab. Master's students that only spend a short time in the lab and many

Ph.D. students do not raise a question to a *'superior'* through a phone call, not even during normal working hours. On the other hand, the senior researchers often prefer to use the phone. They rarely hesitate to call a colleague at home if it is not too late. This is out of the question for most research students. As one Ph.D. student in social science expressed it:

> *"I always use email when contacting my supervisor, I never use the phone."*

For most, email is the tool that is easiest to use. It is a *'socially secure'* way to raise a question because senders disturb as little as possible; it will be read when recipients give it time. The staff members with a higher position often use mailing lists to distribute knowledge. The old myth *"the boss is the last one to know"*, is within A-Lab somewhat untrue since the lab leaders are those that have the contacts and the information. The different strategies to deal with mailing lists are strongly connected with the rank of the person and the social courage. Those that are talkative in the virtual media seem in most cases be the same that raise their voice during, for example, seminars.

The outcome of the first study has strengthened our belief that the work within the laboratory could primarily be described as a social phenomenon. Therefore we think it is very important to achieve a deep understanding of the nature of social activity in the lab. Without such knowledge a collaborative tool might work against social norms. Harper and Newman (1996) state that social behavior is always meaningful, and therefore the study of social behavior is the study of meaning. Findings from their rich material of work practices and studies why certain systems fail show that there is a causal link between system rejection and conflict with responsibilities. In the case of A-Lab the ethnographic study shows the importance of a socially secure collaborative tool. In order to succeed, such a tool needs to support both direct and indirect communication. The tool cannot only enforce direct communication since this would be uneasy for junior members. On the other hand, direct communication is reported as important and needed in some cases.

The second major finding from the ethnographic study is expressed difficulties in keeping in contact with colleagues and students outside

the laboratory. The sign-in board is seldom used and there are many alternatives. This leads us to the conclusion that a computer based tool aimed at bridging those gaps and strengthening awareness and group consciousness among the lab's members also needs to take in consideration persons outside the lab. There seems to be a demand for providing a public interface such that, e.g., students could see if and when their teachers are reachable. This was not taken into consideration in the first prototype since we wanted to start by exploring different matters and see how things work within the group.

3.2.3 The First Prototype

The next step in our design was to develop and put a prototype in the hands of the members of A-lab. The system was named AtWork, an acronym for being virtually at work.

Inspired by systems like, e.g, the Montage system (Tang et al. 1994), the Crusier system (Fish et al. 1992) and RAVE (Gaver 1992), we started using a video conference tool called NV developed by Ron Frederick at Xerox Parc. It provides thumbnail video images of all people that are using the system at one moment. The key idea is to be at all times aware of the presence of colleagues, thereby creating opportunities for spontaneous collaboration. However, as noted by Whittaker (1995) in his review of real-time video for interpersonal communication, the kinds of glances made by video do not necessarily lead to better connection rates compared to phone calling when you have no clue about availability.

One version of the prototype was used by a small group of volunteers in the lab. The size of the group was limited by the fact that the system works only on Sun stations, requiring certain computer resources and a video camera. The experiment confirmed what previous studies, like Tang and Isaacs (1993), showed. Even if people expressed concerns about privacy in the beginning, later on they did not refer to them any more. Having this kind of connection did not change the way people worked during the test period, but users got used to having it on screen and checked it out from time to time.

After a couple of weeks their interest for the system dropped and people stopped using it. We have found different reasons for that.

First, the fact that the group was restricted (by access to technology at least). Second, the fact that the system was *'closed'* in the sense that no one outside the group could access it (in any simple way). Third, it was clear that even if video images could offer some information about the availability of the others, some sort of complementary information was needed. For example, if someone is not logged in, where and how can I reach her/him, or when was he/she last at work?

Hence, our approach becomes slightly different. The kernel in our system is still a number of thumbnail images (Figure 9) but, based on the ethnographic study, we added some explicit awareness information. First of all, the members are able to provide information about their current situation. The Situation makes it possible to set a state indicating your availability. We had to choose between a big set of predefined situations or a free form, where it would be up to the user to describe his/her situation. The advantage of the first system is that setting that information is simple (normally just choosing one option from a menu) while the second one is more flexible. Finally we chose a very small set of states (Here, Away from the keyboard, Busy and Out), but at the same time we provided the user with the possibility to leave text information to others (a sort of *'plan'* as in the finger utility). By this we combined the advantages, obtaining simplicity and flexibility.

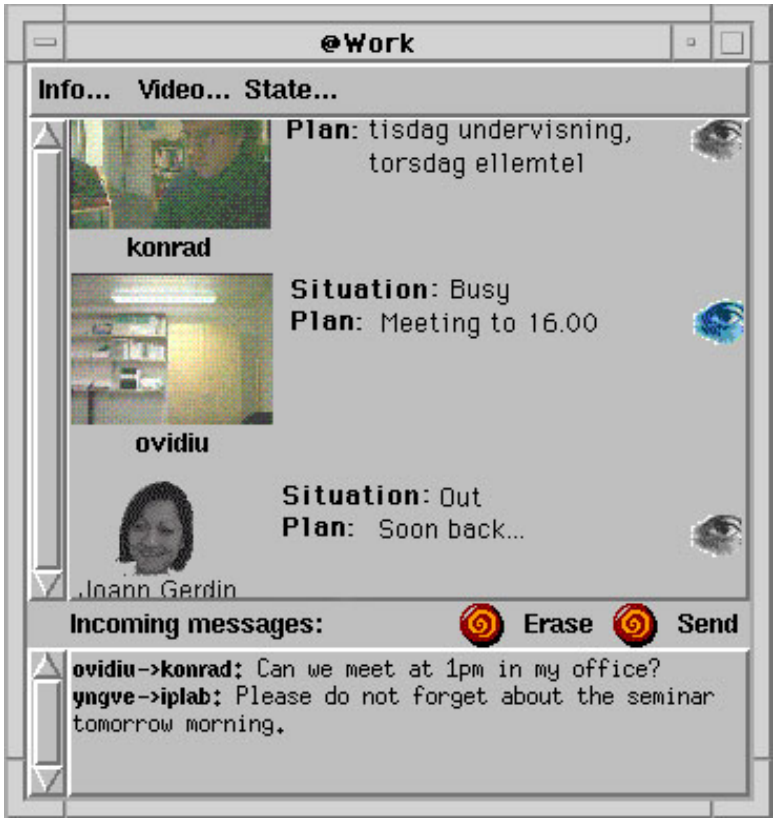

Figure 9: The first AtWork prototype.

We also wanted to provide support for easy, direct communication. We extended the video link with an audio one. We also provided a facility for sending and receiving small messages (a light form of email). The messages also create a kind of history of awareness information, as one of our informants put it: *"it would be nice to have here [in the system] some gossip"*.

We also provided a *'watch'* mechanism. By activating the *'eye'* next to a person, the user will get notified (with a specific sound) when a change in the Situation information of that person appears. A typical scenario for using the watch mechanism is when looking for a colleague. If you see that he/she is out or busy, you can activate the eye and you will get notified when he/she resets the awareness information. Then you could call him/her through the video/audio link.

3.3 Design Workshops

Prior to designing the main prototype system, we ran a series of design workshops where we applied three different cooperative design methods in order to investigate the problem areas. One focus was to encourage the lab members to discuss what kind of problems they currently encountered and what kind of cooperation and communication were needed. During the design phase, we displayed the outcome of the workshops in a common lunchroom in order to enable people to follow the process, to stimulate the discussion and to generate contributions for the workshops.

During the design workshops we displayed the outcome in A-lab's cafeteria to help people follow the process. People not able to participate in the workshops were encouraged in this way to continue discussing and contributing to the workshops. Also people who participated were reminded about the discussions.

3.3.1 Interface Metaphors

The first participatory design method we used was *'Interface Metaphors'* (Ericsson 1991). The method is divided into three phases. In the first, the group collects the tasks that should be fulfilled, in the second phase the group explores a metaphor and finally, as the third phase, the group puts tasks together with metaphor attributes. The rules for the Interface Metaphors state that small cards should be used to keep track of design process.

The task given to the participants was to suggested metaphors of computer-based tools that should support the group with a forum to inform each other about current activities. In our case, this first method acted as a warm-up exercise. People started to think about how computers provide alternative solutions. After completing this method a noticeably greater attention was focused on how to provide such information and not just on how to search for other members' activities. During the exercise the group had problems with how to evaluate alternative solutions. The guidelines for the Interface Metaphors do not suggest how the result could be further used in the design and implementation.

3.3.2 Future Workshop

The second workshop method that we used was *'Future Workshop'* (Kensing and Madsen 1991) which is a participatory design technique that states a common problematic situation, generates visions about the future, and discusses how these visions can be realized.

The method was originally developed to support discussion among citizen groups with limited resources for decision making in public planning. The conduct of the method is fairly strictly regulated by two facilitators. The key idea is that you should never directly criticize a speaker. Statements are written down on sticky notes and posted on a white-board to be later argued over, grouped and eventually ranked.

In our case the method was highly appreciated. A shared problem understanding was genuinely established. During the workshop, the members realized that in order to find each other easier they have to pay greater attention to how they provide awareness information to others. Several valuable statements convinced the group and informed us that the kind of system that we envisioned is needed:

- *People do not have regular working hours.*
- *People have several work places/offices.*
- *Teachers teach in class rooms away from their offices.*
- *Nobody has the specific responsibility for keeping track of people (like in the traditional secretary job).*
- *The lab members do not generally update the sign-in board.*
- *When someone is calling from outside, the lab member that answers cannot see the sign-in board.*
- *Even if email is largely used, the phone is the most used communication tool.*
- *People outside the lab often report problems in reaching lab members.*

3.3.3 Observation & Invention

The last method used was *'Observation & Invention'*. The method is developed by Verplank et al. (1993) to design products with a broad audience, e.g., consumer products. Although the method is originally intended to be used only by the designers, we modified it by letting

the end users participate in the design process. Hence, the design records became unique statements of the participants' understanding of their situation.

The key idea behind Observation *&* Invention is the use of different media to keep a record of the design process which ensures rich findings that engage the whole group. It is important to capture early *'observations of real users in real contexts'*. Based on these observations, '*future characters and scenarios'* are formed that will move the stage to a future use of a virtual system. This is also suggested to be very important in participatory design (Bødker et al. 1991). Finally, metaphoric exercises guide the *'invention of a conceptual model and artifact representations'*.

Observation: One of the observations concerned Lars, a senior researcher. *'A day in the life*' story-board of his morning activities (Figure 10) showed how he would pass the sign-in board, would observe, on the way to his office, who is really *'in'*, would read email, and after that would go for a cup of tea in the cafeteria. The story-board clarified for the participants that they, as a group, share a lot of the communication problems. It is not just they, as individuals, that have problems dealing with the variety of media and expressions that exists. Hence, observations are a bridge across individuals and groups.

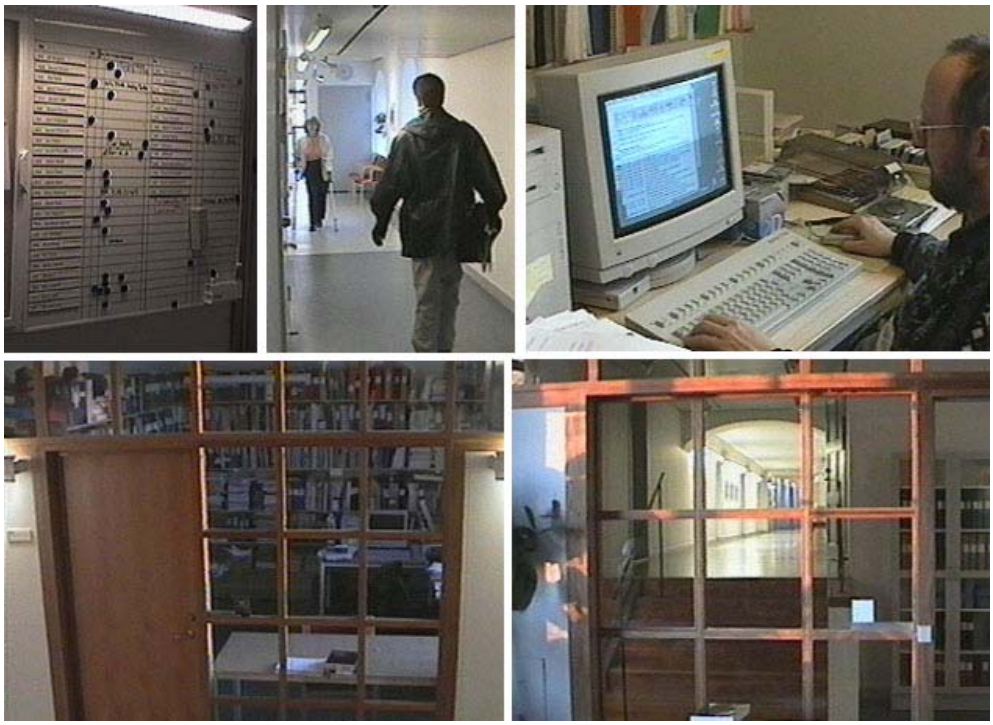

Figure 10: *'A day in the life'* story-board.

As noted in the figure, physical proximity is important to enable awareness of the lab members' presence. The physical proximity of a group can offer some important advantages with respect to group collaboration. First, the shared physical space affords spontaneous meetings. Such encounters prove to be useful complements to scheduled meetings, allowing a more informal way of exchanging ideas and information. Second, physical proximity provides a natural way to develop human relations and build a real community. In the case of A-lab, the design process revealed that because of the working habits members often fail to meet physically. This observation informed the design about the importance of providing similar advantages as physical proximity through a computer system.

Characters & Scenarios: Scenarios help us look at changes in context and can be interpreted as prototypes for a range of users and preferences. In the scenarios, most people recognized a phenomenon earlier observed in the ethnographic study: the existence and importance of people outside A-lab. How those people could get access to awareness information was addressed and discussed. Among the characters we could find students who work partly as lab assistants but also family

relatives who need, on a daily basis, to get in contact with lab members.

Invention: As argued earlier, metaphor design for CSCW is difficult in early phases of the design. Although neat ideas were discussed, most groups within the workshop reported difficulties in finding functional metaphors and artifacts.

3.3.4 Conclusions of the Workshops

The informants expressed a big lack of awareness of each other. The reasons seem to be two-fold: the variety of existing media creates a division and uncertainty of which media to use for a specific situation; and problems with the physical location.

The Observation & Invention method highlighted other aspects. Especially notable is the recognition of having a shared problem and that often people outside the lab are also involved. As stated earlier, the community around A-lab is organized in informal networks and obviously A-lab's problems are not only local. The members' need to communicate within their informal networks was in some scenarios described as even more important than maintaining relations within the lab.

This issue relates to another one reported during the design workshops. The idea is that people would like to provide group specific information accessible to group members but not to outsiders. Internal information could be sensitive and people would like to protect it from external access. Nevertheless, people would like to use the same system for informing people outside the lab about their availability. This leads to the idea that an awareness system must allow differentiated information to be provided under the full control of the user.

As reported from both the ethnographic study and the Future Workshop, the sign-in board is not used very often. Another key aspects of social awareness becomes how this kind of information is gathered. Basically a computer system can automatically trace user activity and can provide this information to other group members. As noted in previous studies of computer communication tools, like

Clement (1994) and Tang et al. (1994), such a way of gathering the information can make the user feel invaded in privacy. The opposite to this method is a user generated awareness information by means of an explicit action. In this way the user can decide what information should be accessible to the other group members. On the other hand this can lead to problems as the price of maintaining the others informed could be higher than the benefits of the system. As reported before (Grundin 1988) this is one of the major causes for rejecting CSCW systems.

If we compare this with real life awareness, we can identify the same ways of gathering information. If we are looking for a colleague and he/she is not in his/her room we might see that while passing by (implicit information). On the other hand if he/she is willing to inform us, he/she might leave a *'PostIt'* on the door with the phone number where to be reached or the time of return (explicit information).

The design workshops generated rather contradicting results, with some users asking for automatic information while others claiming privacy. It became obvious that we had to leave this problem under the control of the user, as actually other studies (Dourish 1993) also suggest.

At the other end, the receiver's, we have the problem of how to display the information. Normally, awareness information about a whole group will overwhelm the receiver. As pointed out by Gutwin and Greenberg (1995) *"a trade-off between being well informed about other's activities but being distracted by the information"* must be made.

Awareness information can be presented to the receiver in a passive or active manner. In the first case it is the responsibility of the user to explicitly look for the information he/she needs. In the case of active systems, the user will be notified automatically about changes in the awareness information. The first approach has the advantage that the user is in control of when and what information is displayed, avoiding information overload by these means. Nevertheless, the disadvantage is the fact that in order to monitor the change in the state of a person, the user has to access that information repeatedly.

We suggest the use of a mixture of the two methods: a selective active information display. In such a system the user selects what informations is to be displayed actively while the rest will be displayed passively. The disadvantages of the two methods are removed and the user is in control of the information presented. The *'watch'* mechanism in our first prototype is an example of this kind of *'subscription-based notification'* services. The GroupDesk system (Fuchs et al. 1995) suggests a similar solutions using subscription in a generic local event mechanism.

3.4 Design For Multiplicity – Our Second Prototype

One of the most important findings of the workshops was the fact that, in order to have a usable system, we had to provide all group members with easy access to it. The system has to be accessible in different circumstances (including working at home or in some remote location, or in situations where computer resources are limited). In order to accommodate all these particular requirements, we decided to provide three different interfaces to the system, each of which allowing access to the same information: an improved video conference version, a WWW interface and a simple, plain text UNIX command. All of these use the same data distribution and storage module, CoObjects (Sandor 1995), allowing them to work together as a single system.

The goal of the WWW interface (Figure 11) is to offer the AtWork functionality to all potential users. As WWW browsers are available on all existing platforms, this interface can be accessed by everybody within the group. In addition, this interface can be simply accessed by someone from outside the group, as no special program is needed.

Figure 11: The WWW interface of @Work.

The fact that WWW interface allows public access to the system raised again the issues of privacy. People would like to provide group specific information accessible only to group members but not to outsiders. The solution was to provide two versions of the information: one for group members (protected by individual passwords) and one for public access. The Plan information from the video interface is split into Internal announcement and Public plan. The first one is accessible to group members only, while the second one is visible to anyone.

The interface consists of a number of pages that allow viewing the group awareness information as well as updating your own information. The main page presents the group members in the form

of a list. Figure 11 shows a snapshot of the private version of the main page (accessible to the group members only). In addition to the text-based interface this one uses the capabilities of HTML and the WWW, providing hyperlinks to home pages of the group members and to the communication tools within the browser (email). Other pages are available for viewing the public data (accessible to everyone), pages for setting your own information (by using a form), on-line manual, etc.

```
konrad@sbrehm.nada.kth.se> ipfinger -p ran

  Name: Ragnar Johnsson
  Situation: Away from keyboard
  Phone: 08-7906283, 070-7961776
  Last seen: Oct. 10 09:45 on sbrehm
  Internal announcement:
  12/10 Ericsson, 13/10 SGN/Kista, 30-31/10 & 1/11
  vacation, 7-11/11 conf: Doors in Amsterdam.
  Public plan:
  Mostly here v40-41, except w-days.
```

Figure 12: The UNIX text interface

Figure 12 illustrates the use of the plain text UNIX command. The accessed information is the same as in the other interfaces. The user can view the awareness information about any group member or can set his/her own information. Authentication will be performed if needed.

The third interface is an improved version of the video conference tool described earlier. The intention was to make it look like the Web pages, for example providing a picture of a person if a video image is not available. This interface is intended to be used only by group members. All the video/audio conference capabilities are still available while we removed the messages since those could not be naturally implemented in the WWW version.

We suggested earlier that gathering the awareness information must be done under the control of the user. In our system we decided to collect some of the data automatically (latest used computer, latest update to the information). More sensitive information (situation, private/public information) is not gathered automatically but we provide the user with a tool that, when used, can do it. Actually the

tool is the already described UNIX command. If used in the .login and .logout file with the appropriate parameters, it can set most of the awareness information properly, reducing the user's effort of keeping the information updated.

3.5 Using a Cooperative Redesign Approach

The first two prototypes of the AtWork were used internally in for a couple of months in the KTH group. But despite the cooperative design approach, it was hard to achieve a critical mass in terms of usage. There were still complaints as to why so few people cared about updating their personal information.

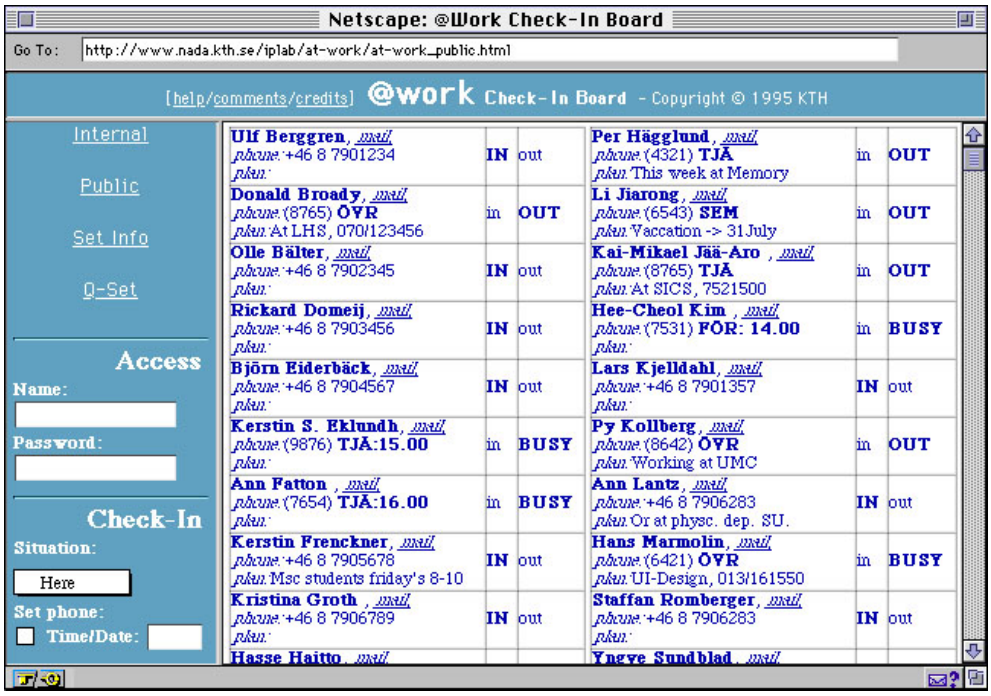

Figure 13: The redesigned WWW interface.

In a second series of workshops we came to the conclusion that one of the main problems was that the accessibility to the system was not sufficient. As noted earlier, keeping in touch with people outside the lab was considered to be very important, and even if e-mail and the web were commonly used, the phone is still the most frequently used communication tool. To overcome this problem, it was suggested in the second workshop to connect the AtWork system to the *'Public Data Exchange'* (PDE). As with most modern PDE, you can leave and

retrieve messages using your phone, but many find the interface (on the phone) unintuitive and hard to use.

To understand better the way in which people use phone programming, we also here mixed in a *'quick-ethnographical'* study by visit and observing how the PDE operators worked. They handle well over 2500 people and 3500 phone lines. They confirmed that most people do not *'program'* their phones due to the tricky interface. Based on earlier positive experience when email was introduced to communicate with the operators, they really liked our prototype with the PDE integration and thought it had the potential of relaxing their work load. From their routines we also learned that, e.g., the office *'neighbours'* of an unreachable person were called for information.

We redesigned our prototype with a web-based interface to AtWork that integrated the PDE functions. This approach did not only attracted a larger number of active users but also simplified the tricky phone interface.

After the second redesign when the AtWork system was integrated into the group's official web pages become the system finally slightly more used. One of the finding from the design phase is that building a system like AtWork can't be done immediately. The tricky handling of providing awareness information and privacy need to be handled incrementally by refining stepwise prototypes through cooperative design workshops.

3.6 Conclusions

From our study we conclude that social awareness is an essential prerequisite for good collaboration. We would like to stress that social awareness is not limited to physical availability but also includes emotional state and group members' knowledge. Considering work practice and social norms, as well as issues like information gathering, displaying and privacy, is a mixed design approach very important that could balancing between tradition and transcendence – the "*dialectical foundation for design"*. Without such an approach it is hard to find a design that is rooted in current mindset but also enable and allow new flexible working environments.

Hence one of the important findings in our study is that designing a system like AtWork is not only about designing for the future but is also about improving current work practices. From that we formulate what we will call the dual-purpose design in our work: For usability and acceptance you should design for both solving a current problem in work practice (like we did with the graphical user-interface to program the phone) and simultaneously offering solutions to enable new forums and new media for computer based communication (like we extended the ability to keep colleagues aware of your presence). We would like to argue that the dual-purpose design could be a helpful guideline in the design of CSCW system.

This form of situated design has also a strong impact on how a system will be anticipated and used. Thus, through the design workshops, several of A-Lab's members felt that they shared a responsibility for how the system would come to be used.

Chapter 4
The VideoCafé Case-Study

The *VideoCafé* project started with a proposal between two research labs that were interested in fostering a new joint research program to virtually connect public places using video-mediated communication. The idea of providing a public mediaspace was based on the assumption that such a space could facilitate informal community building. We theorized that this would benefit individuals by enabling them to take an active part in discussions and influence future plans and activities. In the project, we built and assessed several different social places between the two research labs, each of which was augmented with a mediaspace installation. This environment is commonly referred to within the labs as the VideoCafé. Technically the VideoCafé is a rather simple but (very) high quality videoconferencing system that continuously links the two labs with audio and video.

The VideoCafé project is described both from a design perspective as well technical perspective in Tollmar, Chincholle, Klasson and Stephanson (2001). Junestrand and Tollmar (1998) provide an extended argument about deploying mediaspaces in domestic environments where the VideoCafé is used as an example. My role in the VideoCafé project has been (beside being the project leader) to work with general design issues, both the design process (installing and testing a number of prototypes as will be described later) as well as working with more

specific design matters such interface and interior design issues. This chapter is mainly a revision and extension of the Behaviour and Information Technology journal paper (Tollmar, Chincholle, Klasson and Stephanson 2001), of which I am the main author and contributor.

Our main approach towards finding suitable installations was done through a design of a series of installations that put a focus on *'reflective dialog'*. In our study, we have so far set up eight different prototypes of the VideoCafé environment. Each setting has been evaluated by being put into practical use for several months. We have continually advocated informal group discussions to collect anecdotes and general viewpoints about the system. These informal evaluations were supplemented by asking participants how the VideoCafé has affected their patterns of relationships and their communications with people at both labs. This reflective design of the VideoCafé environment allowed us to collect and store different experiences that we could implement later in our next generation of prototypes. This approach is what we refer to as *'design-in-use'*.

4.1 Related Work

Within the area of CSCW research, the importance of a medium that could support informal communication has been debated for a long time. It has been suggested that face-to-face meetings provide more opportunity for informality (spontaneous, non-planned or temporal) than any other form of communication. Kraut (1990) concluded using observational methods that informal communication tends to be very frequent, above 85% of all interactions, in an R&D environment. More than 50% of the conversations were also unplanned.

According to Morgan (1986), one of the major opportunities to encourage this kind of interaction is to create informal networks that give the members influence over and preliminary information on critical matters. Katz (1978) even suggests that informal communication is the most essential form of human communication. Some companies have realized its benefits and advocate explicitly what Fish et al. (1990) define as the organization's *"instrument to handle flexibility in critical moments"*. Informal communication is used by organizations as an important method for accomplishing work as well as transmitting organizational culture and knowledge.

One of our basic assumptions is that telecommunications will not only decentralize services (this has and will continue to happen in several industries) but will also increase interpersonal communication, as well as centralize some of the most information-dense industries. Sassen (1991) reported in her research on the high-density business centers in New York, Zurich and Sydney, where related businesses are located within a ten minute walking distance. Smart buildings, communication centers, laundry services, espresso-cafes, diners/restaurants and cocktail bars are a necessary component of this infrastructure.

'Mediaspace' is the term coined by Robert Stults at Xerox PARC to emphasize that electronic media can have the property of altering and augmenting physical space. The importance of the Palo Alto – Portland mediaspace was that it provided an opportunity for communication that would not otherwise be possible without actually being there, and that the support extended beyond communication on the explicit content of work tasks. This is what made the mediaspace a sustainer of working relationships (Bly et al. 1993)

The stories from Xerox (Bly et al. 1993), University of Toronto (Mantei et al. 1991), Bellcore (Fish et al. 1993) have fruitfully informed us that video has a profound impact on communication activity and utilizing this medium can take many different forms. Indeed, we can imagine at least three basic types of mediaspaces and envisage how physical metaphors are used to aid our interpretation of the systems. One is exemplified by the Bellcore Cruiser (Coole et al. 1992) and Sun's Montage system (Tang et al. 1994), where glances enable a user to briefly *'look into'* the office of co-workers to assess their communication availability. A second category could be exemplified by Bellcore's VideoWall systems (Fish et al. 1990), which provide open links through which permanent video/audio channels are maintained between public places. Finally, there are awareness applications such as Xerox Portholes (Dourish and Bly 1992), and the AtWork system (Tollmar et al. 1996) in which, in addition to other awareness mechanisms, a video image is periodically sampled and hence could indicate the presence or the absence of co-workers.

Naturally, establishing a usable mediaspace is more than just providing some connected cameras and monitors between two remote places. In particular, as in any semi-public place, there is the dilemma

of where the private and public spaces meet. Paul Dourish reported at the CSCW´96 Community Workshop (Dourish 1997) on the fact that mediaspace projects seem to be characterized by continuous efforts to experiment with different solutions to privacy issues. Dourish pointed out the contradiction in the nature of mediaspaces as hybrid physical/virtual environments:

> *"Many of the significant issues in differentiation arise from the physical environments from which we enter 'virtual' spaces; the exigencies of particular, local situations lead to variations in virtual behavior. The homogeneity of distributed communities is often illusory".*

This is an important point as it indicates that mediaspace projects need to be sensitive to the architecture of the physical places where media has been introduced and, in particular, they must be aware of the social use to which these places are put (Harrison and Dourish 1996).

The evaluation of mediaspaces is also something we wish to attend to. The literature is marked by informal reports of experience, usually by the systems' implementers themselves, and not uncommonly are positive in tone. Evaluating mediaspace projects is, on closer inspection, somewhat of a problematic enterprise. Firstly, it seems inappropriate to evaluate a technology designed to support informal interactions by taking measurements in formal settings and contrasting these with video-mediated and face-to-face settings, though this is commonly done as Dourish (Dourish et al. 1996) points out. Whittaker (1995) noted that subjective and objective data in video-communication studies are often not in agreement, i.e., people reliably prefer video, but it is hard to prove why. In addition, issues of quality sometimes complicate existing studies of media manipulation. Until recently, it has only been possible to achieve high quality media using video-communication within LANs or by analog technology. In two of the few comparisons of media at different quality levels (O'Conaill and Whittaker 1997, Monk and Watts 1992), quality-related differences have been found. In low quality systems, the tone was more formal and lacked the use of quick interruptions, back-channels etc., while the high quality media system provided the opportunity to talk and act much more efficiently and informally.

In conclusion, though the mediaspace research literature is well established, some important possibilities are under-investigated. First, design strategies are required which take an integrated view of how to mix virtual and physical spaces from a communicative as well as an architectural perspective. Second, there is a particular interest in investigating public or semi-public places in organizations (i.e. not offices or formal meeting places). Third, one needs to think carefully about the evaluation of mediaspaces and, by experimenting with very high quality links, avoid technical compromises, which can confound empirical evaluation efforts.

4.2 Design of VideoCafé Places

In the VideoCafé project we have been focusing particularly on how to reuse social places within a workplace to create new means and opportunities for communication. The key point here is our experience in integrating mediaspace installations into public environments in a total of seven different locations. Our main objective has been to develop the VideoCafé so it could connect people in physically separate locations at places that are suitable for social and work-related conversations. In this respect, we can capitalize on the existing *'social architecture'* at the sites we have been working on. In particular, we are looking at introducing communication media to public or *'semi-public'* places within organizations – those places to which visitors have ready access and which form the sites where the social exchange is *'at-ease'*.

As mentioned in the introduction, some of the best collaborative work takes place in informal, playful settings. Creative ideas are more often set free in informal settings than in formal conference rooms. Hence a new design goal was to build a system that advocated communication that was driven by pleasure rather than some practical needs. This has pushed even more on seriously integrate knowledge from architecture and interior design to create pleasant places that integrate technology and social meeting places.

William Mitchell draws a parallel between new electronic places and how urban public places were designed in the ancient Greek agora – *"It was the possession of an agora that made a collection of buildings a city. It*

was essential." (Mitchell 1995). What then makes places agora-like? Mitchell lists four major characteristics:

- *Accessibility and openness. Exclusion from public places involves marginalization from the community*
- *Friendliness, non-hostile environment*
- *Freedom of assembly and action, provide high level of freedom of action*
- *Public control of usage and transformation over time*

In physical public space public control is usually handled in a direct way. The key point is that if there is no public control of usage there is not a public place. The design implication for the VideoCafé is clear, i.e. design of a public mediaspace must be done in a close circle with the habitant of these places. Using pre-fabricated solutions seem to be unwise design. On the contrary, the design-by-use approach that we used actually seemed to match Mitchell's list well. In fact the approach of prototyping cooperative places with physical building blocks, such as tables, chairs, cameras, microphones etc. was firstly more fun and understandable, than for example in the CoDesk cardboard study, and secondly was probably also more efficient since it is hard to see how such design could have been rationally done a priori.

We have deployed our system at locations within the two laboratories, which are characteristically used for activities such as coffee breaks and informal meetings, or which provide opportunities for unplanned encounters between people. In this way, we have introduced the VideoCafé so as to capitalize upon the existing social uses that people make of their environment. Ray Oldenburg in his book *"The Great Good Place: Cafes, Coffee Shops, Community Centers, Beauty Parlors, General Stores, Bars, Hangouts, and How They Get You Through the Day"* conducted an analysis of what he refers to as *'third places'* (1989) claiming that, around the world, they share common and essential features. They are *'levelers'*, socially inclusive rather that exclusive, and hence *"expand social possibilities"*. In design, a third place is typically plain and yet the mood is playful. Our intention has been to locate candidate locales within our labs for developing *'electronic third places'*, which could similarly expand the social possibilities of our two, now connected, research groups.

Some basic needs and situations were identified as being common to everyday usage. For example the VideoCafé benefited from being close to public utilities such as the main entrance, the Xerox machine or the coffee machine. Our experience is that by considering the social environment, we can clearly determine how well such a place could support its task. For example, since not everyone might benefit or have any use for the system, putting it close to individual workplaces may not be a good idea, and vice versa. When the VideoCafé was set up outside of the main loop, the number of chance encounters dropped significantly. There are many concerns that need to be balanced when setting up these places, it is often hard to find locations in actual workplaces. Thus the need to cooperatively discuss and select these places is critical.

To do this, we have reshaped a number of chosen locales through careful interior design while introducing mediaspace technology, including:

- *a common space in a shared lab,*
- *entrance lobbies,*
- *in a corridor close to shared communication devices such as faxes and photocopying machines, and*
- *public coffee places.*

We discuss these in turn.

4.2.1 A Commons in the Shared Lab

The *'common place'* in a shared lab was the first place to explore. It was furnished as an ordinary sitting room with sofas, bookshelves, stereo and TV. The corner had long been used for both relaxation and informal work. At the other end of the room were several workstations for shared use. There was at least one group member in the room most of the time.

A standard TV set (30"/16:9) and a specially composed directional sound reproduction system was used for the VideoCafé. Several cameras were installed in the room to make both sofas at the table visible to the remote site, and a camera was mounted on the ceiling to

make it possible to see parts of the room other than the VideoCafé corner (see figure 14). An IR-device was used to select and control the cameras. These control devices could be used both locally and remotely from the other location.

Figure 14: First installation of the VideoCafé corner

Figure 15: A visual feedback monitor with microphone, speakers and camera control

In our evaluations of this set-up, a prevalent user-concern was the kind and clarity of the feedback that was provided about system status. We had to ensure that buttons were labeled clearly and that, where

possible, we could use buttons which clearly showed their on/off status even at a distance across the room. Users wished to be able to clearly see when the audio channel was open and when not, as well as have feedback about the image that was currently being transmitted to the remote site. In response, we designed a three-button switch (microphone, speakers and camera) with a small monitor that provided visual feedback (see figure 15).

We commonly observed people working in the lab turning the speakers' volume down so not to become disturbed in their work. Of course, however, this would mean that audio was not available as a source of peripheral cues, which might enable people to initiate interaction with someone at the remote site. It became obvious that we needed to replace the direct audio with some ambient form of a less intrusive nature. We return to this issue later in the paper.

4.2.2 The Corridor

We next experimented with '*the corridor*' as a site of installation. The corridor was close to some of the staff members' offices and would be traversed by most lab members several times a day.

Our basic idea was to enrich this place of encounters with the remote lab's presence, but to distinguish different zones that allow different levels of access to lab member' activities by the remote site. Three different communication zones were defined: (1) the inner zone where the user could be both seen and heard, (2) the background where the user could be seen but not heard and (3) a free zone where you are neither heard nor seen, so as to enable people passing through to be left alone (see figure 16).

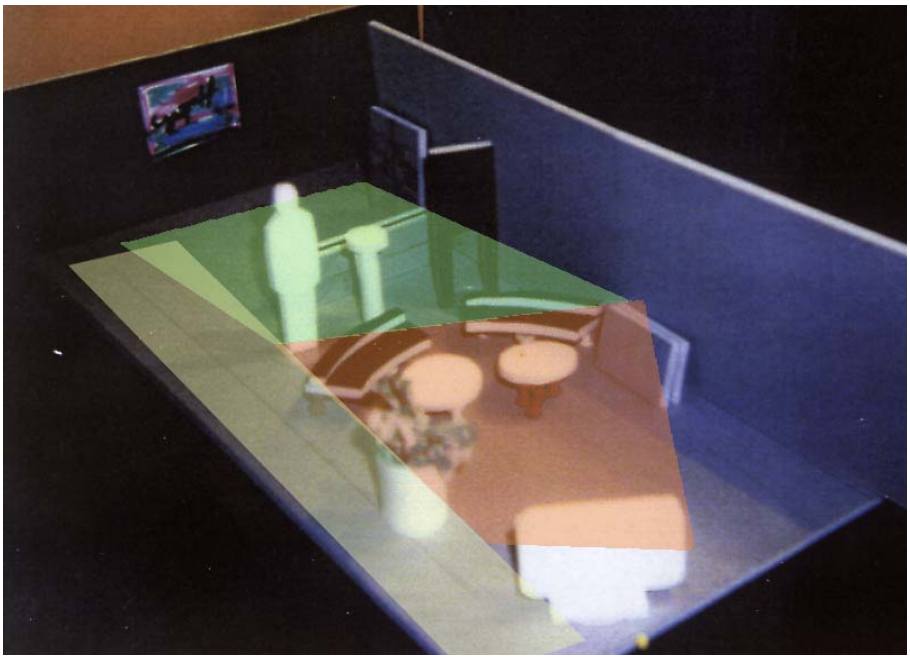

Figure 16: The three different communication zones in the corridor installation.

It turned out to be difficult to strictly, but flexibly, control the technology in such a way that the different zones were clearly distinguished. For example, where the boundaries were actually located was hard to clarify and maintain.

We noted that, although in one sense a public place, the corridor was commonly appropriated for more intimate exchanges between people who happened to meet there. With our zones in place, securing privacy for such exchanges would require that it be done in a particular zone – the one without audio or visual access from the remote site. Needing to move to different zone to secure privacy made it cumbersome to use the corridor for interactions of this sort.

4.2.3 The Lobby

The third place for our prototype was *'the lobby'*. Compared to the corridor, the lobby is usually not so heavily trafficked and hence, in principle, might provide a calmer atmosphere for longer conversations.

However, in our case this place did not become they type of mediaspace we intended at all. Comments that were made indicated that this is a place for merely passing through, and very seldom a place where you stop to chat. The frequency of informal encounters was noticeably low. However, compared to the corridor, this place supported better semi-formal meetings between the labs. Due to its calm nature, it became an appropriate place for extended meetings. However, these uses are a little far away from enabling informal encounters in a lightweight fashion that constitute our main interest.

4.2.4 The Cafébar

'The Cafébar' is, in some respects, the most *'designed'* of our locales. Here we wished to experiment with specially designed tables and chairs that enable people to sit down and talk and deploy the mediaspace technology in relation to this furniture. The resulting solution became a raised table in the form of a bar. We hoped that, by providing an attractive region in proximity to the mediaspace technology, people could readily position themselves to be available for interaction with the remote site, while also able to use the space for short, spontaneous interactions (see figure 17).

Figure 17: An installation in the Cafébar.

One of the problems with the early prototypes was that the space did not clearly indicate how many people it was designed for. One of the outcomes of this was that the distance between the participants and the camera, and between the microphones and the screen varied constantly. The shape of the table also ensured that most participants had a fixed distance between them. In addition, the recess in the middle of the table provided a natural separation between the social interaction area of the table and the technology in the form of tripods, remote controls, cables, microphones and so forth (see figure 18).

Figure 18: The VideoCafé table.

4.3 Discussion

This chapter concludes with some overall observations regarding the success of the VideoCafé at establishing a VideoCafé community. This question has puzzled us a lot throughout the VideoCafé project. There are several informal observations (both anticipated and unanticipated) of situations that clearly emphasize the VideoCafé's communicative strength, and in particular its ability to support informal communication. Paradoxically, we were also told that several participants found the contacts via the VideoCafé to be weak and that the VideoCafé did not fulfill its task.

However, we also observed that the communication between the labs has indeed improved in the sense that more people are acquainted with each other and that work-related contacts have been established. Several spontaneous and unplanned meetings have been observed and reported. All but one person reported to have had several informal meetings over the VideoCafé every month. One of the interviewees reported:

> *"... the usual situation is that you go over to the VideoCafé and sit down and someone is sitting on the other side, and you start talking to each other, and it evolves to a group discussion, and then we talk for a while"*

Another usual situation when contact has been established between the two laboratories is when one side has visitors and they sit down by the VideoCafé. As one interviewee reports:

> *" ... usually you sit in a meeting (with the visitor), then you think it would be nice to sit down there (at the VideoCafé) because you know that someone on the other side might show up, or maybe they too are having a meeting on the other side, and it has happened several times that discussions have started between us while we were sitting there"*

But we also witnessed microphones that were sometimes unplugged and the video camera was re-directed towards a white wall. Our main interpretation of these phenomena is that more work need to be done on privacy issues.

However the system provided many unique opportunities for communication that would not happen otherwise. Still, as debated above, there where no general awareness about the increased number of relationships. There are a number of reasons for this, e.g. could the expectations be set too high and when people felt that the *'get to know process'* was slower than in real life, the increased number of relationships didn't reach a critical mass fast enough. It has recently been debated if, and how, media spaces are truly useful in the support of informal communication. One of the conclusions could be that media spaces are difficult to learn and use in appropriate ways. It has been argued that it is easy to find the system useful for peers who know each other well, but it has also been observed that creating new contacts seems unusual in this context — it is hard to meet new people in a media space. If so, only one dimension of informal communication is supported through a media space.

This inspires us to examine some new developments that arose from the usage of the VideoCafé environment. As the VideoCafé

environment started to become used on a daily basis, we soon witnessed how technical pit-falls easily could break down the flow of conversation. For example, misplaced cameras and improperly adjusted microphones were all simple errors that negatively affected not only a conversation with a remote colleague but even more seriously disrupted the chances for causal encounters. People commonly reported that they wished for a set of tools to automatically configure the equipment in response to the human activity. The underlying design principle would be to reduce the cognitive load on the user by allowing the system to make context-sensitive responses to the user's actions. Tools designed to supplement a video conferencing system should be accessible and usable even by those who have no experience with the technology.

Naturally, simplicity is a key design principle. However the very nature of this kind of technology is complex, hence this principle doesn't necessarily mean that the technology should be simple, rather simple to use. Buxton notes wisely (1997) that – *"each unit for human-human communication is a legitimate candidate for human-computer interaction"*. We would like to extend this design practice based on our observation of how easily complex technology could erroneously interfere the conversation flow. We suggest that the video-communication set-up would benefit by activating the peripheral equipment, e.g. cameras, microphones, loudspeakers, and the environment, with the overall goal of making the mediaspace more context-sensitive to people and activities.

Our general guidelines are to build the interface as transparently as possible. Ideally, you will be able to use your body in the room as the main interaction device, not just one or two fingers on your hand. These *'smart'* or *'reactive'* artifacts will use information from devices including motion detectors, processed video, and contact sensors to control the equipment of the meeting room. Awareness of the user's gaze, identity, and intent can be used to allocate resources more appropriately in multimedia streams, which will automatically select the image and adjust the communication bandwidth according to the semantics and state of the environment at any given instant. This awareness also facilitates the design of low-bandwidth presence and activity indicators, which convey abstract representations of a user's action and intent. Sometimes the mediaspace is too noisy and

intrusive, and on other occasions the mediaspace is too passive and cannot allow the kind of casual communication that it is intended for. Different forms of media transformations seem here to be a promising direction for further development. This is an important research strand, where today we continue to explore new media that could give the awareness information a memory, e.g. like in a physical space where it is possible to sense if some other humans have recently been there.

4.4 Conclusions

We initiated the project believing that the VideoCafé would promote informal personal contacts between people at both the labs and in time could foster a community of interest. After the study, we can see that there have been a lot of new contacts on a personal level. However, these contacts have developed through a need for such contacts and by previous personal links. The VideoCafé has been used as a tool for some of these new contacts, but it is still unclear how many would have occurred even without the VideoCafé. What is unquestionable is that almost everyone liked the VideoCafé setting, in the sense that it was a highly appreciated component of the social, as well as the communicational, environment.

Firstly, we would like to argue here for the importance of incorporating the skills and experience from architecture and interior design in order to create physical and virtual spaces for distributed community building. As noted, a context for the informal contacts is needed. By utilizing notions from traditional, spatially-defined communities we might provide an affordance that could be used and understood in electronic meeting places. However, as it been debated, these spaces are entered and used in a physical space and these need to harmonize. Hence the very importance of expand mediaspace design to include the design of the physical space, i.e. social use, interior qualities etc. The architecture and interior design of these places should reflect the type of communication they are intended for. It is these subtleties in the integration that will shape the usefulness of the mediaspace whether they connect offices, lunchrooms, lobbies or public bars.

Figure 19: A second installation in the Cafébar

Secondly, it is easy to fall into technical discussion and argue that problems in video-communication should be resolved by technical means (e.g. better user-interface) but this is only partly true. Indeed some features could be better designed than in our experimental prototype but we would also like to argue that a public discussion is what best create and keep a public community of use. Here is a list of some of the most important issues that was raised in this discussion:

- *Find a real context for contacts, organize workshops, lectures etc.*
- *Strive towards shared engagements, discuss project and sharing of information,*
- *Discuss about appropriate places that are neutral in terms of local ownership, i.e. space adjacent to offices are partly "owned" by the office holders*
- *Discussion about social (non-technical) rules in VideoCafé*

These are issues that steamed out of the design-in-use approach due to the open dialog we had during the project. Cooperative design of the

physical design seems here to create a sense of shared ownership which is most essential for success deployment of VideoCafé.

Chapter 5
Towards CSCW Design in the Scandinavian Tradition

We started from a point where the aim was to investigate how design practice in the Scandinavian cooperative and participatory design tradition could be used in CSCW. Through the case-studies we have been able to examine a number of design methods in various CSCW situations. What is still left is a more general discussion of how the cooperative design approach has worked through in the CSCW domain.

We found that cooperative design seems to be less rigid than most other design methods and this enables a designer to more freely mix different methods according to the specific conditions of each setting. Based on this I will suggest a flexible use of design methods into *'design orientation'* that combine complementary methods into an approach.

We can view a design orientation as a collection of design practices associated with a certain way of thinking. Hence it will be argued that building new design orientations that are based on cooperative work

and design practice is an important part of extending the practical knowledge of how to design CSCW in the Scandinavian tradition.

5.1 Design Methods Used in the Case-Studies

Even if we limit ourselves to cooperative and participatory design there exist a large number of design methods. Muller et al. (1997) describe over 60 different methods that are all based on cooperative and participative design practice. Their examination made me ask: Which methods belong to the cooperative and participatory design practice and which don't? I would like to argue that it is often hard to identify a single design method as being cooperative or not cooperative, or participatory or not participatory. I have instead tried to create a categorization that enables a designer to group different methods into categories which are used in the context of cooperative and participative design. Our categorization in *'dialogs'*, *'workshops'* and *'prototypes'* is used in the table (see table 1) where the main methods that have been used in the case studies are listed. The structure of these categories follows freely Grönbaek, Kyng and Mogensen's discussion (1993) about the main types of activities in which users are involved in cooperative design.

Type of method	CoDesk	AtWork	VideoCafé
Dialogs	Informal observations	Informal observations	Informal observations, interviews, anecdotes
Workshops	Design workshops	Metaphore games, Future Workshop, Observations & Innovation	Group discussions, design workshops
Prototypes	Cardboard computers, semi-functional prototypes, videos and demonstrations	Functions prototypes and demonstrations	Functions prototypes and worksplace installations

Table 1: *Cooperative design methods used in the case-studies.*

A common thread in the case studies has been to blend various design methods into a design approach that could combine the valuable outcomes from each method in the design. The reason for this approach is that in practice none of these methods is sufficient alone

and hence we needed to complement them with each other. In this table can be observed the use of multiple methods in each study.

In order to understand the particular design methods, and how combinations of design methods could work out, we need also to understand their emergent properties such as their most important merits and problems. Table 2 provides an overview of the most important merits and problems and states also where in the design cycle the different methods have been used.

Some more particular problems in the intersection of cooperative design and CSCW are that in workshops activities it is sometime problematic to envision realistic CSCW situations. On the other hand one of the major merits of workshops is that these activities could smooth the sometime hard transfer into new work practice (e.g. due to technology shift). We have several times observed that group discussions and workshops not only have been used to discuss a particularly issue but also more general matters related to work practice.

Several problems are connected to prototyping activities, such as contradictions between heavy CSCW prototypes and light prototypes used in cooperative design, and that some prototyping activities are tricky to perform in larger groups and will hence lack the needed group dynamics.

These two examples provide an illustration of richness and shortcomings in the various methods. Furthermore this summary underlines the need to combine different design methods (later on will we also integrate methods from other disciplines such as ethnography and architecture) to create a platform for design.

Design Method	Phase	Merits	Problems
Informal observation	Early – Late	Low cost	Difficult to compare
Interviews	Early – Late	In depth personal information	Time consuming, lack of group dynamics
Anecdotes	Early – Late	Cultural snapshots	Subjective and difficult to collect
Future Workshops	Early	Establishing a grounding and a call for change	To follow-up commitments
Metaphore games	Early	Stimulating game playing	Abstract outcome
Observation & Invention	Early	Multi disciplinary approach, rich documentations	Envisioning CSCW metaphors is difficult
Cardboard Computers	Early – Mid	Enable early evaluation	Lack of group dynamic
Mock-ups, videos and demonstrations	Early – Mid	Re-use well known design media	Difficult to show realistic CSCW situations
Functional prototypes	Mid – Late	Allow evaluations and reflection in use	Need advanced toolkits
Workplace installations	Mid – Late	Integrate cooperative properties	Resource demanding

Table 2, Properties of some cooperative design methods.

5.2 Design Orientations

There are currently a large number of design methods in CSCW (and even more if we broader the area to IT or engineering). With daily use, these methods evolve and create new methods, which are further developed and documented. In crafting a method in real life, practitioners often need to integrate experience from different sources. Finding the right information has become very time consuming, which has created a situation where methods are seldom read and rarely fully understood. Hidding (1996) reports that practitioners very seldom use design methods directly. Instead, practitioners seem to solve their design problems by using two different approaches. Firstly, as opposed to conducting elaborate studies of the methods per se, it has been found to be more valuable to talk to others who had to solve similar problems. The second approach is to internalize design methods instead of reading about them. We see this as a way of

individually interpret design methods. This stands in clear contrast to the standard path of *'one-size-fits-all'* in design methodologies. It has therefore been argued that methodologies need to be more generic to allow customization, which van Setten et al. (1997) calls *'methodology engineering'*. When broken down into their core components, different methods can be used by different practitioners based on their information needs. Hidding's viewpoint is that the rich diverseness in a methodology should support the needs of both doers and planners for different information.

In the spirit of the generic design toolbox I suggest an open design approach, labeled as *'design orientation'*, as a methodology that could integrate various design perspectives and guide the designer through the design effort. In our interpretation a design orientation is a set of different design perspectives, which combine concepts and design methods into a tool to use in talks about design matters. Consequently, any design project is likely to express a number of design orientations which are instantiated, each, in a number of methods.

The use of a design orientation helps select the essential element that is at the heart of the design. This essential element can be seen as filter through which a person interprets and interacts with the world. Thus, we can interpret a design using a certain orientation as the result of a created artifact, given a particular set of design elements. This selection is a deeply held set of perspectives concerning the nature of a specific area. In the area of CSCW, this will mainly concern the very nature of people and cooperation in relation to networked computers. This approach seems more usable than working with pure design methods with specific outlines. Clearly, any design will follow some type of plan or a sequence of activities. However the order of these activities can vary very much. Generally because different settings tend to have unique features and design methods typically generate different outcomes in different cases. Hence it is seldom possible to directly use a design method developed in one context in another context without changing the design practice. A design orientation integrates instead a holistic view into the design by rejecting the pre-dominant sequential notion in system modeling.

To be more specific, and in the line of this thesis, I suggest that a CSCW design orientation with its roots in cooperative design should

be seen as a way to highlight particular aspects of people's work and communication activities with the specific design goal of supporting user participation in design.

5.3 Design Orientations from the Case-Studies

Chapter 1 listed a couple of different issues involving the relationship between Scandinavian design practice and CSCW design. In particular, the following issues were raised in Chapter 1.5:

- *How to balance a design that is based on daily work practice but still explore new innovative CSCW solutions?*
- *How to use prototypes in design of CSCW?*
- *How to build a design based on evolving use?*
- *How to combine different design approaches into a coherent design?*

When we tried to approach these issues in the case studies we observed two phenomena. Firstly, these issues seem to be layered containing multiple questions that could not be solved by a single design method and secondly they also appeared to be more interrelated with each other than expected. But in each case (as showed in Chapter 2.4, 3.6 and 4.4) it was still difficult to have a discussion that covered all issues at the same time. However using the design orientation approach it become easier to fruitfully link the issues with another. The outcomes of Chapter 2, 3 and 4 could now be used to formulate a couple of specific CSCW design orientations that tackles in different ways the original questions:

- *Dual design – find bridges between old and new cooperative models through mixtures of ethnographic approaches and cooperative design,*
- *Two-way prototyping – broadening CSCW prototypes by opening up combinations of mock-ups and prototypes media,*
- *Design-by-use – integrate design and deployment by expanding the design-by-doing approach,*
- *Social spaces – integrate new disciplines to find new meetings points for cooperative design.*

In the next section of the text each of these design orientations will be described in more detail. Each description is divided into three major parts. It starts with a discussion of which design methods could operate on a particular issue and how this combination of design methods could complement each other. Then some examples of usage are listed. Finally some more general advices on how to use this design practice is given. This structure is a variation of Alexander's (1977) discussion about describing design patterns in three blocks: conditions of application, anticipated benefits and problems and linkages to examples.

5.3.1 Dual Design
– bridge old and new cooperative models

Using an ethnographic approach provides a deep understanding of the social structures and a deep understanding of the organization of social life, something the more short-term cooperative design methods cannot offer, however there is still a tension between these perspectives. Where the ethnographer is trained to observe and leave the cultural setting unchanged, the inventionist wants changes to take place. Although the real value of ethnography in system design is a matter of some controversy, it is a well-established method for uncovering the subtle details of a situation. Hughes et al. (1997) claim that ethnography sometimes has been misunderstood as to how it can be directly applicable in design. The core problem, as Hughes et al. argue, is the disparity between the rich and concrete portrayal of the situation versus abstract and vague generalizations.

In the AtWork study it was clear from the design phase that neither the cooperative and participatory design nor the ethnographical study could stand alone (see Chapter 3.2). Issues involving more specific details, e.g. which media are used in accordance with the employee's position would be hard to determine in the participatory design methods. Conversely, the group discussion led to a common understanding within the group that there is a need to be able to communicate better in this setting, and that one of the most important factors for successful communication is social awareness.

Mixing an ethnographic approach with cooperative design methods highlights also a number of issues that have a double nature in CSCW

design. CSCW design needs to create a balance between the individual needs and the group's goal, as well as to support both formal and informal modes of communication (see for example Robinson (1991), which suggests use of double-languages).

I would like to expand the mix of the ethnographic approach with cooperative design methods into a design practice that not only designs for the future, but also sees improving the daily tasks as an equally important goal. The essence in this design practice is to design a system that could simultaneously provide the users with improvements in their current work practice and point to new styles of cooperation. This is a design practice that I would like to refer to as the '*Dual Design'* practice (see Chapter 3.6). In the case studies, we found two obvious applications of the Dual Design practice. The first example is from the study of the Collaborative Desktop. Enriching and integrating a commonly used environment with a new set of tools and metaphors improved both the design and the existing environment (see Chapters 2.4). The second example is from the AtWork study. The implementation of dual purpose design in this setting is to both propose a mechanism for improving everyday tasks which currently have a clumsy interface (handling the PDE through the keypad on the phone – see Chapters 3.5), but also to introduce a new vocabulary about availability and reachability that will change work habits over time. Our studies have also shown that dual design practice will often give confidence and acceptance of a new system.

5.3.2 Two-way Prototyping
– combinations of mock-ups and prototypes media

Prototypes have been used extensively in cooperative design. However, as stated earlier, prototypes for CSCW applications create other demands. Here we will list two dilemmas with CSCW prototyping.

The first problem concerns how much functionality that is needed in CSCW prototypes. On one hand, prototypes should be simple, e.g. to enable a free and unconstrained discussion, but on the other hand, CSCW prototypes need to be much broader than a prototype for a single-user application. This is based on the observation in the CoDesk cardboard study that an individual's use of software is highly flexible

(see Chapters 2.3.1). CSCW prototypes need to handle at least some of these variations to be considered worthwhile. Otherwise it is likely that a CSCW prototype that only enforces one single method for performing a task will fail. Such a prototype simply sends the wrong signal – a CSCW system should not impose monopolicity, rather it should advocate the rich multiplicity in cooperative work. I would argue that CSCW prototypes need to handle at least some of these variations to be considered trustworthy. Hence, a CSCW prototype needs to be much broader than a prototype for a single-user application.

The second problem is that while some issues might be tested with a single-user perspective, e.g. interface design, most cannot be evaluated on a short-term basis using a simple prototype (see Chapter 2.3). To be able to build such robust prototypes, we need robust and advanced software toolkits. We have been using both freely available software such as Groupkit (Roseman and Greenberg 1996) and NV/VAT (Jacobson 1992), but also customizable versions of commercial software packages, such as Lotus Notes. The drawback with commercial software packages however, is that they often provide only limited flexibility (in spite of claims to the contrary) and they also require, most often, an advanced infrastructure. In general we would like to argue that the CSCW field lacks such toolkits, and this makes this kind of CSCW prototyping difficult.

The strategy that we have been using involves combining different kinds of prototypes and carefully balancing the amount of horizontal and vertical functionality. This approach do we referee to as *'Two-way Prototyping'*. From our experience does it seem to be very important *to find* combinations of mock-ups and prototypes media in CSCW design.

5.3.3 Design-by-use
- expand the design-by-doing approach

We have observed that CSCW systems do not seem to evolve in the same way as single-user applications evolve (see 3.4). This contrast is embedded deeply into the design. While single-user applications often are layered to enable a growth in skill, this approach is problematic in multi-user applications. Our theory is that a common understanding is based on a shared view, but that different layers in abstraction will

present a diverse range of views and hence make collaboration difficult.

The case studies clearly highlight that one key to CSCW solutions emerging successfully is a combination of using Scandinavian design methods, such as prototyping and workshops, and advanced toolkits (see 2.3). Hence, such combinations in the process of designing and deploying CSCW – an approach that I will label as *'design-by-use'* – is an approach within which an appropriate solution comes forth. The design-by-use approach is also in marked contrast to the common notion that CSCW systems are designed a priori, a misleading theoretical perspective that decouples design and deployment. Instead, the design-by-use approach points to the unfeasibility of delving deeply into design without using a system.

Bødker & Trigg (1994) notes that *'tailors of software'* often start with concrete examples, and normally work out the problem *'in reverse'*. In some cases they come to a conclusion and a theory. The major point here is that learning seems to occur in conjunction with technical and organizational changes since learning and deployment of new knowledge take place at the same time. Therefore, we can see a dual challenge in CSCW design methods. Certainly the design needs to deploy essential components so the systems can support an efficient flow of information. But as the systems intrinsically will reflect the complexity of the tasks, the complexity of the flow of information needs to be adjusted to an appropriate accessible level.

As mentioned earlier (see Chapter 1.4), one of the outcomes from the UTOPIA project was that the use of formal requirement specifications was not successful as a means of communication. They were too abstract. It turned out to be easier to bring graphical workers into the design process via a concrete approach, using mock-ups and simulations of computer based working environments (Ehn and Kyng 1991). This approach was called *'design-by-doing'*. It has been suggested that one of the benefits of this approach is that the workers do not have to explicate their work processes; they can express their skills by demonstrating and doing their work.

I am hereby suggesting one further step in this direction by advocating the design-by-use approach. In this approach, it is assumed that if you

enter into it you have to change (Bannon and Schmidt 1992). A change in software will lead to a change in work practice, or if the work practice changes so will also the use of the technical system that supports this activity. Our approach suggests that the design-by-use approach is a process of fine-tuning the system as it is used. Changes are made in a way such that people are in sync with the development of appropriate solutions.

The idea that *'use is design'* has also been advocated in the reciprocal evolution method developed at Philips Corporation (Allen 1993). However, their focus is to use their method when participatory design is not possible or where broader design implications are sought from user-centered system design. Worksite observations across locations of how these technologies are used may provide both specific and general information about the work practices and the specific technologies.

Our proposed design-by-use approach could be regarded as a dialog between designers and users. But this dialog will not happen by itself, rather I argue that an active cooperative design approach is the most effective means of advocating the design-by-use process. We saw evidence of the design-by-use dialog both in the AtWork and in the VideoCafé project. During the use of the AtWork system an active dialog was needed to discuss the practice of leaving and not leaving awareness information, and how this has changed during the use of the AtWork system (see chapters 3.5). Another design-by-use dialog discussing the need for social spaces took place during the VideoCafé project. In this dialog physical blocks such as chairs, tables, microphones, video-cameras were moved around to experiment with different collaborative environments (see chapter 4.2).

These last aspects are also closely related to the conditions of prototyping in CSCW design. Some toolkits are less constrained and hence allow greater flexibility and changes during the use of a system.

5.3.4 Creating Social Spaces
– integrate new disciplines to find new meetings points for cooperative design.

In a couple of the cases we observed a need to introduce disciplines not normally at the core of CSCW, such as in the VideoCafé case where

the use of architecture and interior design is an essential part of the research. Oldenburg proposes similar arguments when he discusses from an architectural point of view about the general need for "third places" and informal community building and how to merge them into workplaces (1992).

We found, by integrating architecture and cooperative design issues, a base for a discussion about the collaborative space where cooperative work is performed. This discussion about *'Creating Social Spaces'* we think is a very important discussion for CSCW related issues (see Chapter 4.3).

We noticed for example that a feeling of commonality between remote places connected with video-communication is needed. It can be expressed in color, lighting or something else that provides a shared reference point. This discussion connected also back to a discussion about how people thought about their own space and how color and interior design affect the workplace as a place for social interaction.

As discussed earlier, public control of usage and transformation over time, i.e. the cooperative design approach, are also important to encourage the use of public places for cooperative work. Cooperative design of physical design creates also a sense of shared ownership, which is a very important aspect in designing not only mediaspace but also CSCW in general.

5.4 Developing New Design Orientations

The design orientations that are brought to light in the previous text emerged from our case studies but in other cases new complementary design orientations need to be developed. Hence an important property of the proposed *'design orientations'* approach is to regard it as an expandable toolkit that is flexible in use and support adding new approaches and design orientations.

As a starting point for developing new design orientations the structure for describing design orientations can be used (in three major blocks as described earlier). When working with this structure I have formulated some questions, which could help in the development of new design orientations:

- *Which are the design methods that could operate on a particular issue and how can combinations of these design methods complement each other?*
- *Which examples of use are important?*
- *How could this design practice be generalizable?*

But there are also important questions to be considered when working with the specific design goal of how to support user participation in CSCW. As stated earlier I define a CSCW design orientation with its roots in cooperative design as a way to highlight particular aspects of people's work and communication activities with the specific design goal to support user participation in design. Here are some of the most important questions that we have in our cases:

- *How can people be more involved in preparing and carrying out cooperative work?*
- *How can users and developers discuss communication and coordination issues in enhancing quality, efficiency or pleasant cooperative arrangements?*
- *How can users and developers discuss the use of new concepts that have been suggested in CSCW, such as awareness and information sharing on the web?*

In principal it is a discussion about; how to perform cooperative design of cooperative work in order to further empower the cooperative character of this design approach? Done thoughtfully this could generate a spin-off effect, and in return develop general support for cooperation. Given this, the sociality of CSCW design becomes even more important. CSCW design is not only a process to engineer CSCW solutions; it is a core factor of the deployment of CSCW thinking and the development of cooperative work.

Finally I would like to point to some connected topics that could act as inspiration for the reader and be useful tracks for future developments within this area.

In some respects design and evaluation are a pair of activities equally needed when developing new technology. To study this issue further we could ask: What kind of design orientation could handle

cooperative evaluations of CSCW? This falls back on the issue of cooperative design of cooperative work discussed above.

In cooperative prototyping one important aspect to discuss is what kind of representations are used in the design. In terms of CSCW prototyping it would be interesting to study what kinds of design orientation could select work artifacts that are appropriate for use as digital representatives in CSCW prototyping, i.e. what are the special properties of work representation used in CSCW prototypes?

5.5 Final Remarks on CSCW Design in the Scandinavian Tradition

The questions raised in the beginning of this thesis has been discussed above (in Chapter 5.4). But in respect to the two original questions (in Chapter 1.0) I would like to once more underline:

- *Simulation of work situations can be used for cooperative design of CSCW systems if we learn the more specifics about CSCW prototyping*
- *It is very important to use a design approach that take in account both the traditions as well as the transcendence by, for example, mixing explorative cooperative design with ethnographical studies.*

But along the way to explore these issues we found also some other benifits of using cooperative in CSCW design that will be discussed here in the final section.

A common theme in this thesis is to reinforce the notion that CSCW involves a complex interplay of social and technical factors. Inseparable as these factors are, they ought to be designed in tandem. Even though the CSCW community has advocated this for years, it turned out to be much harder to do it in practice. One reason is the lack of understanding of the social aspects of CSCW as a process that will continue to evolve in at an accelerated rate after the introduction of CSCW tools. Designs that promote flowcharts, organizational policies and standard office procedures originate from a *'reasoning-in-rules'* approach that too often displays an inability to handle the flexibility that is embedded in common work-practice.

However, the alternatives seem to be hard to find. We need to ask why it is so hard to enter into the social process that is needed to introduce CSCW technology. Too often is it assumed that the technology should adapt to the current work-practice, but in terms of deployment, both the social and the technical norms need to show flexibility.

Firstly the process of shaping the social aspects needs to be based on constant engagements. This causes problems since engagements in work are often coupled with *'commitments'* – commitments that establish the shared goals. A big part of the problem is that people are inefficient in seeing where these commitments are not in line with common work-practice. Hence, there is gap between what we would like to achieve and what we do in practice. In times of radical change, it tends to be easier to change our engagements than our practice. This could have disastrous effects on the social processes that are a part of CSCW.

Secondly, *'relationships'* are also an important issue to address. Poorly established relationships could lead to poor results or action undertaken without established intentions. This results in design without shared goals. The need to establish relationships before action is an issue that needs to be supported within but also outside the CSCW system. Maintaining relationships falls also in the category of social processes that cannot be performed entirely through technology and hence are greatly supported through a cooperative design approach.

In my experience from the case studies do cooperative design offers here a solution where commitments and relationships are embedded in the design effort. This create a great opportunity for the users to take an active part in defining the goals that CSCW will impose on the social environment.

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