

Circumspective use of equipment: The case of bicycle messengers

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Abstract

This thesis presents an interpretative study of technology use. It attempts to deepen our understanding of the relationship between users and the equipment they use. In particular, it tries to address the ways in which the equipment in use is visible for users. The research presented here aims at dwelling on the concept of *circumspective use*, i.e. a kind of awareness in the situation of use.

The distinction between *visible* and *invisible* equipment in use has been central within the field of HCI. These concepts are used both to inform design and as concepts to describe and analyze the use of equipment. However, the distinction visible/invisible has its limitations for providing accurate descriptions of everyday use. The dichotomy suggests that either the equipment is visible for the user, or the equipment is invisible to the user. The notion of “invisible” equipment in use is particularly problematic, according to this thesis, since it alludes to the perspective that the activity of use is a “blind activity” where the equipment in use is not there for the user.

In order to find out about ways of encountering and relating with equipment in use, an empirical investigation of bicycle messenger operations was conducted. By biking together with bicycle messengers, empirical evidence for a different perspective than the visible/invisible perspective was collected. Participant observation and interviews are the main methods that have been used in this study.

Circumspective use is an important theoretical concept for this thesis. The concept of circumspection (Umsicht) is from Heidegger, and is used to describe *a kind of awareness* in a situation. The phenomenon of everyday use of equipment is described and analyzed with this concept, and doing so has led me to go beyond the visible/invisible dichotomy.

I suggest the concept of circumspective use to provide a theoretical perspective for describing everyday use situations. *This concept directs attention to the user’s awareness of equipment, alternatives and the environment of use.* The perspective provided by the concept of circumspective use suggests that the user always has an awareness of the

equipment, alternatives and environment. Hence, this concept moves us beyond the visible/invisible dichotomy.

Understanding is grounded on this human attitude of being open to possibilities and continuously caring about events, behaviors, and problems.

-Claudio Ciborra

1 Introduction

“Main Street number 5, Mrs. Anderson at TopoCorp waits for you in the lobby now” is the message Peter is attending to while he is rushing through an intersection as the traffic lights indicate yellow. He is listening to the dispatcher while accelerating through the intersection, together with another biker and several car drivers. He is familiar with this area, and estimates that he will be able to pick up the parcel from Mrs. Anderson in less than 10 minutes, and he answers the dispatcher “Will be there in 10”. The sun is shining, and he is adjusting his sun screen while listening to the radio and biking down the road. While adjusting the sun screen he also reduces speed slightly in order to let some pedestrians cross the street. He then turns up the volume of the song Here, There and Everywhere.

This scenario illustrates a situation in which a bicycle messenger, Peter, is using a bicycle for moving around downtown at the same time as he is using a mobile telephone for communicating over a distance. This is an example of a typical situation for a bicycle messenger, a situation in which he is engaged in the world with various people and equipment. Peter is using mobile equipment that he wears or carries (e.g. radio terminal, mobile handset, bicycle clothes), as well as stationary equipment set in the environment (e.g. streets, voice services, wireless network access).

Human users are-in-the-world, with other people and equipment, always in particular places and situations. In the scenario above, Peter is using his bicycle in order to move swiftly towards his destination for picking up a packet and he is using a mobile telephone and a walkie-talkie in order to communicate with the dispatcher in the messenger company. He is also using a cap in order to protect against the sun, and a portable music

device to listen to music. Peter is using the microphone of the radio equipment, the loudspeaker equipment and the front break on his bicycle as well as footwear, a bicycle accessory bag and the street. One can also assume that Peter is using the software code situated in both the mobile terminal and the corresponding infrastructure, which is facilitating the voice communication with the dispatcher. In other words, there is a web of equipment in use for Peter.

This thesis is an inquiry into the use of equipment among bicycle messengers. It is an empirical investigation into the ways in which bicycle messengers interact with equipment in their everyday lives. *It is a thesis about the ways users are in relationship with equipment in use during their everyday life.* The object of the study is the relationship between the bicycle messengers and the equipment in use. *It is also a theoretical analysis that seeks to examine the phenomenon of use from a new perspective.*

The starting point for this investigation is the relationship between self, other people and equipment. There is interdependence among the three. For example, a bicycle messenger is a bicycle messenger by way of using a bicycle and encountering the dispatcher and customers. The bicycle messenger, the bicycle, the dispatcher and the customer are, hence, interdependent. Our everyday practices are ways of coping with the world we live in, with an understanding of living here among other people and equipment.

In our everyday life, we interact with equipment mostly without deliberately thinking about it. The scenario with Peter is one example; he is thoroughly familiar with biking, and the use of telecommunications equipment. For a moment, imagine what would happen if Peter were to reflect on how the voice presented from the loudspeaker was converted from digital to analog signals in the terminal and the headset – or the interaction between himself and the equipment in use. Any such deliberation would probably have fatal consequences while biking. Or, using another example, “If you start to reflect on how your fingers feel around the racket in a game of badminton, you will probably miss the shot” (Kluge, 2005).

This does not, however, mean that we are not aware while in the act of using the equipment. According to Heidegger, everyday use, or familiar use of equipment is guided by the sight of *circumspection*. Circumspection is a kind of awareness that enables us to do the appropriate thing in our given circumstances or situations. By way of *circumspective use*, the equipment and the situation of use is visible – but not in an explicit subject/object mode. The visibility that comes from circumspective use is, however, different from the visibility that comes from deliberate reflection. *Circumspective use* is a central tenet in this thesis. It is an attempt to illustrate by way of theoretical argument and empirical investigations how *circumspective use* can be cultivated and what the consequences of this might be.

In everyday life, we interact with things without deliberately thinking about what we are doing – or how we are doing it – until we are stimulated by something that provokes reflection about what is going on. In some situations, the equipment we use, the skills we practice and the ends which we pursue “show up” and become explicitly visible to us. When equipment is missing or faulty, we are likely to think about what is going on and how to rectify the situation. Heidegger uses the everyday example of hammering in order to illustrate various ways of engaging in the world. We change the way we manipulate the hammer at a point when we are aware that the hammer is not doing what we intend to achieve with it. For example, when the nail does not go into the wood at the intended place, we become aware of the problem and also of the way to handle the problem. Heidegger calls this a “present-at-hand” mode of engaging in the world, which is deliberate thinking (Heidegger, 1962).

At the most extreme, this leads us to think about our engagement in the world with the equipment we use and the goals we pursue. The equipment is explicitly visible for us, and the need to use the equipment may also become explicitly visible. When equipment and the need for using it become visible, we are in a position to improvise and devise new strategies for meeting our needs.

1.1 Research questions

This thesis is an investigation into the ways in which bicycle messengers use and are in relationship with their equipment. Specifically, I am interested in finding out more about the ways in which everyday use of equipment in general is endowed with a kind of awareness. This is done by addressing three research questions, elaborated below:

1.1.1 Everyday use of equipment and visibility

In the literature about the invisible computer (Norman, 1998) and ubiquitous computing (Weiser, 1991), the explicit goal of designing the computer in such a way that it becomes invisible to the user is articulated. For example, Gershenfeld writes, “Invisibility is the missing goal in computing” (Gershenfeld, 1999). The premise that equipment should not be the focus of attention is the starting point for this discussion.

During the everyday use of equipment, the equipment withdraws from the main attention of the user and becomes part of the enabling background. During engaged use, the main attention is on the task at hand, or on the work. An example of this is when writing a note with pen and paper, where the pen and paper is said to withdraw from the attention of the user and the content of the note is at the center of attention. The consequences of the equipment becoming invisible for the user are questioned in this section.

The first question pertaining to everyday use of equipment is:

In what way is the equipment in use visible or invisible for the user during everyday use?

In order to address this question, the notion of the visible and invisible will be discussed. How did the dichotomy evolve, and what is meant by these terms when discussing the use of equipment? This question opens up a discussion for finding out more about a specific kind of awareness during the engaged use of equipment in everyday life.

1.1.2 Visibility of alternatives during use

During the everyday use of equipment, there is an ongoing selection of technologies for communicating over distances. For example, bicycle messengers use mobile telephones, radios, fixed telephones, and pay phones in addition to face-to-face communication.

When moving around, various types of technologies such as footwear, bicycles and buses are selected. A selection process takes place in order to find and select the appropriate equipment. Hence, there is an ongoing negotiation where there is a repertoire of equipment from which to choose.

Any use situation with equipment consists of more than “one person interacting with one machine”. For example, bicycle messengers will choose among bicycle footwear, bicycles, brakes, MP3 players, streets, microphones, payment systems, wallets, mobile telephones and so forth. Also, when he sits down at the office and completes the day’s paperwork, the messenger is involved with multiple types of equipment, such as chairs, telephones, desktop computers, tables and so forth. Bicycle messengers select appropriate equipment on a moment-to-moment basis in order to accomplish their goal.

The specific question pertaining to visibility of alternatives and selection of alternatives is as follows:

In what way do alternatives become visible, and in what way is the selection of equipment for use carried out and managed?

In order to address this question, the specific empirical findings are discussed using the concept of circumspection. In addition, the concept of “need” is introduced in order to explain the appropriateness of the selection.

1.1.3 Visibility and the environment of use

During the everyday use of equipment, there is a moment-to-moment orientation and comportment in the world with the entities that are encountered. There is an ongoing negotiation with the environment. During non-desktop use situations, when the mobile

computer is used in concert with other equipment in a dynamically changing environment, the user is actively involved in the environment. Just how involved and just how visible is this environment, are the issues I am pursuing here. We will describe new ways in which users are engaged with equipment and, in particular, we will analyze findings about modes and *degrees of awareness* during use.

The specific question framing this is:

During the engaged use of equipment, what aspect of the situation is visible to the user?

One way to investigate this question is to look carefully into the use activities of bicycle messengers in the specific environment of use. Like many other user groups that are engaged outside the walls of offices or homes, the bicycle messengers are exposed to dynamically changing environments. In order to address this question, the concept of circumspective use will be discussed. This can be formulated as follows: "... when we deal with them (equipment) by using them and manipulating them, this activity is not a blind one; it has its own kind of sight, by which our manipulation is guided....And the sight with which they thus accommodate themselves is circumspection" (Heidegger, 1962).

1.2 Motivation

Empirical and theoretical investigations into the ways in which computing and communications equipment is used have been offered in the HCI literature throughout the 30-year history of the field. The computer, the user and the activity of use is studied within HCI, where the focus has been upon the relationship and interaction between the user and the computer during the activity of use.

During the last two decades some researchers have published and promoted phenomenological interpretations of the use of computing equipment, and this thesis is a continuation of this work (Svanæs, 1999; Dourish, 2001; Moran and Dourish, 2001;

Fallman, 2003). The work of Winograd and Flores (Winograd and Flores, 1986) in the USA, and the work of Ehn (Ehn, 1988) in Scandinavia have been inspirations for a large body of this work, including this thesis.

1.2.1 New challenges - visibility

This thesis is motivated by the current and ongoing discussion about visibility and invisibility of computing and communications equipment, and the opening up of new ways of thinking about visibility and invisibility in use. In order to address visibility and invisibility, the phenomena of *circumspective use* is presented as a tentative solution. This is developed both theoretically and empirically.

The concept of visibility has a long history in HCI. When moving from command-based interaction toward direct manipulation, the ‘visibility’ was applied in studies of usability and as a concept for promoting design guidelines. When the graphical user interface (GUI) emerged, in the form of menus and icons, visibility became a laudable goal when making and designing interfaces (Hutchins et al., 1986; Shneiderman, 1992). It was possible, for example, to integrate and to make help information directly visible in the interface, not merely hidden inside manuals and documentation.

The desktop paradigm and the WYSIWYG (What You See Is What You Get) slogan have influenced our thinking about visibility in the interface. An example is “Information visualization” which is an active area of research within HCI today (Card et al., 1999). Furthermore, ubiquitous computing has emerged with new ideas for thinking about the very idea of the interface, and the ways in which computers are used in everyday settings. In that case, the notion of “interface” became problematic, since computers have spread out and penetrated the very fabric of everyday life. There is no longer “the interface” to consider, where computation once took place at a specific location with “an interface”.

Within the field of ubiquitous computing (Weiser and Brown, 1997; Want, 1995; Weiser, 1991) the notion of the “invisible” immediately gained attention among researchers and practitioners. There has been an explicit aim to design computers in a way that makes the

computer *disappear* and hence become *invisible* to the user. User-centered design promoted the idea that “I don’t want to use a word processor. I just want to write” (Norman, 1998; Fischer and Lemke, 1988). Hence, the computer was to disappear, and to get out of the way between the user and the task at hand.

Furthermore, the thesis views “use” rigorously as a relationship between a human user and equipment in use. The thesis is aimed, therefore, at opening the “black box of use” and investigating the ways in which engagement, encounter, comportment and dealings with equipment might be described in terms of the relationship between humans and equipment. Thus, we are opening up for viewing both the ways equipment affects the user and at the same time the way the user affects the equipment. The user affects and shapes the equipment, and the equipment affects and shapes the user.

1.2.2 Motivation for selection of empirical case

The case study was initiated to learn about the use of equipment on the part of those moving around in cities. Bicycle messenger operations in Oslo, Tokyo, San Francisco and New York have been studied during the research period. In addition to this author, four master’s students, supervised by me, have been involved in the studies.

Some of the equipment used by the bicycle messengers is in the proximity (hands reach) of the biker’s body. For example, telecommunications terminals are inside the pockets, and the headset with cables, microphone and loudspeaker are fastened to clothes and bags. On the other hand, bicycle messengers are also engaged with equipment that is far away from them – such as network services, wireless connectivity and remote equipment such as desktop telephones. In other words, they are using both “stationary” equipment, which is fixed to specific places, and “mobile” equipment, which they are carrying with them as they bike, walk or travel by tram or other public transportation.

It is becoming more and more common to use computers that are mobile and with the users at all times. The number of mobile phones currently in use now exceeds the number of fixed phones. The emerging fields of wearable computing (Mann, 1997) and

ubiquitous computing (Weiser, 1991) are examples of sub fields of HCI dealing with questions of interaction with this type of equipment.

Using bicycle equipment to help one move around the city is recommended by many bicycle messengers for reasons of swiftness, care for the environment and physical exercise. In other words, many bicycle messengers have made an active *choice* of equipment for their work, based upon an awareness that alternatives to the automobile exist. An underlying motivation for *selecting* this case is to give voice to and promote the value of biking. Biking is an effective and efficient way of meeting the need for moving around in city areas compared with, for example, the automobile.

The bicycle messenger case is about working in city areas, a complex arena as seen from the researcher perspective. It is a complex arena of computer use, because there are multiple technologies in use at any moment in a dynamically changing environment. It is challenging to investigate and study the use of computers that is taking place in such a dynamic setting, since this is done while the users are moving around on two wheels. The use situations change from moment to moment, and this makes the case both challenging and interesting to look into.

There are methodological challenges with a case like this. Considerations about how to get empirical data from this case are plentiful. Participant observation is used as an approach for investigating the questions, where the researchers have been biking and walking together with the bicycle messengers as they go about their working day. The use of equipment has been observed by participant observation and investigated further by interviews in order to study what is going on between the bicycle messengers and the equipment in use.

1.3 Foundations

Users and equipment are co-dependent. Therefore, the ‘user’ and ‘equipment’ are relational terms that make sense as word-pairs. Equipment is used by someone, and the

user is using something. There is already, primordially, a relationship between the user and the equipment in use. This relationship is the foundation of this thesis.

Phenomenology can be used to explain and make sense of the relationship between users and equipment in use, because phenomenology is a relational science (Ihde, 1990). One of the basic conditions for being, in the first place, according to the Phenomenology of Heidegger, is that already we are-in-the-world with an understanding of being here, i.e. a primordial relationship between humans and the world. We, as human beings, already live in a world with equipment and each other, as we have for a very long time. We can only imagine theoretically being isolated and separated from the world of other people and equipment.

What implications does this have for approaching the study of the use of equipment? One implication is that it does not make sense to describe the user in isolation from equipment in use. A second implication is that it does not make sense to describe the equipment in use in isolation from users of the equipment, except during design. Any attempt to do so would be theoretical speculation, since it does not correspond to the ways in which everyday life is lived and experienced with equipment, according to a phenomenological perspective.

In this thesis, it is acknowledged that when talking about the “visible” or “invisible” computer, we are talking about human experiences, and human being-in-the-world among other people and equipment. In some situations, our attention and awareness is directed to the equipment in use, which makes the equipment visible. In other situations the main attention and awareness of the user is elsewhere and the computer is in the background, or periphery, of attention. In situations of use when the equipment in use has withdrawn, or is in the enabling background of the user, the equipment is still visible, albeit not as an isolated, external object for the user. The concept of circumspective use will facilitate the discussion about *degrees of visibility* in order to open up and go beyond the dichotomy of visible/invisible and ready-to-hand/present-at-hand.

1.3.1 Phenomenology and relationship of human - equipment

The starting point within a phenomenological investigation is that we human beings already are in-the-world with equipment, and hence we are already in relationship with equipment. We are not primordially separate, isolated, individual persons who encounter separate, isolated and individual equipment. We are familiar with the everyday use situations, and already have a primordial understanding of being here amidst other people and equipment. In this sense we are “masters of our world, constantly and effortlessly ready to do what is appropriate” (Dreyfus, 1995). As such, phenomenology provides us with a way to focus upon “everyday life” as it is lived and experienced. Phenomenology, since Husserl, proposed a critique of western rationality focused upon building abstract theories where the dichotomy “user” (or person, subject) and “technology” (or things, object) are separated and hence available for investigation in isolation.

This “mastery” of everyday world activities, for example, dressing, talking on the telephone, using computers, bicycling, breathing, walking and so forth, is based upon the fact that we already are in relationship with entities in the world, and that we go about by practical circumspection:

Circumspection oriented to the presence of what is of concern provides each-setting-to work, procuring, and performing with the way to work it out, the means to carry it out, the right occasion and the appropriate time. The sight of circumspection is the skilled possibility of concerned discovery. (Heidegger, 1985)

This way of dealing with equipment in specific situations is pervasive and it is simply called being-in-the-world. Since we are already familiar with the world we live in, being-in-the-world amounts to “a non-thematic circumspective absorption in the references or assignments that make up the availableness of an equipmental whole” (Heidegger, 1962).

Since we are already in relationship with everyday, familiar equipment, we are able to walk, bike and do thousands of other everyday activities effortlessly and with ease. When we start to “think” about the bicycle, for example, by analyzing certain properties of the bicycle, we make it an “object” for our thoughts. This is useful when repairing the

bicycle, but, within such a mental activity, we step out of the primordial relationship with the bicycle, and by doing so under other situations we will probably fall off – or hit something or someone while biking.

Nonetheless, it is possible to start with the dichotomy “human user” and the “equipment in use”, and for some purposes this might be fruitful and relevant. For analytical purposes, it is possible to isolate the subject (user) from the object (the equipment). During situations of use when there is a breakdown or a disruption (when equipment is missing, in the way, or faulty), this mode of encountering equipment is active. However, the deliberation about the equipment as an object separate from its activity of use is a special kind of encountering equipment. This is derived from the actual, everyday manipulating and dealing with the equipment, according to the phenomenology of Heidegger.

When investigating the actual, everyday use of equipment, there is no fixed boundary between the user and the things in use. The user is a user by using equipment, and the equipment is equipment by being used, as such, by someone. Hence, the user and the equipment inter-are, as it were, are co-dependent. Dreyfus says it in the following way: “We should try to impress on ourselves what a huge amount of our lives – dressing, working, getting around, talking, eating, etc.— is spent in this state, and what small part is spent in the deliberate, effortful, subject/object mode, which is, of course the mode we tend to notice” (Dreyfus, 1995).

What consequences does this interpretation of the user and the equipment in use have for the study of use? One consequence is that the object of study is the *relationship* between the user and the equipment in use. The relationship between the two comes into being, it is further sustained throughout the interaction, and at some point ceases to exist. Hence, this relationship is not static, but dynamic and evolving throughout the activity of use.

1.3.2 HCI and the Scandinavian interpretation of system development

There are an increasing number of studies within the field of HCI, which address the everyday use of computers. During the early days of HCI, it was common to study the use of computers in laboratories isolated from the actual life of people (Nielsen, 1993). Since ICT today is part of the very fabric of modern, western life, it is important to also study the interaction that takes place “in the wild” (Hutchins, 1995), outside the laboratory, where people and equipment are moving around in everyday settings.

The terms *mobile* and *mobility* are frequently applied within the HCI literature in order to address “non desktop” computers. However, more often than not it is not very clear what is considered as mobile; is it the terminal in use, the user himself, the services offered, the content or even the context? The concept of mobility has, however, been important for addressing other use situations than that of using desktop computers. In such situations, people are moving around while using equipment. Even studies of how stationary computers have been used have reported and discussed situations in which people are moving around while using stationary computers in office settings (Bellotti and Bly, 1996).

When use is addressed as a relationship between the user and the equipment in use, the relationship between a person who is moving around and the terminal equipment in use can be characterized as stationary. For example, a bicycle messenger who is using his mobile telephone while biking is in a stationary relationship with the mobile telephone, whereas the “user+mobile telephone” is mobile in relation to, for example, the road and stationary computers. Bicycle messengers move around together with equipment, and use both stationary, fixed equipment in the environment, and mobile equipment that they carry with them. Even though the concept of mobility has had much attention within the HCI literature over the last few years, it will not be elaborated further in this thesis beyond the observation that it is a relational concept.

The phenomenon of use can be investigated by observing actual use situations and by talking with users about the activity of use and the way of relating to equipment. To use

the concept of *relationship* between the user and the equipment in use is a way of talking about the phenomenon of use. By making the relationship between the user and the equipment in use the *object of study*, this thesis is following the Scandinavian tradition of systems development (Kaasbøll and Øgrim, 1994; Bjercknes et al., 1995; Nygaard and Sørgaard, 1985; Mørch, 1997; Kluge, 2005). Instead of focusing upon either the user or the technology, the Scandinavian tradition has been concerned with the *activity of use*. To observe, describe and analyze actual encounters between users and technology is at the heart of the Scandinavian tradition, and it is concerned with both understanding the actual use of computers, and with facilitating design and making solutions together with actual users in a participatory fashion (Bratteteig, 2003; Ehn and Malmberg, 1998; Ehn, 1988). The present thesis follows this tradition.

1.3.3 Communication, interaction and transmission

The field of HCI is about the *interaction* and use of the traditional “computer” in various forms. Lately, it is also acknowledged that “telephones” can be considered as computers. The sub fields of ubiquitous computing, tangible computing, and wearable computing have all recognized the importance and relevance of the mobile telephone. In addition to studying the computer as a tool for information storage, sharing, manipulation and retrieval, it is also recognized within these fields that the computer can be in the form of media or equipment for facilitating communication between people. Telephony, etymologically speaking, is about audio over distance (tele-distance, and phone-audio), but in everyday language a telephone today does much more than just provide voice or audio services; it may offer such services as video and text (Winston, 1998).

When person A is talking with person B over the phone, we say A and B are in *communication* with each other, or that they are communicating. They are talking and listening, participating in a dialogue, quarreling, sending and receiving messages, giving orders, or conducting other activities that might be described with the broad term “communications”. Hence, human-human communication takes place when using the main service provided by the telephone. Communication, etymologically speaking, is about sharing or making common. However, the concept of communication is applied not

only to something that happens between people, but also to what is going on in between users and computers (Suchman, 1987), and between humans and the material of a situation (Schön, 1983). In this thesis, however, the concept of communication is applied to what happens between people, and the concept of *interaction* is used to describe what happens between the user and the computer.

When person A is communicating with person B over the phone, there is interaction going on in between A and the terminal he is using, the TA. In addition, the user A is interacting with and using services in the network (for example, voice services) and the network itself. The condition for the possibility of using and interacting with equipment is that there is a relationship between the user and the equipment in the first place.

When computers are used for communication between people, *transmission* also takes place between equipment. The terminals in use, TA and TB are exchanging signals and content in order to make it possible for user A and user B to communicate. In the figure below, the concept of communication, interaction and transmission is illustrated.

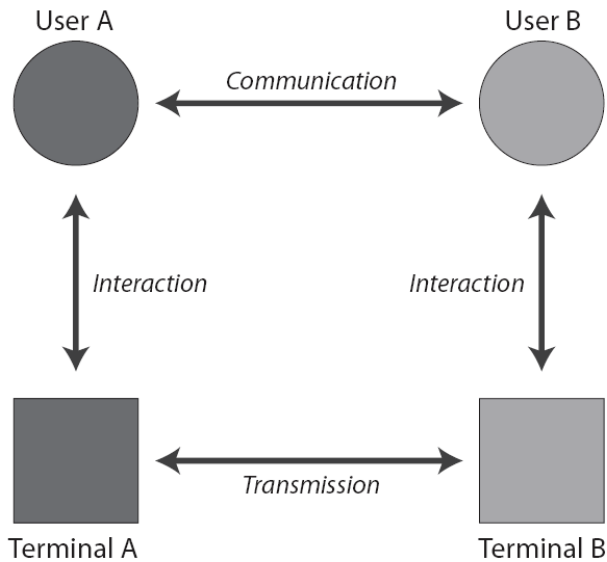


Figure 1: *Communication, interaction and transmission.*

Messaging services like e-mail, instant messaging, presence services, and voice and video services are becoming more and more widely used. The increase in use of social software utilities (for example, Facebook, LinkedIn) is an indicator of this, where computers are used in order to facilitate communication between people in various ways. It is therefore important to investigate and provide perspectives to understand the ways in which computers are used for enabling communication between people over distances. While being engaged in using computers for communicating over distances, the user is still very much interacting with the computer at the same time as communicating with other people.

1.4 Scope and limitations

The object of study in this thesis is the use of equipment by bicycle messengers. It is the individual human interaction with equipment that is the unit of analysis. Software, hardware or systems design as a process is not an explicit part of this thesis, but the author has been involved in such activities in previous work (Herstad and Thanh, 1999; Herstad, 1988; Herstad et al., 1999a; Herstad et al., 1999b; Herstad et al., 1998a; Herstad et al., 1998b). Here, the empirical study and the analytical investigations are limited to the phenomena of use of equipment.

In order to study the use of equipment, there are other theoretical approaches than phenomenology from which to select. The actor network theory, ANT, (Bijker, 1995), and the activity theory tradition (Bødker, 1991) are two such possible alternatives that could have been, but were not selected for this investigation. Within the HCI tradition, phenomenology has been applied previously in order to study the use of equipment, and this thesis is a continuation of this tradition. Neither activity theory, nor ANT has a similar, prominent history within the field of HCI.

1.5 Overview of the thesis

This section is a reader's guide for the thesis. Below, the ten chapters are described sequentially, giving an overview of the thesis.

Chapter 1. Introduction

In this first chapter, the research questions are presented, along with the motivation for this study. The main focus of this chapter is to present the specific research questions, and to introduce this research.

Chapter 2. HCI

The field of HCI has a long history, and there is no single, universal definition or description of what this field is about. In order to present an overview of the field of HCI, the metaphors of library, book, world and desktop are presented. CSCW, ubiquitous

computing and wearable computing are then presented as emergent research fields. This chapter is a literature review of the HCI field.

Chapter 3. Use and need

The human use of equipment is discussed in this chapter. What does it mean to use computing devices such as mobile telephones? What is the relationship between human users and equipment in use? What ways are available for describing and making sense of this relationship? This chapter presents a literature review of some perspectives on use, in addition to various ideas on needs.

Chapter 4. Circumspection and visibility

In this chapter, the concept of visibility is scrutinized. What does it mean for equipment to be visible or invisible for the user? In what ways are the concepts of visible and invisible equipment applied within HCI in order to reflect upon the interaction and use of computers and communications equipment? The first part of this chapter presents a literature review of the ways in which the terms “visible” and “invisible” are applied within the HCI tradition.

The second part of chapter 4 presents the concept of circumspection as a way of describing the use of equipment. The term circumspection is introduced into the field of HCI as a way of describing and understanding everyday use. The perspective that comes with the concept of circumspection is central to this thesis, and forms the theoretical basis for the discussion of the empirical findings from the study.

Chapter 5. Method

In order to study the relationship between users and equipment in use there are many potential methods and techniques available. In this chapter, the research approach, the research strategy and the research methods are presented. Participant observation has been the main method for gathering data about the relationship between user and the equipment in use, and this method is discussed specifically.

Chapter 6. Case – bicycle messengers in action

In this chapter, the bicycle messenger case is presented. This chapter describes the field site where the empirical investigation is conducted. The specific equipment in use and the dynamically changing settings where the equipment is in use are also presented.

Chapter 7. Research findings

The findings from the empirical investigation are described in this section. The three findings are about the relationship between the user and the equipment in use in the given situation. The first finding is about the visibility of the equipment in use, the second finding is about the visibility of alternative equipment, and the third finding is about the visibility of the environment where the use is situated.

Chapter 8. Discussion of findings – visibility in use

The research questions and the findings from the empirical investigation are discussed in this section by applying the concept of circumspective use.

Chapter 9. Limitations and directions for further work

In this chapter, the limitations of the study are presented and discussed. In addition, some directions for further work are suggested based on these limitations. At the end of this chapter, some proposals for implications for design are presented.

Chapter 10. Conclusions

The conclusions from the research are presented in this chapter along with the contributions from this research. The theoretical propositions are offered at the end.

Together, these ten chapters form the thesis. The first four chapters are mainly theoretical, presenting perspectives within the field of HCI about the phenomenon of use. The methods that are applied in order to study use are presented in chapter five. In chapter six, the empirical case is presented, followed by the specific findings in chapter seven. These findings are used to discuss the research questions of the thesis in the next chapter. In chapter nine, the limitations of the study are discussed, together with some

directions for further work. In the final chapter, the conclusions and theoretical propositions are presented.

Throughout this thesis, the user is described in terms of both “he” and “she”.

The human mind is exquisitely tailored to make sense of the world. Give it the slightest clue and off it goes, providing explanations, rationalizations, understanding. Consider the objects – books, radios kitchen appliances, office machines and light switches – that make up our everyday lives. Well-designed objects are easy to interpret and understand. They contain visible clues to their operation.

-Donald Norman

2 HCI

The purpose of this chapter is to present an overview of HCI, Human-Computer Interaction. Various metaphors for thinking about computer use are applied in order to structure a walkthrough of the HCI field.

The HCI discipline has evolved into fields concerning the design and use of computers for communication and coordination, for mobility and “everywhere” use; this is covered with an introduction to the fields of CSCW (Computer Supported Cooperative Work), ubiquitous computing and wearable computing.

2.1 The phenomenon of interacting with computers

There is a relationship between human users and computers, and this relationship is neither determined solely by the computer nor solely by the human user – but is emerging in-between the two, in the situation of use and in the process of use. Anna Croon (Croon, 2006) discusses, questions and reconsiders “... the characterization of the relationship between human experience and information technology. Such discussions often concern which part of the relationship determines the other – human or technology. This in turn is often formulated in terms of questions concerning whether or not technology has inherent properties that determine the way we think and act. There are however, many ways of understanding technology – what it is and how it should be studied” (ibid). Indeed, in the contemporary HCI field, there are many ways of conceptualizing and thinking about computer use.

The computer is continuously evolving and changing, as is its use. Fifty years ago, there were no digital cameras and portable personal music devices, whereas today these “computers” are in daily use by many people. Along with the development of the computer, how we think about computers has evolved. In order to grasp this evolution, let us consider some historical events.

2.1.1 Evolution of HCI

Alan Perlis, Allen Newell, and Herbert Simon founded the computer science department at Carnegie Mellon University in the 1950s. They defined, in their own words, computer science to be “the study of computers and the phenomena that surround them” (Knuth, 2001). Computer use is one of the phenomena that surround computers, and hence part of computer science. It is not the case that people within computer science disagree about this. The difficulty lies, I believe, in being able to *make as science out of computer use*, i.e. to bring this domain into the hands of scientists.

Computer science is a broad field since it is both about the study of the computer “itself” and about the study of the phenomena that surround computers. As computing equipment has evolved, and has been absorbed into broader areas of society, various subfields within Computer science have emerged. One of these fields is HCI, which is specifically geared towards studying the interface between the computer and the user, and the interaction between users and computers.

An approach to HCI is to define each single term: Human, Computer and Interaction. A human can be defined and characterized in biological, psychological, physical, and even spiritual ways. A computer can be defined in terms of hardware, software, functionality, usefulness, aesthetics and so forth. Interaction can be defined and described in terms of comportment, dealings, encounters, relationships, use or the “in-between”.

There are two phenomena that are of main concern within HCI:

- The phenomenon (process and product) of design;

- The phenomenon of use.

HCI can be seen as a discipline concerned with understanding the two phenomena of “design” and “use”. It is about understanding the different processes, methods and approaches for design. HCI is also about the understanding of the phenomenon of use, and conceptualizations about what “use” is.

According to Dahlbom and Mathiassen (Dahlbom and Mathiassen, 1997), the focus for the “new engineering” should be on the “use of artifacts”, and not only on how the artifacts function. Hence, they are calling for attention to how computers are used in “our daily lives”, in encounters of various kinds.

In traditional engineering, we concentrate on how artifacts function, and how to make them function. The new engineering, we envision, will take a different view, attending to the use of artifacts, to the roles they play in our lives and how they play these roles. Such a perspective will revolutionize engineering, embedding it in a social context, making artifacts in use, rather than artifacts its subject matter. (Dahlbom and Mathiassen, 1997)

The phenomenon of “use” and the phenomenon of “design” are interrelated, since design normally influences use through the result of the design, i.e. the artifact, application or services. This is stated by Bratteteig in the following way:

Design normally influences use through the design result; the artifact, as it is introduced to the use context. The artifact is designed to be enrolled in a practice, and materializes the designer’s vision about this practice – at least the vision that the designer agreed to materialize. These visions may be quite different to the actual practice. The degree of influence of the artifact on use varies by the ease of fitting it into the practice, and by its reception in the use context. (Bratteteig, 2003)

The phenomenon of use also influences design in various ways. There is no direct mapping between the understandings of the phenomenon of “use” to any design yet to be found. This does however not mean that there is no influence between the two domains. This is described by Bratteteig in the following way.

Use influences design in several ways, more or less directly. Ideas about future use are the start of design – and a design result is successful when it is integrated into somebody’s everyday activity. Traditionally use is said to influence design through the existence of needs that designers can fulfill. This is a rather simplistic view. Needs rarely occur when there is not already a solution available; there is a complex interplay between what can be offered and what can be sought that defines “needs” in terms of expectations of improvements of some sort. Needs do exist, however, as expectations of improvements, in most life areas. The computer industry benefits from expectations of automation and expectations basically concerned with speed and independence of physical limitations. (Bratteteig, 2003)

We are concerned here with the phenomenon of use, and the ways in which the phenomenon of use can be interpreted. It can be approached in different ways, as has been showed by the example above, such as by observing, interviewing, and studying what people are engaged in together with computer artifacts. At the outset, it is important to be explicit about this inherent challenge within the field of HCI. The understanding that is gained from any study of use is, and will be, interpretations from a researcher’s perspective. The selection and order of the findings from any study or inquiry into the phenomenon of use will be representations of the phenomenon, and not the “phenomenon of use” itself. The use of computers should be approached with this in mind in order to avoid false expectations about understanding the phenomenon of use.

The phenomenon of use within HCI is based on a particular position and perspective from where the research is conducted. This might or might not be truthful to the “actual” use taking place – or that which is happening between the user and the computer. The human user, the actual person and the actual technology, is observed, described and analyzed from a researcher’s perspective. To the best of my knowledge, it is not possible to access directly the phenomena of use, since it involves interpretations of what is going on between humans and equipment.

Within the various traditions of HCI, there are multiple views on the computer, the human and the interaction between the human and the computer. For example, the computer is viewed as a tool by some researchers (Ehn and Kyng, 1984), and as a medium by others (Kluge, 2005). Alan Kay, a principal actor, sees the duality between “tool” and “medium” in the following way:

Is the computer a car to be driven or an essay to be written? Most of the confusion comes from trying to resolve the question at this level... It is a medium that can dynamically simulate the details of any other medium, including media that cannot exist physically. It is not a tool, although it can act as many tools. It is the first metamedium, and as such it has degrees of freedom for representation and expression never before encountered and yet barely investigated. (Kay, 1984)

Today, 20 years after this insight, it seems that we still have yet barely investigated the possibilities that computers facilitate. Baecker, Grudin, Buxton and Greenberg put it this way: “The computer is a tool, a complex artifact that can extend our reach. The design discipline of human computer interaction systematically applies knowledge about human purposes, human capabilities and limitations, and machine capabilities and limitations in order to enable us to do things that we could not do before” (Baecker et al., 1995). The computer as an “extension of humans” can also be seen in the seminal work by McLuhan, “Understanding media – the extension of man” (McLuhan, 1964).

Today, we interact with and use computers and computer appliances (Bergman, 2000; Norman, 1998) such as MP3 players, digital cameras, smart phones, desktop applications, and portable game machines in a variety of contexts. The computer itself is becoming ubiquitous, in the sense that it is “everywhere” – embedded into various everyday human activities. Recently, the traditional desktop computer has become a facilitator for voice communication over distances, merging traditional telephone operations and computer functionality.

It is October 20th, 2005 in Oslo, and I have just used a desktop computer to talk with a friend in Kenya, while he was on his way to an afternoon run in the jungle outside Nairobi. In order to find out about the cost of the call, I click on the “My Account” tab on the VoIP (voice over IP) application, then the “Call list” and then finally, by mistake, “November 2005”. The following text then appears on the desktop computer screen:

No calls found for November 2005.

Sorry, we do not yet support calling from the future. (Skype TM desktop application version 1.4.0.78 – October 2005).

This message on the computer screen plays with the idea of the future, which does not exist other than as a projection. Ways of imagining and discussing “un-dreamed-of” requirements (Preece et al., 2002) and novel computer use is however an important part of the HCI field and a famous saying by Alan Kay is that “the best way to predict the future is to invent it.” Accompanying the emerging technologies within areas such as HCI, CSCW, ubiquitous computing, tangible computing and wearable computing are predictions about what is to come (Brand, 1987). When thinking about technology, we tend to anticipate the future, and forget about the past (Baecker et al., 1995).

HCI is a multidisciplinary research field (Carroll, 2003), with a history, a present and a future. The phenomena of design and use can be approached from a number of different disciplines with unique perspectives and theoretical backgrounds, as is indicated by variety of textbooks in HCI like (Dix et al., 1993; Preece et al., 2002). In (Shneiderman, 1992), there are listed seven different ways students can work through the book, depending on whether the course is in computer science, psychology, library and information science, business and information systems, educational technology, communication arts and media studies, or technical writing and graphic design.

By looking back on the historical development of HCI, some of the underlying assumptions of the current desktop paradigm (Fallman, 2003) can be uncovered, and the various ways in which we think about computer use disclosed. This is the topic for the next chapter, where some HCI concepts and corresponding technologies are presented. But first, some words about the user – the Human who is at the very center of the CHI.

2.1.2 Human users and the use of computers

The most obvious definition of a “user” goes like this: a person who interacts with an artifact for the purpose of achieving a goal. For example, the user of a mobile telephone could be a person who is calling a colleague in order to discuss some matter at hand. The term end-user is sometimes used to emphasize a person directly engaged with the technology (Grudin, 1991). However, Holtzblatt and Jones include in their definition of

users those who manage users (Holtzblatt and Jones, 1993), for example the persons who purchase new systems. In (Eason, 1987), three different classes of users are presented: primary, secondary and tertiary. Primary users are persons who are hands-on, and using the system directly. Secondary users are occasional users, or persons who use the system through intermediaries. Tertiary users are persons who are affected by the introduction of systems or the persons who will influence the purchase process.

In this thesis, the terms “user” and “use” are applied in order to talk about the person who is directly engaged with the artifacts, and in the process of being engaged. The terms “user” and “use” is seen by some authors to have a passive connotation, and by this reason the term is avoided. Alternative proposals are “interactor” (Murray, 1997) and “enactment” (Laurel, 1993) as concepts for describing the process of use. It might be the case that by selecting other words for describing “user” and “use”, new insights could emerge.

Uncovering user requirements and needs has been central to HCI activities, and various methods are available for finding out what the user wants and needs in specific situations. However, what is meant specifically by “need” is often overlooked. Indeed, what is a need? In *Leonardos Desktop*, (Shneiderman, 2002) enters this discussion, and presents various views of “human needs”. By doing so, he is stressing the importance of starting with human needs instead of with the technology or computer per se.

Following this, it is an underlying assumption in this thesis that human needs can be separated from specific technology. Any human need can be met in infinitely many ways, with many different technologies. To think about a need for a mobile telephone or “needing” a bicycle limits the way of thinking about technology and human needs. Needs is seen as related to the human, and some human needs can be met or facilitated by applying and using computers. Hence, the focus on the user within HCI is important, and this is expressed in various ways such as “user centered design” (Hynninen et al., 1999; Norman and Draper, 1986) and participatory design (Bjerknes et al., 1995; Bratteteig, 2003; Schuler and Namioka, 1993).

In order to outline and describe the field of HCI, Kluge proposes three different branches of HCI: task efficient design, participatory design and interaction design (Kluge, 2005). In order to outline and describe the field of HCI in this thesis, some of the influential metaphors thus far discussed are presented. In the next section, the metaphor of the library, the book, the digital world and the desktop are scrutinized in order to present the evolution of HCI. This history indicates that there are different ways of thinking about what the computer is used for. The metaphors are applied in order to organize the walkthrough of some of the ways of thinking about the computer and its use.

2.2 HCI and metaphors

The ways we conceptualize computers and their use is very much influenced by metaphors. Svanæs describes this in the following way:

We conceptualize the computer through metaphors (e.g. information systems, hyper media, communication medium), and externalize this understanding in the conceptual model underlying the systems software (e.g. desktop metaphor, World-Wide-Web, e-mail). We thus ‘freeze’ a certain understanding of the nature of the computer, and this understanding is reinforced every time a new piece of software is created within one of the existing structures. (Svanæs, 1999)

In the early days of computing, the “telephone” and the “computer” were conceptualized differently than they are today. The date for the “invention” of the telephone is usually associated with the patent by Alexander Graham Bell in 1887 (Pasachoff and Gingerich, 1996), and the date for the telegraph is even earlier – about 150 years ago when Samuel Morse was a key figure in its development. The metaphors for thinking about these inventions were, for example, singing wires and remote concert halls.

Computing and telephone equipment has indeed developed over time. Along with the development of the equipment – the software and hardware – concepts about what the computer is and can be used for have evolved. Reflections about what the computer can and cannot do (Dreyfus, 1994; Dreyfus, 1972) have been discussed, as well as ways of conceptualizing the computer with the aid of metaphors (Stefik, 1996). To see the

computer “as” something has been an important way of thinking about what the computer is and for what it can be used.

Metaphors can be pervasive in the sense that when one first lodges in the imagination, it can help us see and think about a phenomenon in new ways. Metaphors have been applied to analyze organizations, for example, by describing organizations as “brains”, “machines”, “organisms”, and even “prisons” (Burrell and Morgan, 1979). Burrell and Morgan caution us that metaphors have both the capacity to illuminate and also to hide. Think about the metaphor of a “computer interface as desktop”. While illuminating the power of the computer to organize information it tends to hide the portable characteristics of a computer.

Metaphors have been influential in the area of HCI, both as sources for interface design (Carroll and Mack, 1984; Mountford, 1990) and for thinking about computers (Coyne, 1995). Especially in operational settings, when the interface is to be designed, built and tested, metaphors have been applied. An example is the Apple Computer:

METAPHOR, someone recently said to me, ‘seems to be the holy grail at Apple.’ It’s true. Just about everyone at Apple knows the phrase ‘desktop metaphor’ and fervently believes that a good metaphor is essential to an easy-to-use human interface. But just as the grail proved to be elusive, so is the knowledge of how metaphor really works. (Erickson, 1990)

The use of metaphors can be a powerful “tool” for communicating about the computer or the telephone. Metaphors are not only to be found in poetry and novels, or in explaining the workings of computers, but metaphors are a constant part of our speech and thoughts. The ubiquity of metaphors in everyday language is demonstrated in the seminal work of Lakoff and Johnson, “Metaphors we live by” (Lakoff and Johnson, 1980). For example, the use of the war metaphor for thinking about argument is used as an illustration.

Arguments have sides that can be defended and attacked. Facts can be marshaled to support one’s position; strategies can be employed. If a position is indefensible, one can retreat from it. Arguments can have weak points – they can even be destroyed; arguments can be right on target; arguments can be shot down. There is

a whole web of concrete military language that we use to describe the rather abstract process of having an argument. (Erickson, 1990)

There are of course many different and alternative metaphors that can be applied in order to think about “arguments” –a dance or traveling, for example. Considering the different things that can be seen by applying alternative metaphors can be an inspiration for thinking about alternative ways of viewing computer use.

The window, folder and dustbin are metaphors which are actively used in computer interfaces today, both in portable computers and stationary, personal desktop computers. Erickson uses the iceberg metaphor in order to present his view of what is behind the metaphor: “A word that is used in a metaphorical way is usually just the tip of the iceberg. A metaphor is an invisible web of terms and associations that underlies the way we speak and think about a concept” (Erickson, 1990). For example, when thinking of a computer in terms of a desktop, this naturally comes with associated words and concepts like stationary, office and so forth. The assumptions about what a computer is and what it is not accompany the metaphor used to describe the computer use.

The concept of the metaphor has been defined in various ways, such as, “The essence of metaphor is understanding and experiencing one kind of thing in terms of another” (Lakoff and Johnson, 1980). In essence then, a metaphor utilizes well understood concepts or attributes from one domain to clarify or to provide insight about another. The following definition of metaphor is more comprehensive:

A metaphor is a description of an object or event, real or imagined, using concepts that cannot be applied to the object or event in a conventional way. The object or the event being described is the target, and the concepts that cannot be applied conventionally are called source...the metaphor is made meaningful by interpreting the source unconventionally in the target. The unconventional interpretation can be arrived at on the basis of some underlying similarity between the source concepts and the target. (Indurkha, 1992)

In the following section, some of the metaphors that are applied to computers and computer use are presented. This is done in order to give an overview of the multiple perspectives within HCI for thinking about and envisioning human-computer interaction.

2.2.1 Computers as digital libraries

The library metaphor takes as its source the traditional library – and enables us to think in terms of search, storage, access and so forth in relation to the use of computers. As with any metaphor, some aspects are illuminated and others are hidden or not made explicit by the metaphor. For example, when thinking in terms of the library metaphor, the portability of computers is not emphasized, nor is the use of the computer for interpersonal communication.

The computer was first thought of in terms of the library by Vannevar Bush in his article “As we may think” (Bush, 1945). Here the ‘Memex’ was envisioned for supporting publishing and the community memory.

Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, Memex will do. A Memex is a device in which an individual stores his books, records and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility....It consists of a desk, and while it can presumably be operated from a distance, it is primarily a piece of furniture at which he works. (Bush, 1945)

This article, written in 1945, has been influential in ways of thinking about the computer and its use. The article has been an inspiration for many people, and it was cited as the main external influence of the work of Licklider (Licklider, 1999). The “Console” which Licklider predicted in 1963 corresponds with today’s personal, desktop computer. Two other visionaries, Ted Nelson (Nelson, 1981) and Douglas Engelbart (Engelbart, 1999) elaborated further on the concept of the Memex. Engelbart focused upon defining a hierarchical structure of ordinary documents in order to enable computer support for preparation. Ted Nelson was concerned about interconnections between documents to make a text space (Nelson, 1981). According to Baecker et al, “They envisioned computers building and manipulating richly structured complexes of interconnected, interlinked bodies of text, which Nelson termed hypertext” (Baecker et al., 1995).

Engelbart presented his work as an “augmentation of man’s intellect”. The computer was envisioned as a supporting environment to the human, and not as replacing the human

intellect, as such. In his own words: By augmenting man's intellect we mean increasing the capability of a man to approach a complex problem situation, gain comprehension to suit his particular needs, and to derive solutions to problems. (Engelbart, 1999)

This way of viewing the computer as something that can augment the human intellect contrasts the view that the computer is "intelligent" (Russel, 1995). The view that humans can interact with computers in order to "augment the intellect" has been influential for thinking about the computer and the use of the computer.

A library is a collection of books, and the book has been – and still is, a central metaphor for thinking about the computer. At this very moment, I am writing on a "notebook" computer, and only an hour ago I visited a web "page". The book metaphor is discussed further in the next section.

2.2.2 The computer as a book

At the time when the library metaphor was first applied, the computer existed in the form of mainframe computers (Winston, 1998), before the days of terminal screens and keyboards. With the development of computing equipment, new ways of envisioning and thinking about computer use emerged. Kay used the metaphor of a single book in order to talk about what the computer could be like:

Devices which variously store, retrieve, or manipulate information in the form of messages embedded in a medium have been in existence for thousands of years. People use them to communicate ideas and feelings both to others and back to themselves. Although thinking goes on in one's head, external media serve to materialize thoughts and, through feedback, to augment the actual paths the thinking follows. (Kay, 1999)

A book is portable and can be used for many purposes. By choosing the book as a metaphor, Kay steered away from the systems view of the library. This book does not need to belong to a library; it can be on the lap of a person and it can be read, annotated and used in any human environment.

A dynamic medium for creative thought: the Dynabook. Imagine having your own self-contained knowledge manipulator in a portable package the size and

shape of an ordinary notebook. Suppose it had enough power to outrace your senses of sight and hearing, enough capacity to store for later retrieval thousands of page-equivalents of reference material, poems, letters, recipes, records, drawings, animations, musical scores, waveforms, dynamic simulations, and anything else you would like to remember and change. (Kay, 1999)

Interestingly, the Dynabook was also envisioned as an audio device. This is of course extending the metaphor of the book, since traditional books did not contain any audio processing capabilities.

We envision a device as small and portable as possible, which could both take in and give out information in quantities approaching that of human sensory systems. Visual output should be, at the least, of higher quality than what can be obtained from newsprint. Audio output should adhere to similar high-fidelity standards. (Kay, 1999)

The metaphor of the book was not the only metaphor behind the Dynabook. Also, musical instruments were used for thinking about ways to use computers, which Kay envisioned and developed further: “There should be no discernible pause between cause and effect. One of the metaphors we used when designing such a system was that of a musical instrument, such as a flute, which is owned by its user and responds instantly and consistently to its owner’s wishes” (Kay, 1999).

Today, with the rapid advancement in computer technology, many of Kay’s ideas have been realized in notebook computers and personal digital assistants as well as portable game and entertainment machines. While the book and the library are part of the “real world”, the “digital world” metaphor has also been influential in thinking about and envisioning the computer.

2.2.3 Computers and digital worlds

The “real world” is what we live in and experience every day – with books, libraries, streets, other people and so forth. The metaphor of a “digital world” has been influential within HCI for envisioning and thinking about the computer. Within the digital world metaphor, there are virtual reality, augmented reality and telepresence:

Digital world are computer augmented or computer created settings for experience. The several kinds of digital worlds differ principally in how the experience is produced and what it means. The term virtual reality refers to an experience of an artificial place that is entirely created and rendered by a computer. Animated video games are virtual realities... The term augmented reality refers to superimposing computer-created information on top of an image of a physical reality... Telepresence is a special case in which communication devices are used to overcome limitations of distance, creating an experience of being present somewhere else. (Stefik, 1996)

The distinction between a “digital world” and the “real world” has been especially influential in the areas of gaming and wearable computing (Rheingold, 1991). The user is in various degrees “in” the digital world, by degrees of experienced immersion. Since we all live in the “real world”; this is invested with meaning about what the world is. Our assumptions about the real world and how we experience it are present when using the metaphor of the digital world. However, there are some differences between the “real world” and the “digital worlds” which need to be made explicit.

One striking difference between the “real world” and the “digital world” is with regards to the interpretation of the concept of *place*. In the real world, we are all in a specific physical place, the place where the body is present, which is our “here and now”. When talking to a friend over a mobile telephone for example, the “place” of the conversation has different characteristics.

We begin with the idea of place. A digital world is a place to go and have an experience. A world contains things, and these things are spread about in different locations. In a real world we either bring things to where we are or travel to see them, whichever is most practical. Generally speaking, the farther away something is, the longer it takes to get there. Things, including us, can be only at one place at a time. To get from one place to another, we have to find a path through, or around, or over, or under the things that are in between. (Stefik, 1996)

Closely linked to the concept of place is the concept of “body”. In the real world, we have – or “are” – bodies (Merleau-Ponty, 1962). Within the digital world’s metaphor, the differences concerning bodily characteristics are examined in the following way by Stefik:

In real worlds we have a body, and our body interacts with the world; thus, the traveler meets certain pleasures but also certain hazards. We can have fun on an adventure, but we can also be injured. Aside from changes in dress, cosmetics, and so on, our body is what we are given at birth and grow up in. We can recognize each other by our bodies, and we cannot trade them in for new ones. (Stefik, 1996)

With the developments of mobile and wearable computing however, the distinction between the “real world” and the “digital world” is blurred, since users of mobile and wearable equipment are both in the “real world” and “the digital world” at the same time. In the traditional use of use of desktop computers, the user is more often described to be solely present in the “digital world” with limited attention and awareness outside the realm of what is happening on the computer screen.

In summary, I have described the computer, and the use of computers with the library metaphor, the book metaphor and the digital world metaphor. However, today perhaps the most influential metaphor recognized within HCI is that of the “desktop”. It has been influential, and is fundamentally embedded into the way the computer is conceptualized, such that even mobile telephones and personal digital assistants have “desktop interfaces”. Imagine having a “desktop” placed firmly in your hand or in the pocket! The metaphor of the desktop for such computers is indeed pervasive (Fallman, 2003).

2.2.4 The desktop metaphor

The vision of the computer as something that is used in an office environment for significant intellectual tasks has a long history. According to Card and Moran, “From its beginning, the technology of personal workstations has been driven by visions of a future in which people would work in intimate partnership with computer systems on significant intellectual tasks” (Card and Moran, 1980).

The “desktop” has been an influential metaphor for thinking about the computer as we know it today, with its keyboard, mouse, screen, processor and memory. The history of the desktop computer can be traced back to the Xerox Star, which was designed in the 1970’s around a number of novel ideas regarding the user interface, including:

- The use of a desktop metaphor, yielding a familiar user's conceptual model with electronic documents on a simulated desktop.
- Direct manipulation, with the ability to see and point to menus and icons rather than to remember and type written commands.
- To use of property or option sheets to specify the appearance of objects.
- What You See Is What You Get (WYSIWYG).
- Universal or generic commands such as Move, Copy, Paste and Delete that are used throughout the system.
- A relatively high degree of consistency.
- Relatively few modes, or states of the system, where certain commands cannot be used. (Tesler, 1981).

With the Xerox Star, the desktop metaphor was explicitly applied as a way of viewing the computer. The ideas behind the Xerox Star were further developed into the Apple Lisa computer – which then became the Apple Macintosh computer. The personal computer software from Microsoft is building on this tradition.

The principle of direct manipulation (Hutchins et al., 1986; Shneiderman, 1983) has been central to describing and popularizing the desktop computer. As computer screens with graphical user interfaces emerged, they started to give users control over the objects of interest (Fischer and Lemke, 1988). Schneiderman has explained direct manipulation as follows: “The systems that best exemplify direct manipulation give us the qualitative feeling that we are directly engaged with control of the objects – not with the programs, not with the computer, but with the semantic objects of our goals and intentions” (Shneiderman, 1983).

In summary, this section has described the use of metaphors within the HCI field. It has not been an attempt to present exhaustively all the different metaphors which have been applied to conceptualize the use of computers. However, what is presented are some of the more influential metaphors which are still alive in the HCI discipline. The importance of recognizing the metaphor which is most often applied in order to talk about the use of

computer is central, since it directs and guides our thoughts about what the computer is, what it does and what it can be imagined to do.

Within the HCI discipline, the focus has traditionally been upon the “one user-one computer”, where the object of study has been the interaction between the user and the computer. Recognizing that the computer has been used for communication, cooperation and coordination between groups of people, the field of CSCW emerged during the early years of HCI. CSCW also has its roots in office information systems.

2.3 CSCW

A shift of focus within HCI came with the emergence of CSCW. Whereas traditional HCI has focused upon human-computer interaction, CSCW is about how computers facilitate human-to-human communication.

Groupware and CSCW represent a paradigm shift in computer use. Human-Human interaction, rather than human-machine interaction is the primary focus; the computer facilitates human communication rather than acting as a purely computational device. (Baecker, 1993)

The shift from HCI to CSCW has been seen as a paradigm shift (Bannon, 1992). A paradigm shift (Kuhn, 1962) is characterized by more than a shift in technology; it involves a shift in perspective as well. The influential phenomena that lead to the CSCW paradigm can be seen as follows:

- Pervasive networking that enables widespread computer-based interpersonal and data communications.
- The extension of personal computing technology to support small group productivity, sometimes known as work-group computing.
- The maturing of technology developed by information systems researchers to support executive and managerial group decision making.
- The merging of telecommunications and computing, as telecommunications companies seek new applications such as videoconferencing that exploit high bandwidth.

- The growing interest in telecommuting and working at a distance.
- The introduction of new technologies and standards, such as ISDN (the Integrated Standard Digital Network). (Baecker et al., 1995)

With groupware technologies, the computer was not only utilized for working asynchronously with, for example, documents and pictures, but synchronously as well with communication links between people and offices. According to Baecker et al, “With the convergence of telecommunications and computation, CSCW can incorporate teleconferencing, the use of audio and video links while conferencing over distance” (Baecker et al., 1995).

The time/place matrix that distinguishes between asynchronous and synchronous communications has been central within the CSCW tradition for classifying various technologies for communication (Grudin, 1994; DeSanctis and Guallupe, 1987). Electronic mail is an example of asynchronous communication, and this application has been an influential CSCW technology (Sproull, 1991). Since the early days, electronic mail has evolved into a variety of other related forms of exchange formats like instant messaging (Nardi et al., 2000), chat and social software utilities.

Groupware has been another central concept within the CSCW tradition. On the one hand, many authors consider that CSCW and groupware are synonymous. Ellis et al define groupware as “computer based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment” (Ellis et al., 1991). On the other hand, different authors insist that while groupware refers to real computer-based systems, CSCW is about the study of tools and techniques of groupware as well as their psychological, social and organizational effects.

Within the field of CSCW, discussions have surfaced about what *collaboration*, *communication* and *coordination* are – as well as what constitutes *work*. Dillenbourg and Baker (Dillenbourg et al., 1995), for example, draw a distinction between *collaboration* and *cooperation*:

Cooperation and collaboration do not differ in terms of whether or not the task is distributed, but by virtue of the way in which it is divided: in cooperation that task is split (hierarchically) into independent subtasks; in collaboration cognitive processes may be (heterarchically) divided into intertwined layers. In cooperation, coordination is only required when assembling partial results, while collaboration is a coordinated, synchrony activity that is the result of a continued attempt to construct and maintain a shared conception of a problem. (Dillenbourg et al., 1995)

The concept of cooperation has been applied by others in relation to the concept of coordination and communication. The term communication has been applied in order to discuss the interaction between humans and machines (Suchman, 1987), between machines (Mattelhart and Mattelhart, 1995), and between humans (Watzlawick et al., 1967).

Traditionally, services and applications facilitating communication between people have been supported from telecommunications vendors and operators, and this development started 100 years before the current tradition of HCI (Grimstveit and Myhre, 1995). There is limited attention toward the traditional services of telephones within the CSCW and HCI literature, and this can perhaps be because when considering technology we tend to anticipate the future, and forget about the past (Baecker et al., 1995). However, with the mobile telephone and VoIP services – the “plain old telecommunications services” has gained renewed attention in the field of HCI and CSCW.

Today, the computer is used both for computation and information management and for facilitating communication between people. The next section is about the computer in its role of facilitating communication between people.

2.3.1 The telephone and the computer

In an article from 1968, Licklider and Taylor describe a novel use of the computer: as devices for communication (Licklider and Taylor, 1999).

In a few years, men will be able to communicate more effectively through a machine than face to face. This is a rather startling thing to say, but it is our conclusion. As if in confirmation of it, we participated a few weeks ago in a

technical meeting held through a computer. In two days, the group accomplished with the aid of a computer what normally might have taken a week. (ibid)

What we see today with emerging technologies such as voice services on the net, Instant Messaging, and various forms of mobile phone use, the computer is used for facilitating communication between people as well as for information management. Also, much of the emerging social software utilities are using the computer and computer network in order to facilitate communication between people over distances.

The observation that the computer is applied in order to facilitate communication between people does not mean that it is no longer used as a tool for computation. It is today not a “battle” between the computers as medium or the computer as a tool – the computer is seen as both a tool and a medium enabling communication. “In domestic settings personal computers are used for entertainment, interpersonal communication self-expression, and access to information of many kinds. Most significantly, in each of these settings computers are used not as calculating machines, but as communication technologies. Computers are being used as media” (Mayer, 1999).

Within the CSCW tradition, there are also occasional references to the telephone, such as the research presented by Sproull: “The networked organization differs from the conventional workplace both with respect to time and to space. Computer based communication is extremely fast in comparison with telephone or postal services, denigrated as “snail mail” by electronic mail.” (Sproull, 1991)

The view of the telephone service as something which is slower than “computer based communication” is not explained further by Sproull. Personal experience and the measurement of analog or digital telephone services indicate that the above suggestion is not accurate. Telephone services are experienced “in real time” – since natural conversations are facilitated by telephone services. But this way of thinking about the telephone, as “slower” than the computer, reveals something about how the telephone is conceptualized: as “old” technology.

The social impact of the telephone has been studied extensively and reported in the seminal work “The social impact of the telephone” (Pool, 1977). The impact of the telephone in family life, business and other parts of society has been studied and interpreted within the sociological traditions. The modern use of mobile telephones has also been studied, for example in studying how micro coordination is conducted with mobile telephones in everyday life (Ling and Yttri, 2002).

Today, the telephone and the computer are still experienced and understood as different kinds of equipment. A telephone is a telephone, and a computer is a computer – but what are the differences? As we will see in later chapters, the term equipment is applied for both describing the computer and the telephone. To use the term “computer” or the term “telephone” bring along pre-understandings of what the device is and what it is not. One way of transcending this is to apply a neutral term, equipment. Another effect with applying the term equipment is that the “computer” and the “telephone” are seen in the same light as other “equipment”, like clothes as equipment for keeping dry, or the bicycle as equipment for moving on top of two wheels.

With the miniaturization of the computer and the development in wireless connectivity, the disciplines of ubiquitous computing and wearable computing, among others, have evolved from the HCI field.

2.4 Ubiquitous and wearable computing

Thinking about the computer as something used only in the office was challenged by Mark Weiser. He coined the term “ubiquitous computing” in the seminal paper about the computer for the 21st century (Weiser, 1991). Weiser describes ubiquitous computing in the following way:

Inspired by the social scientists, philosophers, and anthropologists at PARC, we have been trying to take a radical look at what computing and networking ought to be like. We believe that people live through their practices and tacit knowledge so that the most powerful things are those that are effectively invisible in use. This is a challenge that affects all of computer science. Our preliminary approach: Activate the world. Provide hundreds of wireless computing devices per person per office, of all scales (from 1" displays to wall sized). This has required new

work in operating systems, user interfaces, networks, wireless, displays, and many other areas. We call our work "ubiquitous computing". This is different from PDA's, dynabooks, or information at your fingertips. It is invisible; everywhere computing that does not live on a personal device of any sort, but is in the woodwork everywhere. (Weiser, 1991)

Ubiquitous computing is said to be the “third wave” of computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, with person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives. Alan Kay of Apple calls this 'Third Paradigm' computing (Weiser, 1996).

An example of ubiquitous computing today is automatic door opening systems, where the door is automatically opened when approaching the door. Another everyday example is the always-on or always access situation of mobile telephones, where the user is in 24h/7 day access to a voice and text-based communication network.

The field of Wearable computing dates back to the late 1990s' with the first conference of Wearable Computing held in 1998 in the USA. However, the first “wearable computer” is traced back to the “shoe” computer of 1961, as described in (Thorp, 1998). Edward O. Thorp and Claude Shannon designed, tested and used a computer, the size of a cigarette pack, for calculating odds at a casino in Las Vegas. Since the days of large mainframes, the physical size of computers has decreased, and this, together with the development of wireless connectivity, has lead to the possibility of “wearing” computers by human users.

“Wearing” equipment other than the computer is, however, a well-known phenomena. We all wear equipment like shoes and clothes in everyday life. Many people wear eye-glasses for correcting vision or as protection from the sun. This equipment is close to the human body, and carried along with the wearer – wherever he or she is.

When the computing equipment was in the size and shape of mainframe computer, it made little sense to carry or wear it; the computers were too large in relation to the size of the human body. With the development of miniaturized computing and communication equipment, it became possible to experiment with using the equipment close to the body.

Wearable computers are really just a natural consequence of the personalization of computation. The original impersonal computers were mainframes, locked away in remote rooms. Then came minicomputers, which could be shared by one workgroup. From there came the PC, a computer used by a single person. This allowed much more personal expression, as long as you equate computing with sitting in front of a beige box with a cathode ray tube, keyboard and mouse. Wearables finally let a computer come to its user rather than vice versa. (Gershenfeld, 1999)

Steve Mann has been in the area of wearable computing during his whole professional life, and states this about interacting with wearable computers:

Wearable computing facilitates a new form of human-computer interaction comprising a small body-worn computer (e.g. user-programmable device) that is always on and always ready and accessible. In this regard, the new computational framework differs from that of hand held devices, laptop computers and personal digital assistants (PDAs). The ‘always ready’ capability leads to a new form of synergy between human and computer, characterized by long-term adaptation through constancy of user-interface. (Mann, 1997)

The “always on” world (Agre, 2001b) is one characteristic of wearable computing. Since the computer is where the user is, and always connected to a network, the user is always connected. This again has consequences for the way we think about the computer, as pointed out by Gershenfeld: “Once a computer becomes continuously available it literally becomes part of the fabric of our lives rather than just an appliance for work or play. It is a very different conception of computation” (Gershenfeld, 1999). Instead of approaching the place where the computer is, the computer is always available to the user.

Mobile telephones enable the user to talk and listen to other people who are far away. Is the mobile telephone, then, a wearable computer, as the article “wearing a telephone” indicates (Milewski, 1999)? Today, many people are carrying computing and

communication equipment which did not exist even a few years ago. Mega pixel cameras, multi Gigabyte music and media devices, voice and internet-enabled terminals are examples of equipment that is in daily use by millions of people all over the world. These devices are carried in bags or fastened to clothes and bicycle bags in various ways, and they are with the users at all times, wherever the user goes.

Thirty spokes converge upon a single hub;
It is on the hole in the center that the use of the cart hinges.
We make a vessel from a lump of clay;
It is the empty space within the vessel that makes it useful.
We make doors and windows for a room;
But it is these empty spaces that make the room livable.
Thus, while the tangible has advantages, it is the intangible that makes it useful.
-Tao Teh Ching

3 Use and need

The aim of this chapter is to present the “phenomenon of use”. This is done by addressing the relationship between the user and that which is used, i.e. a relational view on the phenomenon of use.

The two modes of using, “engaged use” and “detached use”, are described. Engaged use is characterized by a situation that the user is familiar with, i.e. the equipment itself and the way to operate the equipment. Detached use is characterized by thinking, reflecting and contemplating in order to proceed with the use at a higher level of abstraction.

In many situations, the use of equipment is unproblematic and smooth, i.e. the situation is as we expect or want it to be. However, in some use situations there are breakdowns or disturbances. This type of situation is often not welcomed by “users”, but for researchers this situation is valuable for analyzing the relationship between the user and the equipment in use. Disruptions and breakdowns are sources of innovation and these are classified into situations when equipment is faulty, missing or in the way.

Why do we use equipment in the first place? It is assumed that, somehow, use is related to a “need”. This chapter presents some perspectives on needs, and how to describe the relationship between needs and the use of equipment.

3.1 Background

The study of computer use has been a topic within HCI and IS studies for three decades. Inquiries, evaluations and studies of how various types of computer tools and media are used are at the very heart of HCI. This is reflected in the increasing number of ethnographically informed studies about how computers and telephones are used (Finken, 2000; Forsyth, 1999; Hughes et al., 1994; Orr, 1996).

Gasser describes the use of computers in the context of work (Gasser, 1986) within an organization. The primary work is, according to Gasser, normally not to operate computers, but computers are operated *in order to* do work. Use is defined by Gasser in the following way:

...any employment of computer-based information or analysis in the performance of other tasks. Thus, computer use presumes the existence of other work – namely, the primary work of the computer “user”. On the basis of this definition, the use of computing is embedded in a context of many other tasks. Computing itself is usually a resource which supports the other tasks. It is difficult to imagine (or to locate in an organization) uses of computing which exist for their own sake... In most cases, it is fair to say that at least a component of most computing is a rational attempt to employ computing as a resource for action. (Gasser, 1986)

The use of computers is seen in association with work. Usually, the “primary work” of the user is not directly about the computer, but something else, as noted by Gasser, accounting being one example. Bratteteig elaborates upon the observation that use can be more broadly defined.

Use is more than operating a computer; it is embedded in work and in the way we think and act in work. Use is usually not the primary interest of the user: while writing this text, typing is not my focus – the computer and its text-processing program is a way to perform writing. I write with pen and paper and I write with the computer – pen and paper are the easier way to create a sequential structure for a text, the computer (and the printer) is the easier way to produce a text product. (Bratteteig, 2003)

Hence, the way computers are “operated” (or any other technology like pen and paper) influences the activity or the work. It is different to write with pen and paper, than with a word processor, according to Bratteteig. In order to find out what the differences are, the study of particular use situations is necessary, and this is done by various case studies, again according to Bratteteig (Bratteteig, 2003). The phenomenon of computer use can be studied empirically by investigating particular users, in specific situations and with concrete technologies. Thoresen (Thoresen, 1999) describes the importance of investigating the individual user with specific use patterns:

Work practice involves operating the system for the purpose of the user’s primary work. Each user has a specific use pattern, which denotes how often she uses the system, which function/parts of the system she uses, and how frequent/infrequent each function is used. (Thoresen, 1999)

The awareness that use is “situated” in a specific context is acknowledged by many. However, according to Thoresen, understanding the situatedness of the computer use is still limited.

Still, many usability studies are weak in understanding the *situatedness of computer use*. They are well aware of the user as a person in front of the computer, but they tend to see this person not as “somebody who works”, but as a “perceptual and cognitive human being”. She has visions, muscles, problems solving capabilities, etc., but the work for which she will use these capabilities is downplayed. (Thoresen, 1999) (italics mine)

Said differently, the use of computers is about what the user wants to perform or do with the computer – in particular situations, contexts or circumstances. It is misleading to imagine any “use” of a computer that has no “purpose” at all, and this is what Thoresen is addressing.

What can we accomplish by studying the use of computers? First of all, it is an underlying assumption that in order to make or design something which is usable and useful, it is necessary to understand use and the situations of use. This makes any inquiry into the use of computers potentially valuable, in the hopes of making designs “better” i.e. more useful, usable and appropriate for the user in the future situations. Secondly, the

study of use is important on its own terms. It provides the condition for the possibility to gain insight, understanding or knowledge about the more general phenomenon of using technology. Since computers are used in contemporary lives in so many different ways, by so many different people, in so many situations – the phenomenon of computer use is worthy of investigation and research on its own terms.

What perspectives are available for describing use? One of the challenges this thesis addresses is that the phenomenon of *use is ubiquitous*. We use words as well as concrete artifacts in our everyday life, and it is difficult to imagine a situation where there is no use. During the day we use letters, words, clothes, computers and telephones, and during the night most probably a bed and a shelter. At this very moment, you are probably using a chair and pieces of paper or a screen in order to read these words. This type of use is ubiquitous, in the sense of taking place in everyday situations. More interestingly, it is also something which is far away for us – and difficult to see.

Our relation to the obvious is always dull and dumb. The path to what lies under our nose is always the furthest and hence the most difficult path for us humans. (Heidegger, 1996)

“Use” is one of these words, concepts and phenomena which “lies under our nose”, and according to Heidegger also furthest away from us. This does not mean that it is unimportant. It is also important to investigate and shed light on phenomena of use that are obvious.

There are some inherent challenges in approaching the phenomenon of use. It is difficult to get outside of the activity of use, since, again, the use of equipment is very much part of being human. It is a relationship between us and the environment. Hence, the activity of use is not an external phenomenon that can best be described and presented from a detached position. However, it is possible as researchers to suggest and pursue various paths in order to observe, describe, and analyze the phenomenon of use.

There are indeed many different reasons for using computers today. The question of why computers are used can be answered in many different ways. Some tentative answers are attempted below:

- The computer is used in order to get a job done, or to perform some task. When writing a letter, for example, a computer is used in order to compose, store and edit the text.
- A computer is in use, because the user “has” to use it; it is part of the job description to use computers. In order to keep up to date with the job, the user is told by the organization to use this or that computer.
- “Computers save time”. In order to collect and distribute information, it is more efficient and effective to use a computer than, for example, paper-based systems or orally based ways of working with information.
- “Computers save money”. It is simply more cost effective to use a computer than it is to use other, traditional technologies such as pen and paper.
- “I do not know – but nevertheless I use a computer”.
- The use of the computer satisfies human needs, such as the need for staying in touch with friends and family and colleagues or even the need for safety when, for example, in a boat on an open sea.

Hence, there are many possible answers to this question about why people use computers. The perspective that the use of computers satisfies *human needs* will be examined and explored in the last section of this chapter. But before embarking on this, I will present a relational perspective on use.

3.2 Use as relationship

“Our existence is technologically textured” (Ihde, 1990). People in the industrialized parts of the world live and move together with an assortment of technologies in their everyday lives. There are various ways of investigating the way we interact and use technology. The multiperspective way of investigating a phenomenon is encouraged

within informatics, by people like Nygaard (Nygaard, 2002; Nygaard and Sørgaard, 1985).

The statement: “ $A=1$ ” describes a relation; there is a relationship between the entities “A” and “1”. This is an elementary relationship found within the domain of mathematics. In this example, the relation is specifying that the entities A and 1 are equal by the notion of “=”. The relational concept is indeed ubiquitous in areas such as mathematics and physics, since it is possible with this device to articulate and express ways in which entities are together.

Outside mathematics and the natural sciences, the concept of relationship is also in use. In everyday life, we can be in relationship with each other, with nature, with technology and with spiritual beings. Often, it is not made explicit what the relationship is, but nevertheless we all understand what it means to be in a relationship. Since “being in” relationship is an intrinsic part of being here, and we are in these relationships, it is sometimes difficult to see the relationship or be aware of the relationship itself. This section is an attempt to present some ways of viewing the relationship between human users and equipment in use.

Relationships are about the “in-between”. The relationship between a person and a computer is that which is “in-between” the computer and the person – and hence neither in the “computer”, nor in the “human” but simply that which is *emerging in-between the two* in the *situation of encounter*. The relationship between two persons is about what is “in-between” the two, or about the encounter between two people and what emerges from the two. We are talking about the thing that arises in the space between the user and the computer. Similarly, the encounter between a person and equipment can result in an emergent phenomenon.

3.3 Relationship in the world

Phenomenology is concerned with how to see, experience and be in the world. Heidegger examines the human-world relations, which determine and outline the dimensions of

human existence (Ihde, 1990). Phenomenology is a branch of philosophy, which has, throughout history, influenced many sciences, including Information Systems and HCI of today. Within the field of HCI, different seminal works have laid the foundations for the application of phenomenology (Dourish, 2001; Winograd and Flores, 1986; Ehn, 1988; Svanæs, 1999; Fallman, 2003; Croon, 2006) to name a few.

Phenomenology can be said to be a *science about relations*. “Being and Time” (Heidegger, 1962) was an account on human spatiality within the world, of human temporality within the world, and of the various structures and dimensions of human-world relations (Ihde 1990). The ways humans are-in-the-world among other people and equipment is at the heart of phenomenology. Phenomenology makes ontological claims as it is concerned with the way we experience and see the world. Ihde (Ihde, 1990) presents a metaphorical model for understanding phenomenology as a relativistic science. A way of stating this model is to indicate that the primitives of the system (the smallest or simplest units) is a set of relations. The person (user) is in a relationship with the world in which she exists. This can be expressed in the following way, according to Ihde:

I – relation – world

This is a way of stating that the “I” (i.e. user) and the “world” (i.e. situation of use) are not two separate, individual entities. The two are primordially in a relationship, and by being in this relationship they are co-dependent. However hard we try, it is not possible to separate the user from the situation of use. Negatively, there is no way to get out of this relativistic situation; any claim to the contrary can be shown to be either naïve or misguided (Ihde, 1990).

A phenomenological account of a phenomenon takes as its primitive the relationality of the human experiencer to the field of experience, or the human observer to what is observed. Einstein (Fölsing, 1997) used a well known example involving train movement to illustrate a relativistic observation, and this example is described by Ihde (1990) below:

If there are three trains on three parallel sets of tracks, the motion observed will be relative to (a) the position of the observer in relation to (b) what is observed. What

is relativistic about this account is that what is observed and the position from where it is observed and the main interrelation between these two must be taken into account. Thus, if the observer were stationed in train B and noticed that train C was moving backward, several hypotheses are possible: either train B is stationary and train C is moving backward, or train C is stationary and train B is moving forward – or both trains are moving. Adding observers in trains A and C and considering all train-movement possibilities shows the complexity of this situation, but in each case there is a “stability” within the observer-observed relation.

It also can be seen that such a relativistic account, which takes into consideration both observer-observed (as a relationship), also can conceptually *absorb* any absolute or non-observational account. For example, where we naively to ask which train is “really” moving, we might construct a fourth position of observation, say, in a train watching tower, D, which oversees the yard. An observer here would not be subject to the relativity of the observers in the trains and could tell which of the hypotheses was “true”.

This privileged position does not escape the absorptive power of a relativistic account, however, because to take such a position as privileged is simply to put in a different place the relativity between the observer and what is observed. It makes the field of what is related more comprehensive and complex; the field now consists of the trains as figures (moving or not) against a ground (which in this position is taken as not moving, but in no way eliminates the relativity of the account. The regional “arbitrariness” of giving superiority to the tower position can itself be transcended, for were the earth itself observed from a more distant point, it would be seen that what was taken for the motionlessness of the ground itself is relative to the motion of the entire earth through its orbit, and so on ad infinitum. Yet the constant of observer – observed would remain no matter what the distance or position occupied would be. (Ihde, 1990)

Like the relativistic account just described, a phenomenological account always defines its primitives as the relationship between the human who experiences in the field of experience. The “relationality” of human-world is claimed by phenomenologists to be an ontological feature of all knowledge; all experience (Ihde, 1990). There is no way to get out of this relational situation as long as we live, according to phenomenology.

For the most part, there is some sort of equipment in between ourselves and the world. Some examples are clothes, footwear, automobiles, telephones, computers, cables, servers and pockets. We live and experience the world with and through these

technologies. Hence, the I-world relationship can be extended into an “I-equipment-world” relationship.

3.3.1 Human – equipment world relations

Being-in-the world is a spatio-temporal project. We move and are primordially *mobile*. We move along with artifacts of clothing like shoes, socks, shirts and other equipment like eyeglasses and wristwatches. We and the clothes we wear are both mobile. The “I” and the world are linked together in a way such that the “I” and the world are not two distinct phenomena; there is a relation between I and the world mediated by equipment in everyday life.

The notion of “relationship” can be a difficult object of study. As Heidegger put it, “We must only bear in mind that that what we casually call a relationship is one of the trickiest of all matters, all the more so since we are bewitched by one-sided notions about what we call a relationship” (Heidegger, 1962). Since the relationship is what is “in-between”, it is intrinsically hard to observe and describe. However, this does not mean that an attempt to investigate it and find out more about the relationship is not possible.

The following example describes the relation between a man and a tree. This example is presented in order to explore the nature of a relation between a person and his environment, as expressed by Heidegger:

.... we stand before a tree in bloom, for example – and the tree stands before us. The tree faces us. The tree and we meet one another, as the tree stands there and we stand face to face with it. As we are in this relation of one to the other and before the other, the tree and we are. This face-to-face meeting is not, then, one of these ideas buzzing about in our heads. We come and stand facing a tree, before it, and the tree faces, meets us. Which one is meeting here? The tree, or we? Or both? Or neither? (Heidegger, 1968)

What does a description of a relation between a man and a tree tell us in this context? Simply that there is not the “tree” and the “man” as isolated entities, but a man that is standing in front of a tree in bloom, and that there is a relation between the man and the

tree. We are interested not in trees, but in examining the relation between a person and the technology in use by that person.

The telephone falls into an auditory embodiment relation, according to Ihde (Ihde, 1990). When the telephone is designed well, the user will hear the other party through the telephone receiver, and the telephone “withdraws” into the enabling background of the user. Eyeglasses in use or footwear in use may be illustrating this embodiment relation further. The example of the blind man's cane (Merleau-Ponty, 1962), shows that the perceptual extension is not limited by the outline of a body or the surface of the skin:

The blind man's stick has ceased to be an object for him and is no longer perceived for itself; its point has become an area of sensitivity, extending the scope and active radius of touch and providing a parallel to sight. In the exploration of things, the length of the stick does not enter expressly as a middle term; the blind man is rather aware of it through the position of objects than of the position of object through it. The position of things is immediately given through the extent of the reach which carries him to it, which comprises, besides the arm's own reach the stick's range of action. (Merleau-Ponty 1962)

In this example, there is a basis for perception over distance, mediated through an artifact. In *embodiment relations*, perception may be materially extended through artifacts. The artifacts in use, be they hammers, binoculars, gloves, cellular phones, feathers or maps withdraw or become “transparent”, i.e. *the artifact is part of the background in embodiment relations that exist between humans and the world.*

3.3.2 Embodiment relations

Embodiment relations are not restricted to tactile technologies such as the blind man's stick, or auditory technologies such as the telephone. Embodiment relations can be monosensory for all of our five material sense organs. More complex than monosensory devices are those that entail whole-body motility such as bicycles, sailing vessels and automobiles. Although riding a bicycle encompasses more than the embodiment relation, its pleurability is frequently associated with the embodiment relation. The rider experiences the road, and the surroundings through riding the bicycle. With a well engineered street bicycle one has a direct feel of the supporting road and the traction that one rides. One embodies the bicycle when off-road biking as well, and when well

embodied one feels rather than sees the supporting ground. The bodily sense is extended through the rider-bicycle body. For example, bikers will frequently make the statement, “We float down the street” (referring to the biker and the bicycle together). And although these embodiment relations entail larger, more complex artifacts and a somewhat longer, more complex learning process, the bodily tacit knowledge that is acquired is perceptual bodily (Ihde, 1990). The experience of the near space around the biker or driver’s body is indeed related to the technology with which one is moving around.

One attempt to illustrate the nature of the nearness and distance of entities experienced through embodiment relations is found in (Heidegger, 1962). Here, there is an embodiment relationship between a person and his spectacles in use:

When, for instance, a man wears a pair of spectacles which are so close to him distantly that they are sitting-on-his-nose, they are environmentally more remote from him than the picture on the opposite wall. Such equipment has so little closeness that often it is proximally quite impossible to find. Equipment for seeing and likewise for hearing, such as the telephone receiver, has what we have designated as the inconspicuousness for the proximally ready-to-hand. So too, for instance, does the street, as equipment for walking. One feels the touch of it at every step as one walks; it is seemingly the closest and realest of all that is ready-to-hand, and it slides itself, as it were, along certain portions of one's body – the soles of one's feet. And yet it is farther remote than the acquaintance whom one encounters on the street at a remoteness of twenty paces when one is taking such a walk. (ibid)

The spectacles sitting on the person’s nose is indeed “transparent” in more than one sense. By using such equipment, something is amplified – and other parts of the world are reduced, as is the case when using many different types of instruments, as described by Ihde (Ihde, 1990). The examples of embodiment relations given by Ihde are followed up by (Fallman, 2003) to also include modern mobile technologies such as mobile telephones and pocket cameras.

3.4 Familiarity and everyday use

Biking, driving a car, using a cup for drinking water, talking over distances with friends by way of the mobile phone are examples of everyday equipment use situations. These

use situations can be characterized by a certain familiarity with the equipment in use and the world.

Any concern is already as it is, because of some familiarity with the world.
(Heidegger, 1962)

But what does it mean to be familiar with the world? Encountering and entering a room is used as an example in order to shed light upon what it means that something is familiar. When entering a house for example, or using a computer, this is done based upon the previous experience of entering houses and using computers.

My encounter with the room is not such that I first take in one thing after another and put together a manifold of things in order then to see a room. Rather, I primarily see a referential whole...from which the individual piece of furniture and what is in the room stands out. Such an environment of the nature of a closed referential whole is at the same time distinguished by a specific familiarity. The...referential whole is grounded precisely in familiarity, and this familiarity implies that the referential relations are well-known. (Heidegger, 1985)

To be familiar in a situation means to be ready to respond and act in a way that is appropriate to it. By being familiar with equipment, we are ready to proceed with what we are currently doing based on previous uses of the equipment, whether this is about moving from one place to another, writing a letter, cleaning dishes or any other everyday activity. As Dreyfus put it:

Thus, the sort of background familiarity that functions when I take in a room full of furniture as a whole and deal with it, it is neither a specific action like sitting in a chair, nor is it merely a capacity in the body or brain for carrying out specific actions. It is being ready in particular circumstances to respond appropriately to whatever might normally come along. (Dreyfus, 1995)

The familiarity with the world is not a skill that sometimes is used, and sometimes not. It is active all the time. Hence, to be a user in the first place is to be familiar with something. We do not activate this most general skill on only certain occasions; it is active all the time. Heidegger calls it the "sight of practical circumspection..., our practical everyday orientation (Heidegger, 1982). According to Dreyfus we are masters of our world, constantly and effortlessly ready to do what is appropriate (Dreyfus, 1995).

Hence, when engaged in familiar situations, the circumspective orientation operates continuously. To be familiar in a situation means that we “know what to do”, and this “knowing what to do” is called the “practical everyday orientation”, or “practical circumspection”. The “things” that we encounter and use in practical, everyday situations are not objects that we analyze and think about theoretically, but things that we are familiar with and simply grasp while going about.

Circumspective oriented to the presence of what is of concern provides each setting-to-work, procuring, and performing with the way to work it out, the means to carry it out, the right occasion, and the appropriate time. The sight of circumspection is the skilled possibility of concerned discovery. (Heidegger, 1985)

In everyday situations, there is a sort of background coping that enables us to go about doing what we are doing. When starting to “think” about all the possible ways we can enter a room, or a workshop, and deal with this situation theoretically, we will probably bump into things when entering a room, or exhaust ourselves mentally.

It is this holistic background coping (disclosing) that makes possible appropriate dealings in particular circumstances (discovering). Only because, on entering the workshop, we are able to avoid chairs, locate and approach the workbench, pick out and grasp something as an instrument, etc., can we use a specific hammer to hit a specific nail, find the hammer too light or too heavy, etc. (Dreyfus, 1995)

The things that are used in everyday, familiar situations are not normally noticed or attended to theoretically. However, as I will get back to later, when there is something in the way, we tend to notice the equipment explicitly.

Normally, we do not notice that things are accessible; we just transparently use them, or notice the difficulty of accessing them, but go on anyway. But if there is an obstacle I may have to stop and think about how to reach my goal. In designing something, or in a dispute, I may have to measure distances. (Dreyfus, 1995)

The way we primordially are-in-the-world, and relate with entities in the world is by way of this familiarity with things and activities, according to Heidegger. The familiarity with the world is of central importance within HCI research; for example, the widespread familiarity with the typewriter is now utilized in state of the art word processors today. Donald Norman (Norman, 1988a), for example, has advocated using insights and

knowledge about the way we go about using and manipulating everyday objects, like doors and light switches, in order to understand and inform interface design for computer systems. Since we are familiar with using buttons, switches, books, pages and so forth in the everyday world, it is assumed that users can recognize and use representations of everyday objects for interacting with computers.

Norman uses this insight actively in order to give design guidelines. The notion of affordance is a concept from psychology (Gibson, 1979) that have been applied actively within the field of HCI in order to examine and discuss interaction with computers (Norman, 1988a).

The notion of affordance and the insights it provides originated with J.J Gibson, a psychologist interested in how people see the world. I believe that affordances result from the mental interpretation of things, based on our past knowledge and experience applied to our perception of the things about us. My view is somewhat in conflict with the view of many Gibsonian psychologists, but this internal debate within modern psychology is of little relevance here. (Norman, 1988a)

Norman applies the concept of affordance in order to discuss the “psychology” of materials and of artifacts. “When used in this sense, the term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used... A chair affords (“is for”) support and, therefore, affords sitting. A chair can also be carried. Glass is for seeing through, and for breaking” (Norman, 1988a).

There are two different perspectives on affordance. The first is that affordance is a property of the thing itself, and the second suggests that affordance is a result of mental interpretations. My understanding is that Norman is advocating the second view. Hence, according to Norman, affordances provide clues to the operations of things in everyday life, based upon previous experience and past knowledge. For example, plates on doors are used for pushing the door open; knobs are for turning. In this way, when the affordances of everyday life are taken advantage of in computer interfaces, the users will “know” what to do just by seeing the interface. Hence, no instruction manual or labels are

needed for the user to use the system where the interface is based upon exploiting affordances, as it were.

The familiarity with the “everyday world” is not only about the artifacts that are in use; it is also about familiarity with other people and places, and even ways of thinking. The principle of “consistency” has traditionally been important within HCI, and the arguments have been both in favor of promoting consistency as a principle and toward seeing the negative effects of the consistency principle (Grudin, 1989). The resemblance relation is introduced by Mørch (Mørch, 2003) in order to examine and use our familiarity with the world constructively in the tailoring of computer systems, in an effort to evolve an existing system into a new (better adapted) one. These ways of applying our “familiarity” with the world are discussed next.

3.4.1 Consistency and “inconsistency”

Consistency is a widely mentioned principle in the HCI literature. It refers to the likeness in behavior arising from similar situations or similar tasks. Shneiderman has advocated consistency in the interface (Shneiderman, 1992):

- Consistent sequences of actions should be required in similar situations.
- Identical terminology should be used in prompts, menus, and help screens.
- Consistent color, layout, capitalization, fonts, and so on should be employed throughout.

Because of the relative nature of consistency, it can be a dangerous principle to follow, according to Grudin (Grudin, 1989). A consequence of following the consistency guidelines might be that in the quest for striving towards consistency in the interface, the tasks of the users are not addressed.

...when user interface consistency becomes our primary concern, our attention is directed away from its proper focus: users and their work. Focusing on consistency may encourage the false hope that good design can be found in the properties of the interface. (Grudin, 1989)

The case “for” consistency has to be seen alongside the case “against” consistency, according to Grudin, who goes on to suggest that only when viewing both the positive and the negative consequences of applying the principle of user interface consistency is there a possibility for making a new synthesis.

The principle of consistency is pervasive and relative. Consistency is in relation to something, whether it be the user’s previous experience, the physical everyday world or similar systems. Again, according to Grudin, user interface consistency is used in three different ways:

...the internal consistency of a design within itself; the external consistency of a design with other interface designs familiar to a user; and an external analogical or metaphoric correspondence of a design to features in the world beyond the computer domain. (Grudin, 1989)

Being sensitive to all three interrelated senses is important, and to follow the consistency principle when appropriate is called for. For example, to make user interfaces on mobile telephones consistent with the user interfaces on desktop computers might or might not be a good idea, depending on the ways in which the mobile telephone is to be used. If it is to be used in a stationary fashion in an office, consistency might be a good idea, whereas if the mobile telephone is to be used while the user is moving on top of two wheels it might be inappropriate.

Consistency is a principle for guiding the design of new interfaces, and its foundation is that the user already is familiar with something. In order to apply this principle, it is a necessary condition to learn about the “user”, especially with regard to the previous experience and knowledge about the domain she is operating in. By studying the way users already use existing equipment, it becomes possible to suggest new designs based upon this knowledge, and then to apply the principle of consistency.

When systems evolve from one “generation” or “release” to the next, there are new challenges. The challenges pertaining to the evolution of systems will now be discussed with the notion of resemblance relation.

3.4.2 Resemblance relation

Pelle Ehn, referring to Wittgenstein, introduced “family resemblance” in order to promote the involvement of users in the design of interfaces for a new typesetting system (Ehn, 1988). The concept of resemblance has been further developed by Mørch (Mørch, 2003) in the context of tailorable systems and adaptive evolutionary information systems.

The resemblance relation is about how systems evolve. By focusing on the way systems evolve over time, a terminology is suggested to capture different resemblances. The resemblance relation is divided into self resemblance, family resemblance and perceived resemblance. This terminology distinguishes between different types of resemblances that the user has while using an application. *Self-resemblance* relations in computer applications are established during application evolution, most notably as applications are adapted locally in user organizations. *Family resemblance* is a common phenomenon in the software industry and telecommunications industry. It is most notably related to where systems have evolved through many releases, and for each new release there are resemblances to previous releases as well as new features introduced. The new features will more often than not show a resemblance with corresponding features found in the previous release. “When a new feature has a well-defined relation to a corresponding feature of a previous release of the same kind (i.e., produced by the same software house) it is called family resemblance” (ibid). *Perceived resemblance* is explained with the paradigmatic example of the relationship between Windows 95 to MacOS (Pre-95) and the relationship of MacOS (release 1) to Xerox Star. “The similarities between the three operating systems are perceived because their resemblance is subjective and disputed in the literature. There are no published reports that state these systems copied ideas from each other (e.g., their windowing and menu systems), a technique which is common when systems are built by self-resemblance and family resemblance” (Mørch, 2003).

One way of using our familiarity with the everyday world is to mimic situations in the everyday world within computer interfaces. Holland and Stornetta (Holland and Stornetta, 1992) have discussed this where the possible positive and negative consequences of mimicking are indicated.

3.4.4 Mimicking

Holland and Stornetta argue that instead of attempting to “mimic” the face-to-face communications situation within telecommunications research and development, we should start with human needs and go “beyond being there” when extending towards the distributed setting (Holland and Stornetta, 1992). The traditional approach is to see the familiar face-to-face communications situation as the “model” for communications, and to attempt to mimic this situation by making telecommunications applications.

It is tempting to think that with perhaps a little more screen resolution, a little more fidelity in the audio channel, a little more tweaking to bring the machinery in conformance with subtle and long-established social mechanisms such as eye contact, telecommunications systems will achieve a level of information richness so close to face-to-face that for most needs it will be indistinguishable. (ibid)

Holland and Stornetta goes on to question if this is the right approach for developing telecommunications technology, by the analogy of using crutches versus running shoes.

It is customary for a person with a broken leg to use crutches, but how odd it would be if they continued to use the crutches after their leg was restored to its natural condition. In contrast, one wears shoes because they provide certain advantages over our natural barefoot condition. Special purpose shoes, such as running shoes, are designed to enhance our best performance. Now crutches and shoes are both tools of a sort, but there is a difference. The crutch is designed specifically to make the best of a bad situation – to let someone hobble around until they are back in shape. On the other hand, shoes are to correct some of the problems of our natural condition, and, in the case of athletic shoes, to enhance our performance. (ibid).

Is there a “perfect model state” such as face-to-face communication, and that our normal state is somewhat broken if we are not physically proximate? If this is the case, the goal is to attempt to restore us to the state of “being there”. According to Holland there are other approaches than attempting to imitate a “natural ideal situation”. The framework suggested is to start with the human needs for communication, and then from these needs work out the possible media and computational mechanisms to facilitate meeting the human needs of communication.

Mimicking is similar to what Fisher calls the “gift wrapping” approach to technology, where old content is wrapped into new media (Fischer, 1998). He argues that most current uses of technology, especially in the domain of education, are restricted to a “gift wrapping” approach, where the new technologies are used as an add-on to existing practice instead of radically rethinking what learning and education should be about.

By now it is clear that the very observation that we are familiar with the world has been examined and exploited within various branches of the HCI literature in different ways, both in order to understand use and in order to guide design. The concepts of affordance, consistency, mapping, resemblance, mimicking and gift wrapping all have their foundation in the observation that we already are familiar with and have experience in everyday life, as it were.

The familiarity of coping in everyday life is evolving with time. Today, the use of telephones and services on the net is part of everyday life for many people, whereas this was not the case only 20 years ago. Grudin (Grudin, 2006) has made the observation that many users now have moved from being “settlers” to being “inhabitants” of the electronic mediated forms of interaction and communication. This is making the concepts of familiarity and consistency more elusive than the situation of the everyday “physical” world.

3.5 Disturbance during use

Breakdown, disturbance, problem, error, fault, trouble, annoyance, dilemma, crisis – indeed there are many words to describe situations when things do not work as we expect them to. For research into the use of equipment, these situations are welcome, since they make the situation of use visible to us, and open for investigation.

When setting a spinnaker during an ocean race, 1000 things may go wrong. The spinnaker may be missing (if someone has forgotten to bring it to the boat from the storage space), it might be faulty (for example, if it is a whole in it), or some other piece of equipment may be in the way (for example, a rope might be in the way while hoisting

the spinnaker). In each case, the “situation is lit up”, and the sailors might be in a position to learn more about sailing with a spinnaker, and at the same time find ways to proceed – with or without the spinnaker.

When there is a disturbance to the ongoing activity, there arises a need to rectify the situation and then proceed. The breakdown situation is usually not welcome in the activity of sailing a regatta, but it might be valuable while practicing and learning the art of sailing. Breakdown situations might also be welcome while conducting on-the-spot research, since it makes visible things and relationships that were previously not seen, and hence a situation for learning and developing an understanding of the phenomenon at hand.

According to Heidegger, there are three different types of disturbances or breakdown situations, further interpreted by Dreyfus in the following manner:

Once ongoing activity is held up, new modes of encountering emerge, and new ways of being encountered are revealed. When something goes wrong with my hammer, for example, I am forced to attend to the hammer and the hammering. According to Heidegger three modes of disturbance – conspicuousness, obstinacy, and obtrusiveness – progressively bring out both Dasein as a thoughtful subject and occurrentness as the way of being isolated, determinate substances. (Dreyfus, 1995)

The modes of conspicuousness, obstinacy and obtrusiveness are explained further by the translator’s note in Being and Time.

Heidegger’s distinction between *conspicuousness*, *obtrusiveness* and *obstinacy* is hard to present unambiguously in translation. He seems to have in mind three rather similar situations. In each of these we are confronted with a number of articles which are ready-to-hand. In the first situation we wish to use one of these articles for some purpose, but we find that it cannot be used for that purpose. It then becomes *conspicuous* or striking, and in a way un-ready-to-hand – in that we are not able to use it. (Heidegger, 1962)

Conspicuousness is translated from “*Auffälligkeit*” and “*Auffalen*” which means to “attract attention – or to become noticeable”. Something becomes unusable within what

is ready-to-hand. When a loudspeaker is “silent”, for example, during active use, the loudspeaker is just there before the user and is conspicuous. Breakdown situations emerge from everyday use situations, when an object is ready-to-hand. The object in question cannot be used for the purpose that the user has in mind, and therefore it becomes striking and hence visible. Another example of this type of breakdown situation is when a network connection to a computer is broken by a cable fault. The cable might then be conspicuous and hence noticeable or visible to the user as an external, isolated object.

The second breakdown situation, according to Heidegger, is when an object is “missing”, i.e. it is not there for the user. The missing article is seen, i.e. what the missing item was ready-to-hand with and what the missing article was ready-to-hand for is seen.

In the second situation, we may have precisely the same articles before us, but we want one which is not there. In this case, the missing article too is un-ready-to-hand, but in another way – in that it is not there to be used. This is annoying, and the articles which are still ready-to-hand before us, thrust themselves upon us in such a way that they become *obtrusive* or even obnoxious. (Heidegger, 1962)

The item which is missing from what is ready-to-hand makes the item which is ready-to-hand become obtrusive. For example, when you want to write something during work, and the writing equipment is missing, the work “lies there” before the user and is “obtrusive”. This breakdown situation also emerges from an everyday use situation when an article is ready-to-hand. However, in this situation there is some article which we expect to use, but it is not there for use. This again lights up the situation of use, and by “seeing” the article which is missing the user is in a position to search for it or to rectify the situation.

The third situation of breakdown is characterized by something being in the way for the user.

In the third situation, some of the articles which are ready-to-hand before us are experienced as obstacles to the achievement of some purpose; as obstacles they are *obstinate*, recalcitrant, refractory, and we have to attend to them or dispose of them in some way before we can finish what we want to do. Here again the

obstinate objects are un-ready-to-hand, but simply in the way of being obstinate. (Heidegger, 1962)

Obstinacy is translated from *Aufsässigkeit* from *Afusässig* - 'rebellious'. If a user is engaged in some task, for example biking towards a delivery destination, and the road is closed off, the closed road “stands in the way” for reaching the goal. This demands that the user takes some corrective action in order to proceed. In this situation, there is some equipment “in the way” for the biker to proceed with what she is pursuing.

Common for all three situations is that there is some equipment ready-to-hand and it loses this readiness-to-hand in one way or another. By losing the readiness-to-hand, they reveal their presence-at-hand. This is another way of stating that the equipment becomes visible for inspection. The assignments become explicit during breakdown situations. This means that the assignment between the equipment and the “in-order-to” becomes visible. Hence, in a breakdown situation, it is more than the mere tools, or equipment, which becomes visible; the very reasons for using the tools become visible.

When equipment cannot be used, this implies that the constitutive assignment of the “in-order-to” to a “toward-this” has been disturbed. The assignments themselves are not observed; they are rather “there” when we concernfully submit ourselves to them. But when an assignment has been disturbed – when something is unusable for some purpose – then the assignment becomes explicit. (Heidegger, 1962)

When assignments become explicit, they are there for the user to analyze and deal with. This is an important point, since it explains a possible way of “seeing” what was not previously seen explicitly, or what was taken for granted. In the same fashion, when equipment which is ready-to-hand is “found” to be missing, the missing article is seen in reference to the use context.

Similarly, when something ready-to-hand is found missing, though its everyday presence has become so obvious that we have never taken any notice of it, this makes a break in those referential contexts which circumspection discovers. Our circumspection comes up against emptiness, and now sees for the first time what the missing article was ready-to-hand-with, and what it was ready-to-hand for. The environment announces itself afresh. What is thus lit up is not itself just one thing ready-to-hand among others, still less is it something present-at-hand upon

which equipment ready-to-hand is somehow founded: it is in the ‘there’ before anyone has observed or ascertained it. It is itself inaccessible to circumspection, so far as circumspection is always directed towards entities: but in each case it has already been disclosed for circumspection. (Heidegger, 1962)

Hence, it is not only the article or item in use which becomes visible during breakdown situations (when missing, faulty, or in the way), it is the whole “use context” that is lit up. This again gives opportunities for discovering and, hence, seeing in more detail what is going on while using equipment.

In order to make use of this typology of breakdown situations, an attempt is made below to describe some guidelines when investigating use.

- First of all, be aware of breakdown situations, since these situations open up new understandings of what is going on in the situation of use. They are potential learning situations.
- This can be done by looking for situations when equipment is faulty, missing or in the way for “getting the job done” or proceeding with an action.
- It is not possible to tell in advance “what” can be seen (when being presented with a breakdown situation), but there are possibilities of *seeing the references and assignments* between people and the equipment in use.

During disruptions and breakdown situations, the situation of use is “lit up” and can be investigated further. The equipment in use is then seen in a new light compared with that of engaged familiar use. In a breakdown situation the thing becomes an “object” that is seen by a “subject”.

3.5.1 Subject and object relationship and use

The “subject-object” relationship between an agent and its environment is one of the oldest issues in philosophy and science (Susi and Ziemke, 2005). One way to view the relationship between a person and a computer is with the well-known subject-object perspective. The person, or user, is a subject who is relating to a computer, which is an object.

The relationship might be described as, simply:

Subject-Object.

An example of a relationship that can be viewed in this way is “user-mobile telephone”. Another way is to describe this relationship more specifically is “Peter-Nokia 6530”. Each of the entities can be described individually, and in isolation with the subject-object perspective. Hence, there is no co-dependency between the entities which are part of the relationship. In practice, this means that the attributes of each entity might be individually measured and described on each of its own terms.

The boundaries for each entity can be defined and stated in explicit ways. For example, if the object is a mobile phone, the boundary of this phone might be defined as the physical aspects of the terminal. The boundaries can be defined in terms of product specifications, requirements, documents and so forth. Parts of the context, situation or circumstances of use can be represented as well, as is frequently done in the tradition of “context-aware computing” (Dey et al., 2001) systems, where sensors are applied in order to measure, collect and compute the environmental characteristics surrounding the user and the equipment.

With the subject-object relationship, there is reciprocity between the two entities. The subject both receives from the object and at the same time is able to manipulate and affect the object. The object is also in a position to receive from the subject, and also to manipulate the subject. However, there is an asymmetry between the subject and the object, since understanding, awareness and consciousness usually is a characteristic of the subject; it is not part of the object. Hence, only the subject is able to express and articulate understanding and be aware of what is going on in the relationship.

The subject-object relationship is one way to describe the way in which users relate to and use equipment. However, it is recognized within the phenomenology of Heidegger that this way of relating to equipment is not the primordial way of dealing with things.

The primordial way is, as described previously, engaged and familiar use of equipment, where we “are-with” the equipment and the situation in question.

Equipment is primarily something that is used in-order-to or achieve something, according to Heidegger. The hammer is used in-order-to build a wall for example, and the wall structure is made in-order-to provide a shelter. Instead of talking about the in-order-to, it is possible to say that the use of equipment facilitates meeting some human needs. The need of the user can sometimes be difficult to see, and a disturbance or breakdown can, hence, be valuable in order to shed light onto what need is being addressed.

3.6 From use to needs

According to the phenomenology of Heidegger, equipment is essentially something *in-order-to*. The telephone is used in-order-to communicate with people who are other places, footwear is used in-order-to keep warm and comfortable when walking for example, and a bicycle is used in-order-to swiftly move from place to place. Heidegger also uses the term *for-the-sake-of-which* and *towards-which* in order to call attention to the way human activity makes long-term sense, according to Dreyfus (Dreyfus, 1995). A bicycle messenger uses the bicycle *in-order-to* move towards a new location, as a step *towards* delivering packets, *for-the-sake-of* being a bicycle messenger. The *for-the-sake-of-which* is not a goal for the activity as such, but rather a “self-interpretation that informs and orders all my activities” (ibid, p95).

However, there are other ways of describing and making sense of involvement with equipment. In this section, the everyday understanding of *need* is discussed in order to examine the use activity. By using a mobile telephone, the need for getting in contact and exchanging, for example, address information can be met. Hence, there is a linkage between the human need and the way in which the need is met. It is possible to use the bicycle instead of the telephone if the need is to communicate with another person. When you want to talk with another person who is 500 meters away, one strategy is to call the other person, another strategy is to use the bicycle and bike to the place where the other person is, a third strategy is to send an e-mail, and so forth. This indicates that there

might be alternative strategies which involve using different equipment for meeting the same need.

With a focus upon needs rather than actual use, it is possible to investigate the various ways of meeting or facilitating needs. Recognizing that there are often many strategies for meeting a need opens us up for reflecting about the way “need” and “equipment” are related. *The underlying assumption here is that human needs can be met in various ways, independently of the specific equipment available.* When discussing one specific type of equipment, there is often assumed a one-to-one mapping between the use of this equipment and the underlying need. When starting with the need, there is a one-to-many mapping between the human need and the alternative strategies for meeting that need. This can be valuable, since it opens up the possibilities for learning more about human needs, and at the same time learning more about strategies for meeting those needs.

However, discussing needs is challenging for a number of reasons. How are needs articulated and defined? Do they emerge or appear suddenly? Who is defining the needs? In what way is it possible to articulate needs without also formulating ways of meeting the needs with technology? In the next section, the everyday understanding of needs is discussed; hence, there is no goal of arriving at a strict definition of human needs in psychological terms. The goal of the next section is to examine the concept of need in order to facilitate thinking about the way of selecting and using equipment.

Before entering into the specific discussion, a clarification is made between the two concepts of “needs” and “requirements”. Indeed, what are the similarities and differences between these two concepts?

3.6.1 Requirements and needs

The concept of *requirement* and the concept of *need* are used in slightly different ways when discussing the use, design, development and evaluation of equipment. Requirement is often specifically related to the equipment or to a solution of a problem in question. For

example, there are usability requirements and functional requirements that are formulated for a specific type of computer interface within software engineering or HCI projects.

Intuitively, we know both what a requirement is, and what a need is. However, they are sometimes interpreted in the same way, whereas it might be fruitful to make a distinction between the two.

A requirement is linked to a specific solution, product or technology, whereas a need has no such linkage to any specific product or technology. This is a main difference between the two terms. A requirement states something about the way a product or service is to work. We can describe it this way (Preece et al., 2002):

A requirement is a statement about an intended product that specifies what it should do or how it should perform. One of the aims of the requirements activity is to make the requirements as specific, unambiguous, and clear as possible. For example, a requirement for a website might be that the time to download any complete page is less than 5 seconds. Another less precise example might be that teenage girls should find the site appealing. (ibid)

When building or designing new products or services, the gathering and testing of requirements is a central activity. This process of getting to know the user requirements is sometimes called elicitation, requirement gathering, or requirement establishment. “One aim is to understand as much as possible about the users, their work, and the context of that work, so that the system under development can support them in achieving their goals; this we call ‘identifying needs’. Building on this, our second aim is to produce, from the needs identified, a set of stable requirements that form a sound basis to move forward into thinking about design” (Preece et al., 2002). Hence, ‘needs’ are in this statement explained as an understanding of the users and their tasks, their environment and their work.

3.6.2 Finding out about needs

Requirements and needs are central to the development of any technology, and according to Shneiderman (Shneiderman, 2002), the main challenge when developing computers is

to get to an understanding of the user: “The challenge for new computing developers is to understand what you, the user, want and to help you get it.” (ibid)

According to Shneiderman, there are two activities to pursue when developing computers. The first is to get to know the user, to learn more about who the user is, what she does, and what she wants. Then, based upon this understanding, the next activity is to help the user get what the user wants. In other words, the first phenomenon is about “understanding the user”, and the second phenomenon is about applying this understanding in the design of new equipment. As Shneiderman articulates it: “The starting point for a new computing project is to understand who the users are and what they are doing. It’s simple to say, but tough to do.” (Shneiderman, 2002)

The various methods available for getting to know the user and the context of the user have increased during recent decades. Shneiderman outlines three different methods for achieving *user-centered design*. The first is *user needs assessment* to determine the range of services needed by users. Ethnographic and anthropological theories can be applied in order to guide observation and interpretation in “ways that lead to more complete and unbiased reports about common practices, beliefs, and relationships” (Shneiderman, 2002). Ethnographic methods have, for example, led to important insights about how air traffic controllers collaborate (Hughes et al., 1994), and how teenagers use mobile telephones. Based upon a description of tasks, designers can make prototypes and mockups of what the application and user interface in question might be like.

The second method is *usability testing*. According to Shneiderman, this method, or class of methods, is simple and cost efficient. The goal of usability testing is to identify where users are facing problems with the prototype, and to suggest improvements based upon what is learnt from the usability testing. At the very heart of usability testing are the test reports, wherein are listed the problems and challenges that users face. From the usability report, solutions to problems are usually suggested.

The third method in user-centered design, Shneiderman calls *customer feedback*. Software tools and network access have made many new forms of customer feedback possible during recent years. Also, feedback from customers by way of interviews and focus groups may elicit many suggestions for refinements and extensions, according to Shneiderman.

These three methods, *user need assessment*, *usability testing* and *customer feedback* are all useful for getting to know the user, i.e. learning more about who the user is and what the user wants. User centered design can be called ‘getting to know the users needs’. All three methods advocate communication in various forms between developers and users in order to gain insights into the human use of equipment. However, neither of the methods elaborates upon what “human needs” are, and what human needs can be described as. Looking into various perspectives on human needs is the topic for the next section.

3.6.3 Perspectives on human needs

What is the connection between human needs and computers? Does anybody really need a computer or a telephone? If we go back in time just over a hundred years, there were no telephones and certainly no digital computers available; hence, nobody had need of either. Today, it is however common to state, “I need a computer”. What does this imply? Has a new human need emerged that was not there 100 years ago? Or is this just a matter of speaking, and what is meant is that “I want a computer”?

It is generally agreed that “basic” human needs are easy and straightforward to identify and relate to. We all need to move around, we need rest, integrity, protection and so forth. According to Shneiderman, human needs and human nature have not changed:

Human nature and needs were not changed by the invention of computers. Human values endured even during the dramatic growth of information and communication technologies. People have always needed food, shelter, and medical care, and they always will. (Shneiderman, 2002)

Often, the term “need” is applied in order to articulate something basic about being human; the need for food, need for shelter and medical care are linked to the very basics

of human nature. But in what ways are human needs at all linked to computers and telephones? What ways are open for us to think about the connection between human needs and technology? In order to address this question, we will consider what is meant by the term “need”.

Shneiderman is an advocate of technology development that starts from an understanding of human needs. To start with an understanding of human needs is seen as important within the HCI tradition in general. Then it is possible to analyze and find out about the ways the computer supports meeting human needs, and also to analyze the way it affects positively and negatively other human needs.

If technology developers start from an understanding of human needs, they are more likely to accelerate evolutionary development of useful technology. The payoff from a technology innovation is that it supports some human needs while minimizing the downside risks. Therefore, responsible analyses of technology opportunities will consider positive and negative outcomes, thus amplifying the potential benefits to society. These themes were inherent in the work of social commentator and historian of technology Lewis Mumford, who characterized the goal of technology with quiet simplicity: “to serve human needs”. (Shneiderman, 2002)

Mumford proposes a connection between technology and human needs, in the sense that technology is to serve human needs (Mumford and Ward, 1968). Said with other words, when technology is in use, it serves some human needs. When you bike with a bicycle, your need for fresh air, exercise and getting around can be met. When you drive an automobile, your need for getting around and for solitude are met. Another way to state the connection between need and technology is that you use technology because you have a need for something, which is met by using the technology. Again, as Shneiderman puts it:

As I studied my own use of computers and information technologies, I found it easy to interpret my own usage in terms of satisfying my needs. I use computers to support my relationships with family and friends, to teach my students, to organize conferences with other professionals, and to buy books from online stores. My activities include gathering information, collaborating with colleagues, designing interfaces, and distributing my ideas. (Shneiderman, 2002)

One way of approaching human needs with regards to computers, is to look for the needs “behind” using computers in the first place, like Shneiderman does in the above excerpt. This way of making a connection between the human use of technology and the underlying need makes a link between the two that will be investigated later. But, first, I will clarify the various theoretical perspectives on human needs.

The most widely known academic model for, and way of thinking about needs was proposed by Abraham Maslow (Maslow, 1968). He proposed that people have a hierarchy of needs, which range from security to self actualization. The early writings of Maslow presented five levels of a hierarchy of human needs:

- *Self actualization*: fulfillment of what a person “was born to do”.
- *Esteem*: self respect and respect for others, generates self-confidence.
- *Love*, affection and belongingness: giving and receiving.
- *Safety*; secure house, no physical threats.
- *Physiological*, biological survival, food, air.

The needs are, according to Maslow, organized hierarchically, so that in order to get the needs on a “higher” level met, you first need to address and fulfill the needs that are lower down in the hierarchy. In other words, in order to get the need for self actualization met, you first have to get your physiological, safety, love and esteem needs met.

Manfred Max-Neef, a Chilean economist, takes a different approach in his work pertaining to the development in the Third World. The publication “Human scale development: an option for the future” (Max-Neef, 1991) is a description of a taxonomy of human needs. By this taxonomy, communities can identify their wealth and poverty according to how the needs are satisfied. The main contribution of Max-Neef is not the list of human needs themselves, but the understanding of the way in which needs are linked to *satisfiers*. Human needs are seen as few, finite and classifiable. Hence needs are distinguished from *wants*, which are infinite and insatiable. Human needs are seen as

constant through all human cultures, and throughout human history. What changes is the ways in which the needs are met. There is no hierarchy of needs within this model.

The fundamental human needs are classified by Max-Neef as subsistence, protection, affection, understanding, participation, recreation, creation, identity and freedom. In addition, needs are also defined according to the existential categories of being, having, doing and interacting. Marshal Rosenberg (Rosenberg, 2003) has been influenced by the writings of Max-Neef, and especially by the way of thinking about the needs and the way needs are met. Marshall Rosenberg's model of Non Violent Communication (Rosenberg, 2003) makes the distinction between universal human needs (what sustains and motivates human life) and the concrete and specific strategies which are used to meet these needs. Rosenberg makes the point that human needs are not linked to any specific technology or any specific other being or thing.

The human need approach can be criticized on a number of bases. How are we to define human needs? How is it possible to know that this need is the actual need and part of the situation which is analyzed? In what way is it possible to know that one human need is met, and another human need is unmet? These are important questions, and point out why it is so difficult to talk about needs in the first place.

However, the important point in this section is not the specific definition of a need as this or that, but the way in which a need is related or linked to the use of equipment. It is argued that a need might get satisfied in many different ways, and there is a *one-to-many relationship* between a human need and a strategy for satisfying needs. When you are in need for subsistence, there are many different satisfiers or strategies available; eat bread and pasta, for example. However, the need for subsistence cannot be argued or questioned. In the same fashion, other basic needs for sharing with others, for autonomy, for creativity and so forth can be considered.

Then, how is the selection among the various ways of satisfying or meeting needs carried out? According to the phenomenology of Heidegger, there is no deliberate “thinking”

going on while selecting the most appropriate way forward when engaged in using equipment.

The range of possibilities that Dasein “knows” without reflection, sets up the room for maneuver in the current situation. This is the commonsense background of circumspection – “the circumspection of concern is understanding as common sense” (Heidegger, 1962). Thus the existential possibilities open in any specific situation can be viewed as a subset of the general possibilities making up significance. They reveal what in a specific situation it makes sense to do. (Dreyfus, 1995)

This way of understanding a situation, *circumspective* concern, will be discussed further in the next chapter. The important point in this section is the perspective that there are some needs that can be identified, and various ways of getting them met. Hence, a separation between the actual need in question and the possible strategies for meeting or satisfying that need is suggested.

3.7 Summing up – use and need

This chapter has introduced and discussed the phenomenon of use. The first section has elaborated on the question about *how* things are used. A relational perspective on the activity of use has been examined. The familiar, engaged, absorbed everyday use on the one hand, and the detached, reflective use on the other are proposed as two different “ways” of using equipment.

Disruptions in use situations have been discussed. These situations are important for looking into, analyzing and learning about the phenomenon of use. When equipment is missing, in the way, or faulty, the use situation is *lit up*, and it is possible for both the user and the researcher to learn more about what is going on.

In the last section of this chapter, the concept of need is discussed. The question about *why* users are using technology in the first place can be answered by stating that the use of equipment satisfies some specific need. To separate the need from the strategy of getting the need met has been presented as one way of reflecting upon the link between use of equipment and needs.

To see a World in a Grain of Sand
And a Heaven in a Wild Flower,
Hold Infinity in the palm of your hand
And Eternity in an hour.
-William Blake

4 Visibility and circumspection

The concept of visibility is central within HCI, ubiquitous computing and CSCW. Within HCI, there has been an explicit aim to make Graphical User Interface objects visible, and in ubiquitous computing the aim has been to make the computer invisible. Within CSCW, visibility refers to awareness of what other users are doing and interacting with. Hence, the concept of visibility does indeed point to different phenomena in these related areas of research.

The aim of this chapter is twofold: first to provide a literature review of the ways in which the concept is used for “promoting visibility” and for “promoting invisibility”, and second, to present the theoretical concept of circumspection.

4.1 Background

The concept of visibility does indeed have different meanings in different settings and traditions. Within the discipline of Human Factors, it is described as follows:

Visibility refers to how well something can be seen by the human eye. Visibility, therefore, involves human judgment. There is no device that can measure visibility directly; a human must always be involved in its determination. One key factor influencing visibility of a target is how well it stands out from its background, that is, its contrast....Although contrast is related to visibility, it is not the same as visibility. (Sanders and McCormick, 1992)

Visibility can also be applied in the broader sense of understanding or interpreting something, not only by seeing with the eyes, but through the act of disclosing and

attending to something. The fact is “visible”, and the “situation might be visible” by, for example, explaining, hearing or in other ways experiencing a phenomenon in a situation. Hence, visibility is not only about what can be seen with the naked eye, but also about what can be interpreted and understood. Sanders and McCormick describe this further:

Visibility, we said, was how well something can be seen, but seeing can be defined in different ways. For example, seeing the elephant might mean ‘detecting its presence on stage’, or it could mean ‘recognizing the elephant as an Indian elephant’. These different definitions, or information criteria, obviously have a bearing on the visibility level of the target. The more time you have to look at the elephant, the easier it becomes to recognize it as an Indian elephant (they have smaller ears). Incidentally, the visibility of a target should not be a function of the observer; visibility should be a characteristic of the task itself. (Sanders and McCormick, 1992)

Here, Sanders and McCormick point to three entities that are involved when discussing visibility: the observer, the target and the process of seeing. It makes little sense to investigate visibility without taking into account that it is about a human activity and engagement, and that this activity is directed at something. Further, it makes little sense to talk about “absolute” visibility, since visibility is related to a person’s position. In other words, it is a relational concept, just as, for example, “mobility” is a relational concept describing movement relative to people and equipment. In addition to being a relational concept, it is also intrinsically tied to a specific situation. During daylight, a mobile phone might be visible on a table, whereas during the darkness of the night it might be invisible for the user.

Discovering, disclosing, revealing, illuminating, making explicit, shedding light upon – these are all expressions to describe the process whereby something becomes visible. To cover up or hide are the opposite, that is to make something “invisible”. Both visibility and invisibility are topics within HCI and ubiquitous computing that are applied in order to describe and understand use, and to guide design. This chapter surveys the literature on visibility and invisibility within the HCI field.

4.2 Advocates of visibility in HCI

The advocates of making things visible in the human-computer interface can be understood by studying the history of HCI, and the evolution of user interfaces to computers. When moving from command based interfaces to direct manipulation and graphical interfaces, the possibility of making objects visible in the interface have opened up the notion of making information visible to the user in the form of graphical elements in the interface. The motivation for making more information visible has been to improve the usability of computer applications, for novices and experts alike.

During the transition period from command based to direct manipulation interfaces, the everyday world of physical keys, menus, lists and buttons have improved the design of interfaces. The WIMP slogan (window, icon, menu, pointing device) has been important during this transition, where for example the menus and folders in the desktop were made visible on computer screens in order to make the alternatives for interaction salient to the user.

Norman (Norman, 1988a; Norman, 1988b; Norman, 1993; Norman, 1992) has written extensively about interaction with everyday objects like doors and light switches – or *everyday things*. According to him, much can be learnt by observing, describing and analyzing the use of things in our everyday settings. We are “interacting” in the world at all times, and not only when sitting in front of a computer screen with a keyboard and mouse. When opening a door or turning the light on, we are interacting with door handles and light switches. In the situation of opening a door for example, there are certain parts of the door which are visible to us, making the activity of opening the door possible.

In his seminal book, “Design of everyday things”, Norman introduced a set of general concepts for thinking, analyzing and reflecting upon human-computer interaction: *affordance, constraints, conceptual models, mappings, visibility and feedback*. He advocates making the options in the computer that are available *visible* for the user. Also, he advocates making the results of each action (feedback) *visible* to the user. In addition,

he highlights the importance of making it possible for the user to determine the system state, and this is enabled by making this data *visible* for the user.

The concept of visibility has been applied to the discussion of graphical user interfaces, and what can be seen with the naked eye on the screen. However, the concept of visibility has also been a topic when discussing the *experience* of interacting with the computer with other senses, such as hearing using the auditory icons, for example. However, this was a limited concern within HCI during the 1980s and 1990s, since the most crucial part of the interface was about designing and evaluating the use of the computer screen, the mouse and the keyboard.

4.2.1 Using sound for visibility

Any interaction-in-the-world can be said to be a full-body-experience. When using a computer with a graphical user interface, there are today sounds, images and tactile sensing of the keys, mouse, USB sticks and headsets. With Ihde, we can say that there is a “full-body-experience” (Ihde, 1990) even while interacting with desktop computers.

Gaver (Gaver, 1991) has advocated the active use of sound in the user interface, again based on the way we interact in everyday life with objects. He argues that auditory information is as important as visual information for interacting with computers. When encountering, using and relating with any artifact, this is not only a visual experience. According to Norman, the way we interact and use everyday things can be a source for learning about the use of not only visual cues, but the sound as well.

Many devices use sound, but only for signals. Simple sounds, such as buzzers, bells or tones. Computers use bleeping, whining, and clicking sounds. This use of sounds is valuable and serves an important function, but it is very limited in power; it is as if the use of visual cues were limited to different colored, flashing lights. We could use sound for much more communication than we do. (Norman, 1988a)

The use of sound in the interface has been recognized by educational institutions and computer manufacturers today. Sound design relevant for human computer interaction is becoming established as a separate topic, as “graphical” design has been for years. A few

years back there were, for example, few ring tones available for stationary and mobile telephones; today it is common to tailor the sonic characteristics of the mobile phone by various ring tones and message sounds. Indeed, this is currently a large industry in itself, providing services based on sound in the interface (Nielsen and Herstad, 2004).

Sound in the interface is used extensively when interacting with mobile phones, in the form of notification messages. Information about an incoming call is, for example, provided, and hence visible, in different ways to the user – both by displaying information on a screen and alert messages in the loudspeaker. By this message, the user “sees” that there is a message or an incoming call, either by looking at the screen or listening to the audio or both. The phenomenon of “someone calling” is hence displayed and presented by multiple modalities in the interface, often referred to as multimedia interfaces. This has later been the topic within the so-called “intelligent user interface” community (Herstad et al., 1999c), and multimedia discussions.

With the perspective that we are in the world of everyday objects, with all our sense faculties, “visibility” is not restricted to the use of sounds and visual information. When the starting point is that we are-in-the-world, and experience the world with the faculty of sight, hearing, smell, taste and touch it is a natural development to also consider other ways of interacting with the computer. However, this has to be seen in the light of the development of the computer; in the 1980s and 1990s the main focus within HCI was facilitating usability by focusing upon the interaction between the user and the computer in terms of visual communication.

This section has described the advocates of visibility in the interface. When moving from command-based systems to graphical user interfaces, the concept of visibility was important in order to ensure useful and usable systems. Below is a summary for this section.

- Visibility has been an important concept within HCI as a principle for guiding the transition from command-based interfaces to graphical interfaces.

- The visibility concept is applied in order to discuss the “graphical” interface and “visual” information on the screen, but it is also related to using sound and tactile ways of interacting with computers.
- A motivation for promoting visibility is usability.
- What is made visible in the interface is both the input possibilities (menus, for example), the feedback (response) from the computer, the system status and the model of the system.

In the following section, the trend of making the computer “invisible” for the user is presented.

4.3 Advocating invisibility within HCI

The idea of “the interface” to a computer, and the way of interacting with computers had to be reconsidered when computers became mobile and embedded into the fabric of everyday life. When computation (storage, processing, input, output, search etc) enters the broader environment of the user, beyond the fixed terminal, the idea of “the interface” becomes problematic (Grudin, 1993). The environment is now the interface, and it cannot any longer be tied to a fixed position on a desk. Instead, the computer disappears into everyday life and by this the computer become “invisible” to the user (Weiser, 1991; Fishkin et al., 1998). According to Dourish it can be explained in the following way:

...the ubiquitous computing vision necessitated a reconsideration of the very idea of the interface. When computation had been spread throughout the environment – embedded through the very fabric of the environment, the notion of “an interface” became problematic. Computation was no longer located in one place, so how could there be a single interface? Computation was everywhere – how could the interface be in one fixed location? (Dourish, 2001)

Ubiquitous computing indeed describes a different type of user experience than the stationary, fixed desktop computer affords. When the computer “disappears”, it is also said that the computer no longer is visible to the user; it is invisible. However, what is meant by something not being visible? This is the topic of the next section, where the concept of visibility and invisibility within ubiquitous computing is discussed.

4.3.1 Ubiquitous computing and visibility

According to Weiser, the history of interface design and computer design has been along the path of the “dramatic” machine, where the focus was to make the computer wonderful and interesting. Weiser presents an alternative to this predominant view which he names “invisible”.

A less-traveled path I call the ‘invisible’; its highest ideal is to make a computer so embedded, so fitting, so natural, that we use it without even thinking about it. (I have also called this notion ‘Ubiquitous Computing.’) I believe that in the next twenty years the second path will come to dominate. But this will not be easy; very little of our current systems infrastructures will survive. (Weiser, 1994)

Within ubiquitous computing, the highest ideal is to make the computer so embedded, so fitting, so natural that it can be used “without even thinking about it”. In order to investigate this way of using and interacting with computers, Weiser and colleagues at Xerox PARC have been building and testing out prototypes that are inch-, foot-, and yard-sized computers called “Tabs, Pads and Boards” (Weiser, 1994).

There are many different names for this emerging field, such as *calm technology* (Weiser and Brown, 1997), *unremarkable computing* (Tolmie et al., 2002) and *invisible computing* (Norman, 1998). These are all pointing toward the use and design of computers outside the “desktop” paradigm. Common for all of these fields is that the dichotomy of “visible and invisible” has been applied in order to discuss and analyze the ways in which the interaction between users and computers differs from the desktop GUI.

Weiser’s seminal paper “The computer of the 21st century” (Weiser, 1991) has been an inspiration for many researchers within HCI during the last decade. The paper shifts the focus away from interaction with “stationary fixed desktop computers” to interaction with computers that are embedded into the environment and towards mobile computing devices that are worn or carried along with the user. What does it then mean that something “disappears” and become “invisible”? Weiser puts it in the following way: “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.” (Weiser, 1991)

The technologies in question are not disappearing literally, but they are used without thinking about it, or, in other words, they are taken for granted. There are indeed many examples of technologies which have weaved themselves into the fabric of everyday life, such as dishwashers, radios, television sets, automobiles and mobile telephones.

According to Weiser, the traditional personal computer cannot become “an integral, invisible” part of the way people live their lives. It is a point here that the computer is allowed to “vanish into the background” and hence become invisible in use by being part of the background. The vision that the computer should vanish into the *background* of the user is stressed; it should not be in the foreground as it is today with the desktop computer.

Weiser uses the term invisible in both a factual way and as a metaphor. Factual invisibility is describing a situation where the computer is “hidden” to the naked eye; for example, a computer server in a network infrastructure is not normally visible to the user – and hence invisible in a “factual way”. When the computer is visible by the naked eye, but “taken for granted” or not seen during use, it is invisible “in metaphor”, according to Weiser.

Weiser states that the computer becomes “invisible to common awareness”. The awareness of the users is described as being somewhere else, for example directed to the task to be accomplished. Users will use the ubiquitous computers “unconsciously” in order to accomplish their everyday tasks, according to Weiser. These are important points, alluding to ways of using the concept of visibility and invisibility. Visibility has to do with “awareness” and “consciousness”, according to Weiser, in use situations when there are many computers present. The consequence of making the computer disappear, and hence invisible, is that users are then in a position to use computers unconsciously.

The ubiquitous computing tradition is advocating the explicit aim of making the computer “disappear”, and hence invisible to the user. In order to continue the search for

ways of interpreting the “invisible” computer, one more strand of research needs to be discussed.

4.3.2 The invisible computer in use

Norman is an advocate for user-centered design, also in the ubiquitous computing area. Instead of starting with the technology, and what computers can do for users, it is more appropriate to start with the user, and find out what the user needs and wants, according to Norman.

In the book “The invisible computer” (Norman, 1998), Norman confesses what many people do not dare to say: “I don’t want to use a computer,” he says, “I want to accomplish something. I want to do something meaningful to me” (Norman, 1998). In other words, he doesn’t want to use applications, services or utilities; he does not want to work with file formats or word processors. What he wants to do is to communicate, play and learn. Norman advocates, like Weiser, to make the computer and its software fade into the background of the user. When the computer has faded into the background, it is “invisible” according to Norman.

According to Norman, in order for computers to become invisible, two main things must happen. First, the simple, inexpensive information appliances (Bergman, 2000) must increase significantly. Secondly, the infrastructure that enables devices to communicate with each other must seamlessly exist. This again leads away from centralized computing and towards decentralized computing. In order to exemplify the way in which equipment is moving from being centralized to distributed, Norman uses the example of the electric motor. With this example, he is explaining that the same is happening with the computer: it is in the process of moving from a “centralized” position to being distributed into different devices.

This same transition is, according to Norman, likely to happen with the computer as well. Instead of thinking about the computer as a centralized device that we use in particular situations, the alternative is to think in terms of appliances that are spread throughout the

environment. Also, Norman argues that users will be *unaware* of the computers even while using them.

I believe the same kind of transition will happen with computers, that instead of one massive device that occupies considerable space on our desktop, we will have a wide range of devices that are designed to fit the task that we wish to do. And that inside of them there will be computers and communication structure, but we'll be unaware of it. It will simply empower us to do our tasks. (Bergman and Norman, 2000)

In an attempt to clarify what is meant by invisibility, Norman differentiates between two types of invisibility. He names the first kind of invisibility 'true invisibility'.

There are two kinds of invisibility. One of them is true invisibility: the way most infrastructures in a house is invisible. So, my house could not function without the sewer, the sewage pipes and systems; without the delivery of hot water and cold water throughout the house; without the electric infrastructure. But it's primarily invisible. You're only aware of it when something goes wrong with it. That's one kind of invisibility that I expect to see more and more of. It's the same kind of invisibility of most of the electric motors in the house that we're really truly unaware of..... So one kind of invisibility is that the stuff is embedded within products and I can be unaware of their presence, or they can be hidden beneath the surface, like the sewage pipes in my house and like the internet connection of my house. (Bergman and Norman, 2000)

True invisibility is when the computer is embedded within the infrastructure somewhere, and simply cannot be seen by the naked eye. This is the same kind of invisibility as Weiser called factual invisibility, and is the literal meaning of invisible. When something is truly invisible it is hidden somewhere, and cannot be detected or seen by the user at all by the very fact that it is not there for the user to see.

The second kind of invisibility is linked to a use situation, and that the user forgets that a computer is there in the first place. For example, when writing a message, the computer is invisible while writing the note and the note itself is visible, according to Norman. This kind of visibility has nothing to do with what can be seen or observed, but has to do with where the main attention or awareness of the user is. This kind of invisibility is explained further, by stating that the computer is "not occupying any psychological space". This is what Heidegger calls the "ready-to-hand", but without using the term visible or invisible.

This second kind of invisibility can be called *invisible in use*, where the technology in use is taken for granted during use. This requires that the user is familiar with the technology and that by this familiarity it is taken for granted. Norman promotes the idea that the future of computing will be about computers that we will take for granted, and about computers that are invisible in this sense.

Older, stable technologies, like the telephone, are also invisible as technologies, according to Norman. In discussion about interaction with machines, the stable, older technologies are not normally recognized as technology at all. Because of this, they are not considered in discussion about technology use, and as a consequence they become invisible in discussions about technology use.

Another term which has been introduced in order to discuss the way in which computers are taken for granted is “unremarkable computing”, coined by Tolmie et al. Instead of viewing the computer as a dramatic machine, an alternative is to look towards the “unremarkable computer”.

Things with a routine character may then have many of the qualities we are aiming for by being tacit and calm in that they are not “dramatic” and do not command attention except when they need to. They are seen but unremarked, used as resources for action, and themselves use everyday resources (doors, alarms coffee shops, etc.) in ways that have a wealth of significance but have been made equally unremarkable. However, just how to go about designing computing “so embedded, so fitting, so natural” remains, we would suggest, unsolved. (Tolmie et al., 2002)

The “unremarkable” is what is often “closest” to us – and hence hardest to see. Hence, the challenge of making the computer “invisible” or “unremarkable” is a challenging task that is unsolved according to Tolmie et al.

This section has been about the invisible computer, and below a brief summary from the advocates for the invisible computer is given:

- Invisibility has been an important concept within HCI in the transition period from “desktop computer interfaces” to the ubiquitous computing area.
- The motivation for promoting invisibility is usability.
- The underlying assumption is that the computer is becoming increasingly “complex”, and in order to overcome the complexity the computer should be “invisible” to the user.

When the user is familiar with using a computer, and hence the computer withdraws, does this imply that the user is “unaware” or “unconscious” while using the equipment like the advocates of the invisible computer propose? This seems to be the very premise that the discussion about the invisible computer is built upon. In the next section, an alternative view of everyday, familiar use and a kind of awareness in use is presented.

4.4 Visibility during engaged use – towards circumspection

Winograd and Flores (Winograd and Flores, 1986), Ehn (Ehn, 1988) and Dourish (Dourish, 2001) have discussed the importance of breakdown situations, and the ways in which technologies in use become visible as objects during such events. However, also in everyday use situations, when there is no disruption or breakdown, the equipment is there for the user in some way, i.e. it is not invisible for the user. This will be discussed below.

According to Heidegger, any activity has the function of discovering and making things explicit and visible. By using and manipulating equipment, we are in a position to “see” and “discover” what is going on, and hence let something be visible to us.

Our concerned absorption in whatever work-world lies close to us, has the function of discovering; and it is essential to this function that depending upon the way in which we are absorbed, those entities within-the-world which are brought along in the work and with it...remain discoverable in varying degrees of explicitness and with a varying circumspective penetration. (Heidegger, 1962)

One way to describe the encounter between a user and a computer is to state that the two are individual entities that can be analyzed separately, outside the activity of use. This perspective is present when computers are analyzed, described and explained

theoretically. From this perspective, we can state that things are encountered as objects, with properties, attributes, functions and specific characteristics. We, as users or subjects, encounter objects. This enables us then to describe, analyze and discuss the use, and the equipment which is used as separate, individual entities. A top down description is for example possible, or to break down the equipment into smaller parts, and then inquire into the detailed parts of the computer. When constructing things, this approach is highly useful. However, my aim in this thesis is to investigate what is actually made visible during a specific use situation, not only during breakdown situations.

In order to find out about the being of the “things” we encounter in everyday life, our everyday being-in-the-world is the starting point. We do not simply encounter things for the sake of encountering, but we encounter these things with some kind of concern, with which we manipulate and put these things into use. For example, when putting on footwear during a winter morning, we are concerned with keeping our feet warm. However, we usually do not think about footwear or other everyday things as objects that we use during everyday activities.

Heidegger argues that we need to put aside our “interpretative tendencies”, and instead look directly at the phenomenon at hand. Instead of interpreting “knowledge” as explicit, tacit (Polanyi, 1983) or embodied (Dourish, 2001), Heidegger argues that we are to investigate more closely in what way we encounter and deal with everyday equipment – such as doors, for example:

This is the way in which everyday Dasein always is: when I open the door, for instance, I use the latch. The achieving of phenomenological access to the entities which we encounter, consist rather in thrusting aside our interpretative tendencies. (Heidegger, 1962)

What “entities” do we encounter? In the curriculum of HCI, there are currently hundreds of names and descriptions of computer entities, such as desktop, laptop, expert system, information system, communications appliance, information infrastructure, GUI objects, machine, system and so forth. In order to investigate the way “things” are encountered and used, Heidegger searched for an appropriate word which he then explains and uses

actively in his writing. In order to describe the encounter with “things” in the environment of the user, such as radios, telephones, doors and hammers, he uses the term, ‘Zeug’ translated into English as ‘equipment’.

We shall call those entities which we encounter in concern Equipment (Zeug). In our dealings we come across equipment for writing, sewing, working, transportation, measurement. The kind of Being which equipment possesses must be exhibited. The clue for doing this lies in our first defining what makes an item of equipment – namely its equipmentality. (Heidegger, 1962)

This choice of the word “Zeug” is not random. It is a central concept, since it is a general term for describing all kinds of tools, media or artifacts that are used. The translators of *Being and Time*, J. Macquarrie and E. Robinson note the following:

The word Zeug has no precise English equivalent. While it may mean any implement, instrument or tool, Heidegger uses it for the most part as a collective noun which is analogous to our relatively specific “gear” (as in gear for fishing) or the more elaborate paraphernalia, or the still more general equipment....In this collective sense Zeug can sometimes be used in a way which is comparable to the use of “stuff” in such sentences as there are plenty of stuff lying around. (Heidegger, 1962)

This selection of a particular word for the entities which we encounter in practical activities is useful since we want to investigate the ways in which humans encounter, deal with and use computers – which today is described in so many different ways, as indicated above. It is also useful to use a term describing “all kinds of stuff”, since computers are today used in concert with other artifacts such as footwear, desks, streets and so forth. The term “Zeug” or “equipment” is a name for both “new” and “old” technologies, and does not differentiate between them, as is often the case between what is regarded as “technology” and what is not regarded as “technology”. To recognize that footwear, shirts, buttons, streets, PDAs and so forth is all equipment is essential when attempting to find out in what ways we encounter and use things.

The concept of equipment is not to be viewed as an “isolated object” or “external thing”, but as something that people are encountering, dealing with and using in order to go about living. Heidegger describes the way we encounter equipment in our everyday life,

and says that the equipment is essentially “something in-order-to”. For example, the bicycle (as equipment) is used in-order-to move around, and a telephone as equipment is used in-order-to communicate with someone who is separated by some distance.

Equipment is essentially ‘something in-order-to...’ A totality of equipment is constituted by various ways of the ‘in-order-to’, such as serviceability, conduciveness, usability, manipulability. (Heidegger, 1962)

The “in-order-to” is hence the assignment or reference between the user and the thing encountered in the situation of use. This is a central point for Heidegger; it is a way to state that the “equipment” and the “user” are not two isolated entities but two sides of the same coin, in effect, that co-exist and are co-dependent with each other. In other words, according to Heidegger it is only theoretically possible to view a user isolated from the equipment in use, and also to view equipment in isolation from the user. The user and the things which are used are a unity, and this totality is called the “in-order-to”. “In the ‘in-order-to’ as a structure, there lies an assignment or reference of something to something.” (Heidegger, 1962)

This point of there being an assignment or reference creates a link between the “user”, “that which is in use” and the “situation of use”. It is hard to imagine any equipment which has no users, and hence is part of no situation of use. What would that be¹?

Dreyfus elaborates upon this assignment in the following way:

Equipment makes sense only in the context of other equipment; our use of equipment makes sense because our activity has a point. Thus beside the “in-order-to” that assigns equipment to an equipmental whole, already discussed, the use of equipment exhibits a “where-in” (or practical context), a “with which” (or item of equipment), a “towards-with” (or goal), and a “for the sake of which” (of final point). To take a specific example: I write on the blackboard in a classroom, with a piece of chalk, in order to draw a chart, as a step toward explaining Heidegger, for the sake of my being a good teacher. (Dreyfus, 1995)

This way of viewing the equipment “chalk” makes it part of the human activities of writing and being a teacher. With this perspective, it does not make sense to talk about

¹ It may be argued that outdated equipment is a possible candidate; however it can be argued that also such equipment is linked to users.

the equipment in isolation from human activities and skills. Equipment is described as primarily “in-order-to”, and this reference to human activities is what constitutes equipment primordially. The equipment is ready-to-hand during engaged use.

In our everyday dealings, equipment does not exist in isolation from other equipment. A mobile telephone is a mobile telephone with reference to the battery charger, a network connection and appropriate services in the network such as voice services. Equipment always exists in an equipmental nexus, or an equipmental whole, as it were:

Equipment-in accordance with its equipemntality – always is in terms of its belonging to other equipment: ink-stand, pen, ink, paper, blotting pad, table, lamp, furniture, windows, doors, rooms. These “Things” never show themselves proximally as they are for themselves, so as to add up to a sum of realia and fill up a room. What we encounter as closest to us (though not as something taken as a theme) is the room; and we encounter it not as something ‘between four walls’ in a geometrical spatial sense, but as equipment for residing. Out of this the ‘arrangement’ emerges, and it is in this that any ‘individual’ item of equipment shows itself. Before it does so, a totality of equipment has already been discovered. (Heidegger, 1962)

In other words, when we encounter equipment like the mobile telephone (by actively using and manipulating it), we do so by also seeing the way in which the mobile telephone is connected to other equipment. The mobile telephone is associated with other equipment such as network access services, tables, pockets, SIM-cards, telephone books, hands-free sets, stationary computers and an infinite web of other equipment.

An important point in the above description of equipment is that the actual use of the equipment informs us about what the equipment “is”. The primordial way of encountering equipment is during the use of the equipment for some purpose; that is, the “in-order-to” do something. *In situations of use, the equipment is what it is primordially.* When the equipment is analyzed, it is of course the same equipment, but we are in a different relation with it, and hence it is seen as an object which is isolated from the context, circumstances or situation of use.

What does it mean that the relationship with equipment can be more or less “primordial”? If we consider equipment that is familiar to the user, such as the bicycle and the radio for a bicycle messenger, or a hammer for a carpenter, this way of regarding the relationship makes sense. If the user is familiar with the equipment, and uses it daily, there is a more *primordial relationship* than if the equipment is used occasionally and the user is not familiar with it. Heidegger calls this equipment in use “readiness-to-hand”.

The hammering itself uncovers the specific ‘manipulability’ of the hammer. The kind of Being which equipment possesses – in which it manifests itself in its own right - we call ‘readiness-to-hand’. (Heidegger, 1962)

Heidegger goes on to explain further what he means by the term “readiness-to-hand” in the following passage:

The kind of Being which belongs to these entities is readiness-to-hand. But this characteristic is not to be understood as merely a way of taking them, as if we were talking such ‘aspects’ into the ‘entities’ which we proximally encounter.... (Heidegger, 1962)

This very being of the equipment, readiness-to-hand, cannot be investigated by looking at it from a detached observer perspective, according to Heidegger. It has to be experienced during actual use situations. According to Heidegger, there is a difference between just looking at the outward appearance of a thing (or its internal workings), and actually using and manipulating the thing. In order to discover readiness-to-hand, it is necessary to actually use and manipulate things.

No matter how sharply we just look at the ‘outward appearance’ of Things in whatever form this takes, we cannot discover anything ready-to-hand. If we look at Things just ‘theoretically’, we can get along without understanding readiness-to-hand. But when we deal with them by using them and manipulating them, this activity is not a blind one: it has its own kind of sight, by which our manipulation is guided and from which it acquires its specific Thingly character. Dealings with equipment subordinate themselves to the manifold assignments of the ‘in-order-to’. And the sight with which they thus accommodate themselves is *circumspection*. (Heidegger, 1962)

When using and manipulating² equipment in-order-to do something, there is a specific kind of understanding, or a specific kind of sight. *Circumspection*, which is translated from the German *Umsicht*, is explained further by the translator's note in the following way.

The word 'Umsicht', which we translate by 'circumspection', is here presented as standing for a special kind of 'Sicht' ('sight'). Here, as elsewhere, Heidegger is taking advantage of the fact that the prefix 'um' may mean either 'around' or 'in-order-to'. 'Umsicht' may accordingly be thought of as meaning 'looking around' or 'looking around for something' or '*looking around for a way to get something done*'. In ordinary German usage, 'Umsicht' seems to have much the same connotation as our 'circumspection' - a kind of awareness in which one looks around before one decides just what one ought to do next. But Heidegger seems to be generalizing this notion as well as calling attention to the extent to which circumspection in the narrower sense occurs in our every-day living. (Heidegger, 1962)

Hence, circumspection is a *kind of awareness* one has access to while using equipment. This awareness has to do with our understanding of what is going on in the process of using the equipment. *Circumspective use*, the term chosen for this dissertation, refers to an understanding of the circumstances of the use. "Umsicht" is translated into Norwegian as "omsikt", literally translated into English as about/around sight. This word, "omsikt", is however not actively used in Norwegian today, but it is found in the older dictionaries (Kirkeby, 1993). However, out of roughly thirty people I have asked inside and outside of the research community here at the University of Oslo, nobody knew this Norwegian word.

Heidegger continues to elaborate upon the way of using equipment circumspectively in the following passage:

The ready-to-hand comes explicitly into the sight which understands. All preparing, putting to rights, repairing, improving, rounding-out, are accomplished in the following way: *we take apart in its 'in-order-to' that which is circumspectively ready-to-hand*, and we concern ourselves with it in accordance with what becomes visible through this process. (Heidegger, 1962), my emphasis.

² The term "manipulate" is translated from "handtieren", and literally means to handle.

Circumspection can be interpreted as a kind of awareness which enables users to see equipment, but without asserting characteristics and properties of the equipment in use, as is the case when an “object” outside of a use context is seen. When dealing with and using equipment, we are concerned with something; an example is that of getting the work done. According to Heidegger, our concern when going about everyday business is guided by circumspection and what is ready-to-hand becomes visible through the process of using the equipment. It is important to stress that according to Heidegger, the ready-to-hand is not visible as an “object” during actual use, but it is visible through the sight of circumspection in the situation of use.

Whenever we have something to contribute or perform, circumspection gives us the route for proceeding with it, the means of carrying it out, the right opportunity, the appropriate moment. Concern may come to rest in the sense of one’s interrupting the performance and taking a rest, or it can do so by getting it finished. (Heidegger, 1962)

According to Heidegger, the way of using equipment is guided by circumspection, and this very circumspection is making it possible to “contribute or perform something” in the appropriate moment. When concerned with something, this very concern may come to rest by interrupting the activity or by completing the activity. During encounter and use of equipment, the equipment is “withdrawing”, according to Heidegger. The equipment is not literally “withdrawing”, since it is still with the user, but the withdrawing refers to the withdrawing from the attention of the user. The main attention of the user is elsewhere, and not directed towards the equipment in use. However, this does not mean that the user is unaware or unconscious of the equipment in use. By the sight of circumspection, the user is using equipment with a kind of awareness which enables him or her to do the appropriate things in the situation.

The peculiarity of what is proximally ready-to-hand is that, in its readiness-to-hand, it must, as it were, withdraw in order to be ready-to-hand quite authentically. (Heidegger, 1962)

What does it then actually mean that the equipment which is ready-to-hand withdraws? One interpretation is that the equipment is becoming “invisible”. Since the equipment has withdrawn, it is not there for the user to attend to and see, and hence it is “invisible”.

This, again, can be interpreted as engaged use of equipment being a “blind” activity. However, the user is still with the equipment with a sight, the sight of circumspection. This opens us up for thinking outside the dichotomy of “visible” and “invisible”, towards degrees of visibility and different ways of seeing. It is not as though the equipment is physically withdrawing; it is very much still there with the user. *However, what is meant is that it withdraws for the user as an “object” with properties and characteristics.*

According to Heidegger, the main concern during everyday use is the “work”, and not the tools or the equipment itself. And again, this does not mean that the equipment is not seen and hence invisible, it is still there and visible by the sight of circumspection, as it were.

By introducing the terms *equipment, readiness-to-hand and circumspective sight*, Heidegger is presenting an account of the way we encounter, manipulate, deal with, relate to, comport to and use equipment in everyday life. Heidegger is contrasting this way of encountering and using equipment with theoretical, detached thinking about “things”, and stating that the former is the primordial way of relating to equipment.

During everyday, familiar use of equipment, the equipment “withdraws” into a larger frame of activity (Dourish, 2001), but it is still there. It is very much present and attended to by circumspection as “a kind of awareness”. In other words, equipment in everyday use is not “invisible”. *It is visible by the sight of circumspection.*

The term *circumspective use* is suggested in this thesis as a way to open up and go beyond the dichotomy of invisible/visible which has dominated the HCI literature over the past 20 years. To think in terms of equipment being either “visible” or “invisible” frames the interaction with computers as an either/or issue. However, as will be illustrated in the description of the bicycle messenger case, this does not capture the richness of the interaction with equipment in use.

4.5 Summary visibility and circumspection

This chapter has investigated the concept of visibility. The explicit aim of making information visible in the interface has a long tradition within the HCI community. When moving from command-based interfaces to graphical interfaces with new possibilities of dealing with information in the interface, the aim has been to make information visible in the interface, for the user to see. The WYSIWYG slogan denotes that what is presented in the interface is seen by the user, and it is up to designers to present adequate and appropriate information for the user to see in and through the interface.

The tradition of ubiquitous computing promoted the invisible computer; the goal was no longer to make information about the system visible in the interface, but to make the computer and the interface disappear altogether. Within the ubiquitous computing paradigm, the whole idea about “the interface” was questioned, since the computer is distributed and embedded in the very fabric of everyday life.

Hence, there are proponents of both visibility and invisibility of the computer and the interface to computers. In order to go beyond “either” making the computer visible “or” thinking in terms of making the computer invisible, Heidegger’s concept of circumspection is presented. This term denotes “a kind of awareness” while using and manipulating equipment and it articulates that while engaged in manipulating and dealing with equipment, this activity is not a “blind” one, where the equipment and situation of use is “invisible”.

The concept of circumspection is used in order to open up discussion about what is seen, and how it is seen during the use and manipulation of equipment in everyday life. With this concept, the dichotomy of “visible” and “invisible” arises.

I keep six honest serving-men
(They taught me all I knew);
Their names are What and Why and When
And How and Where and Who.
I send them over land and sea,
I send them east and west;
But after they have worked for me,
I give them all a rest.
-Rudyard Kipling

5. Method

This chapter covers the research approach, research strategy, research method and data analysis pertaining to this thesis. The research approach has been interpretive. The research strategy has been to investigate a case where bicycle messengers are engaged with using equipment. The main research method has been participant observation.

The empirical data have been collected while biking together with the bicycle messengers in their environment. Field notes have been taken while biking and during interviews with the bicycle messengers. Video recording, audio recording as well as photographs have been captured in the field and at the dispatch center.

5.1 Research approach

Kristen Nygaard (Nygaard, 2002) describes the characteristics of science in the following way:

Sciences are usually described as having three main aspects: *Observation*. The empirical study of phenomena: their identification, observed properties and behaviour. *Analysis*. Comprehension and explanation of phenomena in terms of an underlying theory. *Synthesis* (or construction of technology). Knowledge

organized for the purpose of designing, generating or modifying phenomena. (ibid) (*italics mine*).

Observation, analysis and synthesis are three aspects of the sciences, according to Nygaard. For each of the three aspects, there are various perspectives and corresponding methods that can be used in order to conduct research. Especially important for Informatics is *multiperspective reflection*, according to Nygaard. Since informatics is both about computers and the phenomena that surround them, it is necessary to apply perspectives from different traditions.

Multiperspective reflection is not considered so regularly, but it does occur. In the social sciences one often has to deal with conflicting interests. Multiperspective reflection is important, whereas synthesis, “social engineering”, is less prominent. In informatics and operational research both synthesis and multiperspective reflection are essential and are at the core of the sciences. (ibid)

Nygaard’s Informatics is a science where there are methods and perspectives from a variety of traditions. HCI also has been characterized as a multidisciplinary science or discipline (Carroll, 2003). Psychology, engineering, anthropology, mathematics, pedagogy are some of the traditional disciplines constituting the field and bringing to it many a variety of different research approaches. According to Verplank (Verplank, 2002), interaction design has been characterized as a cross-disciplinary field without any well accepted base of theory to draw upon.

Nygaard’s informatics is closest to the Information Systems (IS) tradition. The research approach from the IS tradition adopted for this thesis is the *interpretive approach* to a *case study* (Walsham, 1993; Walsham, 1995; Klein and Myers, 1999). Interpretive research aims “at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context” (Walsham, 1993). Here, context refers to “the phenomena that surrounds the computer” (Knuth, 2001; Newell and Simon, 1976), where an in-depth understanding of the phenomenon of “use” is central.

Interpretive research starts from a particular view of what knowledge we have, and proceeds to what knowledge can be gained in the future. An assumption within interpretive research is that knowledge is socially constructed by human actors (Berger and Luckmann, 1966; Floyd et al., 1992). What we can know about reality is therefore not objective facts “out there”, but interpretations of reality that are socially constructed.

Interpretative methods of research start from the position that our knowledge of reality, including the domain of human action, is a societal construction by human actors and that this applies equally to researchers. (Walsham, 1993)

The phenomenological influence within interpretative research is found in research like that of Boland (Boland, 1985), Mingers (Mingers, 1984) and Ciborra (Ciborra, 2002). Research becomes an existential inquiry where the researcher relates to and explores world phenomena (Jacucci, 2006). The phenomenological approach can be seen as unveiling the phenomenon from its appearances to let us encounter it and experience it first hand. What is taken for granted is questioned, and the goal is to get to an understanding of the untold and often unnoticed way of using and being with technology. In the research methods section, there will be a few more words about the phenomenological attitude adopted for this thesis, but first some words about the research strategy.

5.2 Research strategy

This thesis reports from a case study (Yin, 1989). The case study is one of the many strategies for doing research, such as experiments, surveys and analysis of archival information. According to Yin, a case study can be defined as an empirical inquiry that (1) investigates a contemporary phenomenon within its real-life context, (2) where the boundaries between the phenomenon and the context are not clearly evident, (3) and in which multiple sources of evidence are used. Among the sources for the data within case studies are, according to Yin, documentation, archival records, interviews, observation, and physical artifacts.

A case study involves an in-depth, longitudinal examination of a few instances or events; that is, a case. A case study provides a systematic account of observing events, collecting the data, analyzing the information gathered and disseminating the results.

Yin suggests that a case study is defined as a research strategy. Since a case study is about studying phenomena in its real-world context, it is different from laboratory studies and field experiments (Kluge, 2005). These other research strategies were not selected for this thesis, since the objective was to get to know the real-world use of mobile technologies. In this case, it is not possible to isolate the use situation from the actual context of use.

When selecting a case, researchers often use information-oriented sampling as opposed to random sampling, according to Flyvebjerg (Flyvebjerg, 2006). This is due to the observation that the average or typical case is not always the richest. Three types of information-oriented cases are distinguished by Flyvebjerg: 1) Extreme or deviant cases, 2) critical cases and 3) paradigmatic cases. The extreme case is well suited for getting a point across in an especially dramatic way. A critical case is defined as having strategic importance in relation to the general problem studied. A paradigmatic case may be defined as an exemplar or a prototype, based on Kuhn's illustration that background practices of natural scientists are organized in terms of "exemplars" or "paradigms". The case of the bicycle messenger was selected, since the case illustrates an atypical use of mobile technology, i.e. the use of communications equipment while biking. Hence, it can be classified as an extreme or deviant case according to the classification scheme of Flyvebjerg.

Five researchers were involved in the study: four students working on their master's theses in addition to myself. The inquiry was conducted over thirty-seven days, spanning 1998 to 2006. Most of the fieldwork was conducted between 1998 and 2002. Twenty meetings with bike messenger companies and bike interest organizations were held. Eight different bike messenger companies were investigated: three in Oslo, three in New York, one in San Francisco, and one in Tokyo. The inquiry was conducted at the dispatch

centers, and in the streets under various environmental conditions, like a winter day in Oslo and a summer day in San Francisco.

The description and the analysis of the findings were conducted by research teams, and are not individual work. After one or more inquiry sessions, the researchers met to discuss and analyze the findings in groups of two to four. From the analysis of the cases, various short descriptions, vignettes, have been produced. The technique, to present findings and observations in a vignette, was suggested by Orr (Orr, 1996). The use of vignette is different from the use of e.g. scenarios as reported in (Carroll, 1995). In scenarios, the reported stories describe a future work practice or an envisioned future situation to span out a possible design space or a possible space of actions. In the vignettes, a synthesized story is presented as a description of the observations from the field, and this is appropriate since this thesis investigates the use of equipment.

5.3 Research methods

The research for this thesis is influenced by the phenomenological attitude (Fallman, 2003). Fallman notes that "...it is problematic to pin down a fixed phenomenological method, as phenomenology is a diverse field. Because of this, it is important to keep in mind that phenomenology is not so much a method as it is an attitude to how things in the world are to be approached, dealt with, and understood." (Fallman, 2003). The phenomenological attitude is concerned with what takes place in everyday life, or in the life-world (Lebenswelt). In other words, it is about what is actually experienced in our everyday life; it is what we experience as opposed to what we think is the cause and implication of this experience.

Ethnomethodology (Garfinkel, 1967; Heritage, 1984) is influenced by phenomenology. It is a sociological discipline that focuses on the ways in which people make sense of their world. The term was initially coined by Harold Garfinkel in the 1960's and has since influenced the HCI field with descriptions and accounts of the way computers are used in everyday life. Ethnomethodology is different from traditional sociology in that it is concerned with the very methods by which social order is produced and shared. In

addition, ethnomethodology seeks to give detailed accounts of the methods that individuals use in actual settings. Ethnomethodology is firmly grounded in the phenomenological tradition (Dourish, 2004), and has lately been applied within the ubiquitous computing field (Brodersen and Friis Kristensen, 2004) in order to investigate the “ordinary”.

One central technique within ethnomethodology is *conversation analysis*. Conversation analysis takes as the object of study “talk in interaction”. Conversation analysis attempts to describe the orderliness, structure and sequential patterns of talk between people, both casual and official talk. In the present thesis there is no ordinary conversation going on in-between the user and the equipment. The conversation between people is different from the “conversation” between people and equipment in the sense that equipment is a “silent” partner in the conversation. Phenomenologically speaking, equipment lacks *intentionality*, and hence the use of conversation analysis has not been applied in the research.

Central to the phenomenological attitude is a concern for what takes place in the life-world of people. The ordinary, everyday life of the bicycle messenger is about moving around by bicycle, and communicating over the air with, for example, mobile telephones and radio equipment. In order to find out more about these everyday activities, the *participant observation* (Skjervheim, 1996) method is applied. Participant observation is a central method, along with interviews for studying everyday use activities. According to Skjervheim, the researcher is both a participant and an observer during the research, i.e. he is participating in the context of use and is not a detached observer. To combine observation in the field with an interview addresses the fact that “the distinction between what people do and what they say is also related to the fact that people often don’t have access to the inarticulated, tacit knowledge associated with certain activities” (Blomberg et al., 1993). There are many activities that are part of our everyday lives that we are not able to articulate in accurate accounts when we are asked to reflect and talk about them. Hence, there is value in observing of the actual activities taking place in actual use situations.

It has been important to study the actual use in the real environment of the user, i.e. in the context of use. This has been important methodologically because the focus here is on observing what is going on in between users and equipment. If the interest was what users think about the relationship between themselves and the equipment, other methods such as surveys, laboratory studies or in-depth interviews could have been selected.

5.3.1 Techniques for studying use activity

Contextual inquiry is one specific technique proposed by Beyer and Holtzblatt (Holtzblatt and Beyer, 1998; Holtzblatt and Jones, 1993) in order to learn about users in their use situation. The main principle of the contextual inquiry technique is that the researchers are to be with the user, in the physical environment where the users are. The researcher may observe the user, the tools and equipment that the user is using, the tasks that the user is performing and the surrounding environment of the user. The researcher is to be in the background, and make notes and comments with various forms of recording technologies, like pen and paper, audio recording devices, or visual imaging devices. The researcher also may ask questions to clarify a situation, but the main idea is that he or she is to be in the background and not disturb the user. With this technique, the understanding the researcher builds up of the user, the task, the tools and the media in use is often evolving while in the field. When the researcher is back from the field, the notes are transcribed and discussed with other researchers.

The technique builds on a traditional principle of the master-apprentice relationship (Brown et al., 1989) and later developed in conjunction with community of practice by Lave and Wenger (Lave and Wenger, 1991). The apprentice learns what the master is doing, by looking, listening and gradually adopting the practices of the master. This way of learning is often more natural and effective than abstract ways like classroom teaching, or in general out-of-context learning. When talking at the same time as doing, the master is clarifying and defining the structure of the tasks. This technique gives detailed information because the master is in the real context with the real artifacts that are part of the work. By observing different masters, in different situations, it is possible to discover

common strategies and patterns in the work processes and thus it is possible to generalize findings. Actual artifacts and use situations will help the master to remember, and at the same time make it easier and more concrete for the master to tell the apprentice about the work. The master may also tell about earlier experiences, when artifacts are discussed in the context where they are encountered.

With the master-apprentice model it is common for the apprentice to follow a master for many years. Due to practical constraints in time and resources, the master-apprentice model needs to be adjusted for HCI studies. Beyer and Holtzblatt (Beyer and Holtzblatt, 1998) suggest four areas for such an adjustment. These are *context*, *partnership*, *interpretation* and *focus*, and will be discussed below.

First, to be in the *context or environment* of the user and observe the activities that are conducted is the most important principle in the contextual inquiry technique. The researcher has access to real-use data instead of abstractions and representations of use situations. The researcher may need detailed information about specific activities or equipment, and this can be accessed in the use situation. Through communication between the researcher and the user in the real context of the user, it is possible to get to information that is not mere abstractions or beliefs that the user has about the tasks he or she is performing. Instead, the researcher gets data about actual use situations and work practices.

Second, the researcher and the user have to be *partners* to achieve a mutual understanding. The master-apprentice situation where the apprentice is only receiving information that the master is willing to share is too limiting. The researcher has to ask questions and inquire during the time spent together. The user is normally doing his daily tasks, while talking about the tasks he is doing, and the apprentice is observing. If the researcher sees something, a bit that he does not understand, or some structures that he does not know, he may ask questions. The user and the researcher may then exit the work and discuss what is happening before the user returns to his task. The researcher often

reflects upon possible solutions to the problems that he is observing. This may be used as an opportunity to test out ideas with the user in the time and place of the work.

Third, the researcher has to do more than merely collect information about the work practices, the objects of work and so forth. The researcher has to *interpret* the information. This interpretation may give the researcher an understanding and background information for the analysis. By sharing the interpretations with the users themselves, it is possible to double check that they are correct. To discuss the viewpoints in the context of the user is important. The argumentation in the context of the user will be different compared with argumentation outside the context of the user.

Fourth, what viewpoint should the researcher have on the work of the user? An apprentice will learn what the master wants to teach, but a researcher needs more information – often specific to details of the work that is performed. By being aware of the *focus*, the researcher may adjust and change perspective, so that that he or she may alter the discourse without taking control over the situation. By having a specific focus, the researcher may observe details of the area that is in focus, but at the same time miss key observations of the surrounding environment. This may be avoided by using a group of researchers that start with the same focus, but then adjusting the focus in the course of the inquiry. During the interpretation meetings, the researchers may use the different foci or viewpoints to challenge each other's findings. During the inquiry, it is the "gut feeling" of the researcher that is used to set the focus. The researcher may often intuitively decide if his perception is aligned with the perception of the user. When discovering problems, the researcher may adjust his focus.

5.3.2 Studying networked equipment

Within HCI, both the "human" and "computer" on their own, along with the "interaction" in between the two are the objects of study. Today when computers are used for communication over distance, the computer itself is more than a "terminal" at the desk; it is a networked communication device. In order to be specific about the technology in use, a classification scheme is used for describing the equipment.

Different schemes (Bowker and Leigh Star, 1999) may be used in order to classify technologies. One specific classification scheme considers “long linked technology”, “mediating technology” and “intensive technology” (Thompson, 1967). This classification is developed further by (Stabell and Fjeldstad, 1998) in order to examine value creation within “value chains”, “value shops” and “value networks”.

The “value network” will be used as a classification device in order to describe the various equipment that have been investigated in use. This classification scheme of value network divides the technologies into three layers:

- Access and promotion.
- Services and applications.
- Infrastructure.

This has been applied to classify communication equipment. This way of classifying networked technologies makes it possible to see and understand the equipment beyond the end user terminal. The access layer is about the actual terminals in use (i.e. mobile telephones), the service layer is about the services in use (i.e. voice service), and the infrastructure is about the underlying infrastructures (i.e. wireless access, cables).

The access and promotion layer may be divided into input technologies and output technologies, as is common within HCI (Dix et al., 1993). The input and the output technologies may be seen according to our five senses, as enabling technology to augment human intellect (Engelbart, 1999), and as the interface to personal dynamic media (Kay, 1999). The users in this study, the bicycle messengers, were observed to use a number of different terminals for access to voice services, like cellular phones, desktop computers and personal digital assistants. These observations lead to considering the seamless use of a variety of terminals for access and promotion.

The “value network” helps us to consider the layered and networked equipment that is in use. Today, the computer is more often than not linked to other equipment, and is not

isolated, stand-alone equipment that can be studied in isolation. This is closely linked to what Heidegger describes as the equipmental nexus (see chapter 3).

5.3.3 Participant observation

In a panel discussion at the “IEEE third international symposium on wearable computers” (Kaario et al., 1999) there was an agreement among the panelists from industry and academia on the importance and necessity of conducting field studies in the area of wearable computing. The contextual inquiry technique was used as an example of a suitable method.

In (Väänänen-Vainio-Mattilla and Ruuska, 1998) the contextual inquiry method is used to investigate the requirements for communication appliances (Bergman, 2000). It is reported that the technique is useful for getting to a better understanding of the activity of use, but that there are some weaknesses with the technique, some challenges, and some problems in the application (Hynninen et al., 1999). The authors report on the use of the contextual inquiry method of specific services, and find the method useful – but hard to apply.

One challenge with participant observation is for the researcher to be situated in the background, but at the same time able to move to the foreground and ask questions when something of interest or relevance occurs. It may be difficult to see the situations when they occur. The researcher may also easily distract the people in the region of the observed user. Situations that may seem unimportant at the time when they occur may be seen later as important in a wider context. This may be avoided by having more than one researcher, so that a larger spectrum of the activities, situations and structures can be observed.

The problems noted by Kaario et al (Kaario et al., 1999) were also found in my study. For example, the bike messenger masters that we observed often had to explain to their customers who the researcher was and why the researcher was with him. This may have challenged the situation, and it might have biased some of the observations.

Not all the users involved were interested in participating in the research. The normal way to get in contact with the bike messenger was to call the person in question and plan the meeting place and time. This seemed to be an adequate approach, since both the researcher and the bicycle messengers had the chance to prepare somewhat for the meeting. During some of the cases, the manager of the bicycle messengers assigned couriers to be part of the study. A couple of the inquiry sessions did not lead to much, and had to be aborted due to lack of mutual understanding between the researcher and the field personnel. At one specific incidence, a bike messenger asked as the first question, "are you fooling with me", and then he biked away from the researcher, before the proper introduction was done. The overhead and the cost of using the technique were high, and incidences like this were challenging to the morale of the research team. Actually, the challenges of getting empirical data are plentiful, as, for example, described in (Finken, 2000; Finken, 2005).

The bike messenger research was conducted in the USA, Europe and Japan. Two different languages, Norwegian and English, were used as the main vehicle for communication between the bike messengers and the researchers. However, since the bicycle had such an important role for the bike messengers, this was also used as a device to form rapport across the differences in culture. Some inquiries into the subject of cultural difference were made through a literature survey of books concerned with cultural issues (Hofstede, 1997; Hall, 1976; Mumford, 1938).

When conducting participant observation, the researcher is observing, describing and analyzing specific situations and phenomena. The result or the output of the participant observation is a representation of the activities, artifacts, communication and so forth that have been observed and taken place. Representations of the situation in the form of thick descriptions (Maanen, 1988; Geertz, 2000) are used as analytic devices, and are different from the actual situations that were observed.

5.3.4 Data collection

To collect data from the field was indeed challenging, since both the users and the equipment in use move around. In what ways is it at all possible to collect data about the actual use of mobile equipment? What are the challenges when people and technologies are mobile? To collect data about the use of mobile technologies is inherently challenging because the technologies in question are mobile (Weilenmann, 2003).

Collecting data for understanding the use of mobile technologies is also challenging since the activities are going on in many different places at the same time. When two bicycle messengers (A and B) are biking and at the same time talking with each other via the radio, there is activity both where A is and where B is. It is not possible to be with the user at all times, and hence, getting representative data from the field is a challenge.

Paper notebooks were used for jotting down the notes. The notebook was small enough to fit in the pocket, since both hands were needed for biking or giving the bicycle messenger a helping hand. A *camera for capturing images* was also used for taking pictures of artifacts and work situations. The camera was found to be useful, in that the photographs as artifacts could be used later for discussing specific observed details. However, the camera was also found to be distracting to the user and therefore had to be used with care. A *video recording* camera was used at the dispatch center of one of the bike messenger operations. As reported in (Suchman and Trigg, 1991) large resources are required to review the tapes from the video recording, and this was generally not found to be a necessary technique for our study. The same holds true for the use of audio recording. An *audio recorder* was used for capturing the voice and background audio of one bike messenger. If a detailed study of the audio level were to be performed this technique could be useful, but for our object of study it was seen as unnecessarily obtrusive on the one hand, and on the other hand too resource intensive to work through all the audio material after the participatory observation session.

A project library, with all the descriptions and analysis from the inquiry was distributed electronically to all the researchers. The Internet and the World Wide Web was used to

facilitate the storage and availability of the project libraries. This enabled a distributed, flexible environment for sharing documents, pictures, audio clips and other relevant information from the study. This environment also enabled the researcher to share information with the user in the study. Indeed, this was seen as one way of strengthening the partnership between the users and the researchers, and an efficient and effective way of receiving feedback from the users.

Below is a list of the various techniques that have been used for capturing data in the field:

- Photographs.
- Video recording.
- Audio recording.
- Note taking.

Some suggestions for new techniques for capturing information were discussed, but not implemented. More extensive use of recording techniques, together with searching and filtering mechanisms, were believed to have improved the capturing process. The mechanism suggested by (Held and Krueger, 1999), where the researcher makes his own digital recording window on top of a personal digital assistant in the context where the research is to be conducted, could be pursued for future research. The capturing and analysis of information to some degree determines how the results are communicated among the various stakeholders taking part in the research. When the results from the field are to be reported to the stakeholders that have not been part of the field research, it is indeed effective to share captured audio, video and artifacts from the field.

5.4 Data analysis

According to Walsham (Walsham, 2002), there are three distinct roles of theories in interpretative research: (1) as an initial guide to design and data collection, (2) as part of an interactive process of data collection and analysis, and (3) as a final product of the research. I have used theories from HCI to frame the research and provide a perspective to the problem of understanding use.

The use of theoretical concepts and frameworks can be both a help and a hindrance, according to Walsham.

Theory is both a way of seeing and a way of not-seeing. A particular theoretical perspective blind us to other perspectives at its moment of application. A second, and more subtle, criticism of theory is that in any real human activity, particularly that involving others, we take action without the conscious use of theory, and certainly the action is conditioned by more than any singular theory. (Walsham, 1993)

It is not possible to be theory unbiased:

... we are conditioned by theories whether we like it or not, since we are exposed to a multiplicity of theories from our earliest childhood and we are undoubtedly influenced by them. So the argument in favor of theory does not rest on it being essential to good practice; rather than an appropriate blend of theory and practice may be more valuable to an individual practitioner than practice alone, and that explicit theories may aid the synthesis of implicit practical knowledge and, equally important, may provide a means to communicate this knowledge to others. (Walsham, 1993)

Pre-understanding (or prejudice) is a necessary condition for being able to interpret and understand anything in the world, according to Heidegger. We already, by being-in-the-world do have, or are, an understanding of what we are in relationship with. "...the interpreter does not exist independently: existence is interpretation and interpretation is existence" (Walsham, 1993).

Grounded theory (Glaser and Strauss, 1967) has been influential in describing a way of conducting qualitative data analysis. Grounded theory was influential in the social sciences during the 1960s as a framework that legitimated an alternative approach particular to survey research. As the name 'grounded theory' suggests, it is an approach that assumes that theory can be found in the field if the research activity is "grounded" in the field. Grounded theory relies on a set of procedures for collecting and analyzing empirical data. One characteristic feature of grounded theory is the several stages of sampling, analyzing, memoing, and interpreting materials.

Analyzing quantitative data from an empirical investigation can be described as “almost a magic dimension that comes from the invisible, hard work of creating explanatory patterns grounded in what to an outsider appears as messy, fussy, chaotic practices” (Bratteteig, 2003). The empirical evidence suggests that the explanatory category of *circumspective use* is appropriate. In my findings, I have chosen to look into the following three explanatory categories: 1) visibility of equipment, 2) visibility of alternatives, and 3) visibility of the environment.

5.5 Generalizability

Generalizability is about the possibility that explanations of a particular phenomenon derived from the interpretation of empirical evidence collected in specific circumstances can be of value in other contexts (Walsham, 2002). Generalizability is also a disputed issue within interpretative research (Walsham, 1995; Lee and Baskerville, 2003).

Lee & Baskerville argue that interpretive research can provide analytical generalizability. Walsham points to four types of generalizations and corresponding contributions from interpretive research: 1) development of concepts, 2) generation of theory, 3) drawing specific conclusions, and 4) contributing rich insights. Contributions from interpretive research may fall into one or more of these types.

The findings presented in this thesis do apply to other contexts than the specific use of equipment among bicycle messengers. The question is how relevant the findings are for the other contexts of use? There are two important characteristics of the use situations that have been investigated in this thesis, namely situations when 1) there are multiple, alternative technologies in use and 2) when the equipment is in use in dynamically changing contexts. The three findings that will be discussed in the next chapters and the conclusions that are drawn from the discussion to follow is about the visibility of equipment in use, the visibility of alternative equipment and the visibility of the environment.

It is suggested that the concepts of *circumspection* and *circumspective use* provide a theoretical perspective for describing everyday use situations. *These concepts direct attention to the user's awareness of equipment, alternatives and the environment of use.* The perspective provided by the concept of circumspective use suggests that the user always has an awareness of the equipment, alternatives and environment. Hence, this concept goes beyond the visible/invisible dichotomy that is prominent in the HCI literature.

The question concerning the analytical generalizability for a study with only one case study can of course be questioned. Nevertheless, the depth and richness of a single case study can grant a level of generalization that makes the findings valid and relevant for other contexts. According to Flyvbjerg (Flyvbjerg, 1998) concrete, local knowledge is the only source of real knowledge, and the case study is therefore the way to gain knowledge from research. In qualitative-oriented research, generalization is normally done based on recurring themes that are found within the case, which is the case of this empirically based study.

Wind, sea, boat and sails, a compact diffuse whole, without beginning or end, a part and all of the universe.... I watch the sun set and inhale the breath of the open sea, I feel my being blossoming and my joys soars so high that nothing can disturb it.

-Bernard Moitessier

6 Case – bicycle messengers in action

This chapter presents the empirical case study. The aim is to describe the bicycle messenger case and observations pertinent to understanding the characteristics and conditions of the various relationships, which are between the bikers and the equipment in use.

6.1 Bicycle messaging

The main task for messengers is to pick up, transport and deliver things like documents, product samples and other relatively small items to business establishments and private homes. Messengers use different equipment such as bicycles, footwear and public transportation in order to get around in city areas.

A courier service is a highly communication-intensive operation. Firstly, the customer with a need for the service communicates with an operator at the courier service provider, and places the order for a packet to be picked up and delivered. Then, this information is communicated with the dispatcher at the courier company. After this, the dispatcher communicates with a bicycle messenger in order to share this information. There are a variety of strategies that are applied in order to facilitate all this communication, from face to face encounters to the use of stationary telephones, e-mail, instant messaging, pagers, open radio systems, mobile phones, pagers and paper records. Below is a short story, which describes the courier service in a top-down fashion.

Peter, a broker, has worked out a contract to be signed by Ann, a dealer, who is located in the same city as Peter – but in a different office building. The paper contract is located in

the office where Peter works, and he has promised Ann that the contract is to be at her desk for signing today. In order to meet the deadline, Peter asks his secretary Susan to arrange with a courier to pick up and deliver the document. Susan receives the document from Peter, and she calls the courier company to place this order. The call taker at the courier company notes the relevant information. The dispatcher at the courier company establishes a radio call to John who is on his bicycle. Approximately 20 minutes later, John arrives at the office where Susan works and where the packet is ready. Susan hands over the envelope to John, who checks the delivery address carefully and then places it in his delivery bag. After this, John walks down the corridor and runs the stairs to his bicycle, which is parked outside the office building. He then bikes approximately 15 minutes over to where Ann is working and parks his bicycle outside this building before he walks into the building in order to find the reception area. John hands over the packet to Ann less than one hour after Peter decided to send the packet.

There are a number of stakeholders involved when courier services are invoked (Peter, Ann, Susan, John, the call taker, and the dispatcher) and various equipment is engaged (telephones, radios, and bicycles). There is also more equipment involved besides the telephones, radios and bicycles, such as the messenger bag, the radio terminal, radio services, equipment for payment, information system for registering the order and so forth.

Bicycle messengers use communications technology in order to communicate with each other, the dispatch center and their customers. At the same time, they are engaged with the bicycle in order to move around from place to place. While communicating over a distance, the bicycle messenger is present with the person with whom he or she is speaking; they are communicating over distance. At the same time, the bicycle messenger is present with the bicycle, biking through the streets with other road users such as pedestrians and automobile users.

Observed from the position of a researcher, the situation of the bicycle messenger is “complex” and hard to grasp; to be fully present both in the urban city traffic and at the

same time talking with other people over a distance can indeed be described as a “complex situation”, where short moments of unawareness can have fatal consequences.

However, it seems to be most effortlessly managed by the bicycle messengers. The two activities just described are handled simultaneously with ease, lightness and care. From the outset, it seems like there are two different “spheres” in which the bicycle messengers are present: the physical, concrete space where they roam the streets, parks and offices, and the “electronic world” where they communicate effortlessly with each other by way of telecommunications equipment. However, for the bicycle messengers who are actively involved in talking over distances and biking at the same time this is more often than not conducted with ease and grace. The distinction of the two “spheres” is analytically created and useful for research, but does not correlate with the mindset of the bicycle messengers in their everyday activities.

Common for all courier services is that it is highly time critical, with tight demands on delivery times. Most courier companies price their services based on both packet weight/size and delivery time; hence, time is a critical factor. Customers often express a request for delivering a packet “immediately”. In order to facilitate services which meet the requirements of delivery time, both efficient transportation equipment and efficient, state of the art communications technology are applied by the courier service companies.

In the next section, a description of the dispatch center and the call center is given, in order to get familiar with the operations. The bicycle messengers are communicating with the dispatcher in various ways, as we will see in the next section.

6.2 The call center and the dispatch center

The way of organizing bicycle messenger operations vary from company to company, but there are some common characteristics. First of all, there is usually a call center and dispatch center which is located in an office environment, and there are bicycle messengers who are biking through the city area. The communication centers, which are also called ‘operations centers’, are often located downtown in city areas where the

customers are located. The people working at the call center handle incoming calls, usually by telephone, from customers who are asking for courier services. The dispatchers are in contact with the call center and the bicycle messengers who are out on the streets. Usually, there is an information system which is used both by the dispatcher and by the call center operator where the information about customers and delivery jobs is registered.

The bike messengers are usually connected to and in contact with the dispatch center over distance by way of radio. The operation centers that we have visited are centrally located in the cities, so that there may be regular contact with the bike messengers. Often, the operation center is co-located with a bicycle repair shop and a rest area for the bicycle messengers.

The common communication technology found in most of the dispatch centers that we have visited show the following electronic equipment:

- Information system for delivery services.
- Private Mobile Radio system operator consoles.
- Private Branch Exchange desktop telephone set.

The customers call the dispatch center in order to place delivery orders. The dispatcher jots down all relevant information, and either assigns one bike messenger to the job, or asks a group of messengers to take on the delivery job. There are indeed various ways of handling the scheduling of the delivery jobs and each delivery company has its own policies and strategies to facilitate the services it provides. Private Mobile Radio systems, cellular phones, smart phones, pagers and public pay phones are used to facilitate the communication between the bike messengers and the dispatch center. Below is a diagram of the way the work is organized.

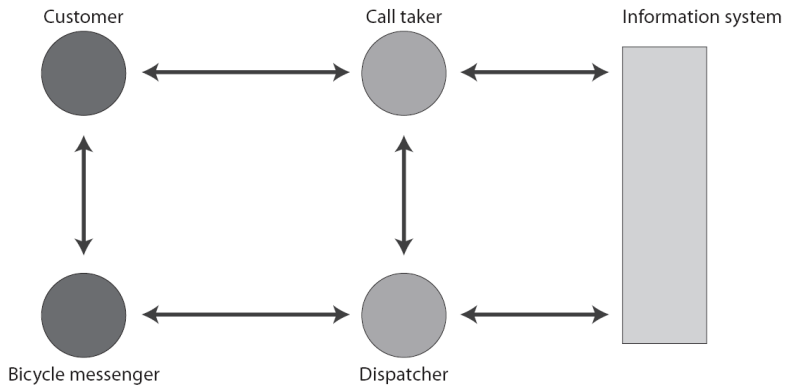


Figure 2: *Network structure of the organization.*

A bicycle messenger needs to be in touch with the dispatch center in order to get information about a delivery job. Various schemes for communication between the bicycle messengers and the dispatch center have been observed during the empirical investigation:

- Bicycle messengers use radios in order to be in audio contact with the dispatch center. The bicycle messengers are always connected to the communication network, and are able to engage in two-way audio contact with the dispatch center.
- Bicycle messengers use mobile phones in order to be in audio contact with the dispatch center. They are always connected to the communication network, and are able to engage in two-way audio and text contact with the dispatch center.
- Bicycle messengers are not equipped with any telecommunications terminals. The way they communicate with the dispatch center is to call by way of office phones and public phones to the dispatch center.

- Bicycle messengers do not use any telecommunications equipment. Instead, the bicycle messengers cycle to the dispatch center in order to receive a paper record with address information for pick-up and delivery tasks.

As the above list indicates, different strategies are applied in order to facilitate meeting the need for communication between the bicycle messenger and the dispatch center. During the empirical investigation, no text-based or map-based system was seen in full operation; it was all voice-based systems for communication between the dispatch center and the bicycle messengers.

The communication equipment which the bicycle messengers use to communicate with the dispatch center is also used by the bicycle messengers to communicate with each other, and with their customers. Especially during breakdown situations, where there is uncertainty about delivery and pick-up locations, the bicycle messengers communicate with the customers over mobile telephones directly.

Those working in the dispatch center and the call center are often past or present bicycle messengers as well. The communication between the dispatcher and the messengers is time critical, and there is a strongly perceived advantage if the dispatcher also knows about what is going on out in the streets.

The bike messengers operate relatively autonomously in the field, but they also operate in teams. In larger courier companies, bicycle messengers often report to a zone manager, who is responsible for the operations in a specific territory. The local operation managers and the bike messengers meet in regular meetings, and there are frequent social arrangements where the bike messengers, the dispatch operators and other interested people meet and socialize. In addition, some of the more active bicycle messengers engage in bicycle messenger competitions and promote cycling in various ways in city areas. These events are possibilities for informal exchanges between bicycle messengers across courier companies.

The bicycle messengers serve their customers in the proximity of many other people, such as pedestrians and car drivers throughout the working day. The customers that the bike messengers are in contact with are mostly receptionist and office staff in corporations. The customers that we have spoken with do indeed have different reasons for engaging bike messengers instead of regular car delivery services, the most important being the speed and cost of delivery, and the positive environmental effects of the bike messenger operations.

6.3 Using multiple technologies at work

The focus area for the empirical investigation has been the use of mobile communications technologies by bicycle messengers, but in course of the investigation itself we learned that this equipment is used in concert with a variety of other types of equipment, like the bicycles, the messenger bags, the biking clothes and public transportation systems. In order to present an account of the ways in which the mobile equipment is applied, the complete equipmental nexus has to be accounted for. Mobile communication equipment is never used “in isolation”, but always in the world of a human affairs where there is other equipment in use. Below is a picture of a bicycle messenger who is using a radio while seated on the bicycle, talking with the dispatcher.



Figure 3: *Bicycle messenger in Oslo on his bicycle talking on the radio. The radio is fastened to the messenger bag, and the mobile telephone is placed in the accessory bag.*

The bicycle is for many bicycle messengers the piece of equipment which they are both mostly interested in and dependant upon for their work. At the same time, the use of mobile technologies and the bicycle affect one another – biking when talking with people who are distant is clearly different from biking when not talking with other people. While

both biking and talking on the phone, the messengers are attending to both the local environment and the conversation happening over a distance.

Bicycle messengers are both *with the bicycle in the streets, and communicating with people who are other places* – for example at the dispatch center. Hence, the fact that bicycle messengers are in such circumstances gives us a milieu wherein to study the ways in which people engage with various personal technologies for moving around (bicycles footwear) at the same time as they are applying various technologies to communicate over distances. Analytically, and as seen from an observer perspective, it might seem that the bicycle messengers are in two different worlds; that is, the “immediate, unmediated world” of bicycles and roads and the “virtual, mediated world” of communication with people. However, it is clear from the observations that the bicycle messengers are in “the world” with no distinct separation of what is “real” and what is “virtual”. They are relating to and using some equipment with local reach, and other equipment with a larger reach.

Some bicycle messengers have two network connections, one associated with the mobile phone and the other with the radio terminal. The awareness of the status of the network connections is usually gained by listening and talking on the communication networks. If there is any problem, the display of the terminal is investigated to look at icons representing the network connection status. The communication devices are often mounted on the strap of the delivery bag or placed inside the appliance bag or in a pocket in the jacket or trousers. The bike messengers that did not carry their own communication terminal have an arrangement with telephone cards and coins for public telephones. Various forms of clipboard were used for keeping track of delivery and pick up addresses. Different forms of pen arrangements were observed for writing on the clipboard. In the picture below, a bicycle messenger is using the clipboard while seated in a café:



Figure 4: *A bicycle messenger at a café in Oslo, using the radio while eating breakfast; the clipboard is on the table.*

Most of the bike messengers in our study use two body-worn bags: one delivery bag for the packets that is to be delivered and one hip carried appliance bag. The appliance bag was used for keeping personal equipment like maps, bike repair tools and first aid kits. Some of the bike messengers carried various forms of marketing material in the appliance bag, such as nail files, pens and post-it notes – portraying the logotype of the company.

The clothing for the bicycle messengers varied among the different companies. Some companies had bicycle uniforms, with jackets, trousers and bike shoes with the logo of the company printed on it in addition to other prints. Some bike messenger companies did not offer any uniform to the bike messengers to wear. The bike messengers carry most of the electronic equipment with them, so that the equipment is in the personal region of the bike messenger – inside pockets or fastened in various ways onto the clothes they wear.

Their equipment is mostly “off the shelf” technologies, which are somewhat tailored to fit the individual size of the biker and the biking and walking situation. An example of tailoring is the fastening of cables and terminals to the shoulder strap of the biker bag with duct tape. Some common characteristics for the end user equipment are that it is close to the body of the biker and fastened to the bikers’ clothes or bags. In the picture below, the radio is fastened to the messenger bag.



Figure 5: A bicycle messenger in Tokyo who is waiting at an intersection; the radio is fastened to the strap of the courier bag.

The communication terminals that the bicycle messengers use are very seldom mounted onto the bicycle. When using telecommunications technology while driving an automobile, it is often the case that the device is mounted and even integrated into the dashboard with its loudspeaker, microphone and control unit. However, since the bicycle messenger often parks the bicycle outside office buildings, and he or she has a need for communicating over a distance while walking through the buildings, the communication equipment is fastened to the bag or the clothes. In this way, the communication terminal is with the bicycle messenger at all times and in all situations, even when the bicycle messenger is separated from the bicycle for some time. Even the bicycle bell is carried around the neck, and always at hand for some bicycle messengers, and not fastened to the bicycle. In this way, it is always available, when the hands of the bicycle messenger are busy with, for example, operating other equipment.

The end user equipment just described is close to the messenger's body, and is also a type of mobile technology. In addition to this, the bicycle messengers also use stationary equipment. A common characteristic for this type of equipment is that it is fixed in the environment of the user, such as servers and network access in the form of wireless networks.

The interaction between the bicycle messengers and the equipment in use is tactile in the form of keys and screens, visual in the form of reading displays, and auditory in the listening from loudspeakers and talking into microphones.

6.4 Moving around in the open air

For bicycle messengers, biking is clearly the central activity. In order to move around, the bicycle is used on streets, pavement and bike paths. However, sometimes the bicycle messenger also walks inside office buildings and through corridors, or they use the public transportation system if it is appropriate. Movement is hence facilitated in many different ways, but the main way is to move on top of two wheels through the city.

To move around by bicycle is full body engagement, which most people learn at an early age. It is a practical activity, which is hard to explain in words, but easy to do and show to others. It requires limited theoretical knowledge about velocity, balance, gyro stabilization, gravitation fields and the efficient use of human power. Biking has been used in various writings to illustrate the notion Polanyi calls *tacit knowledge* (Polanyi, 1983). According to Polanyi “we know more than we can tell”, and he has extensively applied the example of riding a bicycle to make the point, and to discuss what he means by tacit knowledge.

During the empirical investigation, we met many bicycle messengers who indeed express feelings of joy, strength and buoyancy evoked by biking. Some bicycle messengers show, by words and body expression that they simply love biking and are thrilled by moving on top of two wheels in city areas. Of course, there are not only positive feelings associated with biking; negative feelings of anger and sadness also arise in certain circumstances. After a long day of biking, and a few “near-death” experiences, bicycle messengers both express anger and fear.

For bicycle messengers, biking is an activity that is conducted mostly in the open air. While moving around by driving an automobile or by public transportation, the person is confined to a sheltered cocoon. The environment in which the biker is moving, the open air, is experienced differently than when immersed in a closed environment. Bike messengers express that they enjoy biking, for this very reason. One consequence of biking in the open air, though, is that the biker has to protect him or herself from the environment by way of a layer of clothing and garments according to the season. Bicycle messengers work outside, in various temperatures and climates, from the summer heat to the winter cold. In Oslo, for example, the temperature during winter days can be minus 15 degrees Celsius, and in the summer up to plus 30.

When it is cold, windy or rainy, the bike messenger protects himself with proper clothing, like jackets, trousers, raingear and so forth. Some equipment that is not designed and engineered for outdoor use has to be protected from the wet and cold as well. Plastic

casings, plastic bags, and placing equipment inside of clothing are widely used strategies for protecting one's important gear while biking. The bicycle bags are mostly waterproof, so that the packages are protected against rain, snow and dust.

Again, the bicycle messenger also works in indoor environments. In these cases, the bicycle messenger usually leaves the bicycle outside an office building, or inside the lobby of the office building while walking the corridors and offices. He or she moves around from place to place, and brings equipment along while going about the daily work of delivering packets. The messenger is in a stationary relationship with both the bicycle and the equipment for communication and transporting packets; they move together.

6.5 The messengers

Bicycle messengers do not talk about themselves as "users" of bicycles or any other equipment even though they cycle and operate their equipment extensively. Instead, they say that they are biking or moving with the bicycle. Many bicycle messengers have a special interest in biking, and this interest has guided them to work as bicycle messengers. They relate to their bicycles in various ways, while repairing the bicycle after a breakdown or when contemplating a bicycle rig that was stolen from the place it was parked outside an office building. Many bicycle messengers share this interest for biking as an activity. They often bike in their spare time as well.

In the same way, the bicycle messengers do not talk about the "use" of telecommunications equipment. They roam around by way of bicycles and footwear, and at the same time they communicate with each other, the dispatch center and customers face to face and through radio and mobile telephones. The equipment that bicycle messengers are with –the bicycle, the electronic equipment, the bicycle clothes and the messenger bag –are important for the bicycle messengers. This equipment is necessary in order to do the job in this environment.

The bicycle messengers are often physically fit, which is essential for their job. Often, a bicycle messenger bikes about 80 kilometers a day. In order to navigate through heavy

traffic, and to find the best route from A to B, the bicycle messengers need to be fully awake and aware of the city they are in. A bicycle messenger often gets new delivery jobs over the radio while being on an assignment, and hence they need to remember addresses and names of delivery companies while biking. So, it is both a physical and a mental activity.

The bike messengers have different backgrounds when it comes to education and work experience. During the empirical research, we biked with messengers who have graduate degrees and have worked previously as engineers, lawyers, medical doctors, taxi drivers and athletes. Many bicycle messengers are also part-time students at colleges and universities. The majority in this study were male. The age varies from about 20 to 45 years, where the majority is between 25 and 35 years of age.

Many bike messengers stressed that on-the-job training and learning from practice is very important for them. Larger bicycle companies have established practices for such training. The master-apprentice scheme (Brown et al., 1989) was observed at some of the companies where a senior bicycle messenger was biking with and coaching a junior bicycle messenger as part of their training. The practices varied from company to company, but it seemed that in most cases a junior bicycle messenger was together with a senior messenger for a couple of days before handling delivery jobs alone.

You air that serves me with breath to speak!
You objects that call from diffusion my meanings, and give them shape!
You light that wraps me and all things in delicate equable showers!
You paths worn in the irregular hollows by the roadsides!
I think you are latent with unseen existences—you are so dear to me.
-Walt Whitman

7 Research findings

This chapter presents the empirical findings of this research. These findings emerged from the investigations of the ways in which bicycle messengers encounter and use equipment in everyday life. The organizing principle for presenting these findings is the three research questions raised in the beginning of the thesis. These questions provide perspectives as intermediate abstractions.

7.1 Everyday use and visibility of equipment

The empirical findings have emerged during the process of conducting the investigation among bicycle messengers while they were working. The empirical findings are both in the form of utterances from the bicycle messengers, as they are heard during the participant observation, and in the form of descriptions of recurring activities that are observed and later recorded in written words.

The first research theme that emerged from the empirical investigation was in what way the equipment in use was visible for the bicycle messengers. The theme is addressed by the first research question:

In what way is the equipment in use visible or invisible for the user during everyday use?

The findings pertaining to this question are presented in the two next sections.

7.1.1 Using and seeing cables, access and connections

Bicycle messengers are very much concerned with the cables that link the equipment together. Especially the cable connecting the headset with the telephone, radio or music device were of great concern to the bicycle messengers. In some situations, cables are fastened to the bicycle bag and bicycle clothes with, for example, duct tape, in order to make sure that the cables are out of the way while moving. Since the messengers move around on foot and on the bicycle, the cables have a tendency to be in the way. If the cable is not fastened to the clothes or bicycle bag, it can easily be broken if the cable hooks onto something while the biker moves around.

It is possible for the bicycle messenger to find ways to fix the problem, and to get the equipment working again when physical wires break. This is done either by replacing the cable or by mending the terminal of the cable. For example, a biker who has experienced cable problems told me:

“...this is a known problem. When the cable to the headset is broken, we have no contact with the dispatcher – even if the radio is working fine. I know that it is not the cable itself that is the problem, but the connection of the cable to the radio – and I know how to fix it”.

This was a recurrent theme among the bicycle messengers, that the cables connecting headsets (microphone and loudspeaker) to the terminal device was broken while moving around. For example when parking the bike, the headset cable might be in the way and lose connection to the radio terminal.

However, some of the “wires” that bicycle messengers use are not directly seen by the naked eye. These are “wireless connections” and “wireless access”. The fact that these wires are not directly visible to the naked eye does not mean that the “wireless” connections are not “seen”. The bicycle messengers are very much aware of the network connection, and also “see” this connection while using the equipment. For example, by interacting with the terminal device that displays the status of the network connection to

the user, the bicycle messenger “sees” the wireless network. Another example is when bicycle messengers are walking in and out of lifts. Here is how a bicycle messenger describes the situation:

“This lift is a Faradays cage. There is no connection to the network here, so sometimes I take the stairs instead.”³

The awareness of the quality of the network connection is high among the bicycle messengers; they often talk about specific areas like lifts or office environments where the network connection is less than perfect. Bicycle messengers know about these “traps” and try to avoid them and work around them.

7.1.2 Using and seeing equipment in use

Network connections are “visible” for bicycle messengers in the sense that they are aware of the presence of the wireless network and the network connection enabled by the wireless access. The presence of the network connection can be detected in different ways. The most frequently observed way is that the user is actively engaged in talking and listening through the device, and by this engaged use he is aware that there is a network connection. There is a diode or an icon in the interface on some devices which provides a visual cue about the presence of the network, and this is useful when the device is not used actively for speaking or listening. On some devices, there is an audible signal which indicates that the device is entering and exiting network connections. In other words, the data suggests that it is possible to “see” something, which is in effect invisible to the eye.

A special case is when the network connection is broken, since this instance explicitly indicates the visibility of the network connection:

“I feel totally lost when my network connection is broken”.

³ A Faraday cage is an enclosure formed either by a conducting material, or by a mesh of such material. The enclosure blocks out external static electrical fields. Faraday cages are named after the physicist Michael Faraday. The term Faraday cage in this excerpt suggest a weak radio reception in certain areas.

The awareness of the network connection is important for bicycle messengers who use mobile telephones and radios. The status of the network connection(s) is monitored on a continuous basis. As the excerpt above indicates, the bicycle messenger becomes aware when the network connection is broken. This is usually recognized when the radio or mobile telephone becomes “silent”, the audio from the other side can not be heard, or the side-tone in the terminal loudspeaker has disappeared. The next step when a situation like this occurs is to try to figure out what is the cause, which is typically done by either trying to call again – or looking at the display where the network icon indicates the status of the network access to monitor the signal strength.

These findings also suggest an *awareness of the presence of the “invisible” connection*. The recurrent observation that the bicycle messenger is in an embodiment relationship with the network by using it effortlessly is an indication that he is indeed aware of the network connection of the device, even when it is invisible to the naked eye.

Bicycle messengers talk about *being connected*. This does not refer to the “terminal” that is connected to the network, but rather that the bicycle messenger himself is connected with the network. A bicycle messenger put it this way:

“I and the bicycle are one.”

This way of talking about the relationship with the bicycle indicates that there is a close relationship between the bicycle messenger and the bicycle. This relationship comes into being by using the device. It also comes to an end in some situations.

The bicycle messenger is always on the move and roams from one type of equipment (the bicycle) to another (footwear). *The transition between the two types of equipment* illustrates that this is not a blind activity, since there is a selection process going on. The procedure when a bicycle messenger arrives at an office building is to find a way to park the bicycle and proceed into the building on foot. An alternative procedure is to proceed

into the building with the bicycle. This is done in order to secure the bicycle in a safe place. However, I have not observed any attempt to use the bicycle on stairs or inside a lift.

How can the use of equipment be a “blind” activity? It seems from the two examples above that the user is highly aware of the equipment in use. The bicycle messenger uses equipment appropriately in the situation of use, and he does what seems appropriate with the equipment in order to respond to situational changes. The bicycle messengers are domain experts in their work, as seen from this researcher. They “know” how to go about biking and using telecommunications equipment in city areas. The skill level in the domain of biking is high; they know the art of biking.

Equipment is visible for the user both during everyday, engaged use and during situations when there is a disruption or breakdown. When equipment is in use, there is a *kind of awareness of the equipment* that is different from other forms of awareness discussed in the literature about computational awareness mechanisms.

7.2 Visibility and selection of alternatives

The second finding is addressed by the following research question:

In what way do alternatives become visible, and in what way is the selection of equipment for use carried out and managed?

Bicycle messengers make many decisions about how to approach their work. For example, when finding the way to an office building, the most efficient and effective way is based upon decisions made on a moment-to-moment basis. The environment or situation is “read” by the bicycle messenger who chooses to do this or that based upon previous understanding of the situation and reflecting on the various alternatives available to him.

A recurring theme that emerged during the empirical study was that bicycle messengers employ multiple strategies in order to move from one place to another; they do the same in order to communicate with the dispatcher. The assumptions at the outset of the investigation were that “bicycle messengers use bicycles and telephones/radios only”. However, these assumptions turned out to be incorrect, and the theme of *alternative strategies* emerged.

In order for the bicycle messenger to select an alternative to accomplish what he wants to achieve, he needs an awareness of what he is already doing. For example, when navigating and finding the way to an office building, the bicycle messenger knows that he is going to deliver or pick up a parcel at that specific place. The need for moving to the place in an efficient manner is hence present, and there is an awareness of this need.

The *alternative strategies for meeting the need* are available to him based upon previous experiences and understandings of similar situations and encounters. In the next two sections, two findings pertaining to the selection of equipment are presented.

7.2.1 The choice among multiple ways of communicating

A bicycle messenger needs to be in touch with the dispatch center in order to get information about a delivery job. Various schemes for communication have been observed during the empirical investigation:

1. *Radios.* The bicycle messengers are always connected to the communication network, and are able to engage in two-way audio contact for listening and talking with the dispatcher.
2. *Mobile phones.* Bicycle messengers use mobile phones in order to be in audio contact with the dispatch center. The bicycle messengers are always connected to the communication network, and are able to engage in two way audio and text contact with the dispatch center.

3. When bicycle messengers are not equipped with any telecommunications terminals, i.e. do not carry or wear any equipment, they communicate with the dispatch center by using stationary office phones or public coin operated phones.
4. When bicycle messengers are not using any telecommunications equipment, stationary equipment in offices, pay-phones or mobile equipment fastened to straps and bags, they bike to the dispatch center in order to receive a paper record with address information for pick up and delivery missions. Or they get the message by spoken word and write it down on paper themselves.

Some bicycle messengers are comfortable with all four strategies for communicating with the dispatcher, whereas others prefer only specific methods.

Bicycle messengers also make personal choices of how to communicate with other bikers, car drivers and pedestrians on a moment-to-moment basis. The finding pertains to the observation that different types of equipment were used for the same purpose; i.e. notifying and communicating with fellow road users and office walkers. The various ways that were observed were talking, shouting, screaming, and using the bicycle mounted bell or the whistle carried in a string around the neck. The way of selecting the communication method in the proximity of the biker varied greatly.

The awareness of the need to be in contact with the dispatcher is indeed important for bicycle messengers, since without this contact there is no work to be done. Interestingly, the bicycle messengers select the perceived most appropriate way of being in contact with the dispatcher based upon an *awareness of the various alternatives* in the situation.

7.2.2 The choice of method of moving from one place to another

At the start of the investigation, I wondered why none of the bicycle messengers had the communications equipment mounted onto the bicycle. I had seen some non-professional bikers with communications equipment mounted on the bicycle previously, and wondered why this was not the case for the professional bicycle messengers?

The answer to this emerged as the participant observation proceeded. My idea and assumption about bicycle messengers was that they mainly use the bicycle for moving around. But this assumption was wrong. Bicycle messengers also move from place to place by way of footwear and by public transportation if this is found appropriate. In situations when the bicycle messenger is away from the bicycle, he still needs to be in contact with the dispatcher; hence, it is more appropriate for him to carry the communications equipment on the body than to have it mounted on the bicycle.

All of the bicycle messengers observed found it more appropriate to “wear” or “mount” the equipment onto the clothes or the strap of the bicycle bag, since this equipment (the clothes and the bag) is with the user at all times. Hence, when the bicycle messenger wants to contact the dispatcher while in an office, and the bicycle is parked downstairs, he is in a position to do this by using the equipment he is carrying with him.

The awareness of the need for movement is present among bicycle messengers. In order to pick up a packet in one location and deliver this packet at a different location, the bicycle messenger needs to move around. This need can be met in different ways, and the bicycle messengers are aware of the different ways of moving around by bicycle, footwear and public transportation. Based upon the urgency of the delivery job, and the importance of keeping deadlines, the appropriate strategy for moving around is selected.

Of course, the bicycle is the primary device for getting around and doing the job. Interestingly though, bicycle messengers use many other technologies as well for moving around in city areas and office complexes. The following equipment was observed as supporting the bicycle messengers’ movements:

- Footwear (and corridors, office floors).
- Bicycles (and streets, pavements).
- Underground public transportation system.
- Lifts (inside buildings).

- Escalators (inside buildings).

The bicycle messengers were consciously aware of these alternatives, and selected the appropriate equipment as the situation demanded. Hence, the *alternative technologies for moving around are visible to the bicycle messenger in the situation of use*, and the selection of the appropriate technology is based upon the understanding of the situation.

In sum, the alternative strategies for meeting bicycle messengers needs are visible during everyday use of equipment for the bicycle messengers.

7.3 Visibility of the environment

The third finding is addressed by the following research question:

During the engaged use of equipment, what aspect of the situation is visible to the user?

One of the recurring themes that emerged during the empirical study is the relationship between the user and the air, and the communications equipment and the air. The air is a condition for the possibility of being able to use and relate with equipment in the first place.

The bicycle messenger is aware of more than equipment in use when the situation is opened up. By biking around in the city, talking on the radio or telephone network, bicycle messengers are aware of their presence in an environment or situation. The bicycle messengers are primordially *present* in the given situation.

One “entity” that is continuously present for the bicycle messenger is the air that surrounds him. The previous findings indicated that a bicycle messenger is aware of the wireless network connections. However, the bicycle messenger is also aware and “sees” the air in other ways, as the next finding indicates.

Both the “user interface” and the “computer interface” (Grudin, 1993) of mobile telephones is surrounded by air. With the relational perspective on the activity of use, the “interface” in between the user and the computer is in focus, and can be described either as the “user interface” or as the “computer interface”, pointing to what is in between the user and the equipment in use. When listening and talking, the audio is in the air between the microphone – mouth, and the loudspeaker – and the ear. In other words, the air is the primary medium between the bicycle messenger and the equipment when communicating over a distance.

In the context of using mobile devices in the air, I have observed instances where bicycle messengers have been in situations where it has been difficult, challenging or impossible to use the telephone for communication over a distance. Interestingly, the triggers for these situations are not “in” the equipment, nor “in” the bicycle messenger, nor “in” the physical environment. *What is breaking down is the assignment between the different parts of what is observed.*

The list of instances when the bicycle messenger is not able to speak or listen is mentioned below:

1. *He is breathing too fast while biking at up a hill.* This frequently happens while the bicycle messenger is actively engaged in biking, and is tuned into a delivery which has a tight deadline. Often a bicycle messenger slows down in order to get back to breathing at a pace where it is possible to articulate words. In other situations, the biker proceeds ahead, waiting until a situation suitable for talking and listening occurs.
2. *The air smells too “bad” at the given location* - for example, in a tunnel with exhaust from automobiles. This is observed during rush hours in downtown areas, both in the open roads and under bridges and narrow passages. The bicycle messenger moves away from the polluted air to an area where it is possible to talk in relatively fresh air as a remedy.

3. *The air is filled with too much noise* – for example, from automobiles and other entities in the environment. This is frequently observed, and the obvious way to be able to communicate is to move to an area where there is less noise, such as further away from the source of the noise toward, for example, the other side of the street.
4. *There is too much wind* – which, again, passes the microphone and the loudspeaker. This is observed on windy days. The bicycle messenger moves to an area where there is less wind in order to communicate.
5. *He is biking so fast that the air is flowing* past the microphone and loudspeaker too fast and making too much noise. The biker usually slows down in order to communicate. In other situations, he waits until an appropriate moment for talking and listening unfolds.
6. *He is in a place where there is no radio coverage.* This is observed in certain lifts and parts of buildings. Experienced bicycle messengers express that they are aware of various areas with no or limited coverage. This is seen especially in lifts, and sometimes the bicycle messenger uses the stairs instead in order to be able to speak or listen over a distance while at work.
7. *The microphone and loudspeaker are covered with clothes* that are in the way. This is observed during cold and wet days. Communication is re-established by removing the clothes, or rearranging the way the communications equipment is fastened to the clothes.
8. *He is not in a mood for making any sense* – and this mood is affecting the breathing and the ability to listen. This is seen during some “extreme” situations, where the biker has had an “almost” accident. The way to get into communication again is simply “calming down”.

9. *He is in a place where it is not "suitable" to speak* due to social protocols, for example inside a restaurant. The atmosphere of the place is not suited for using communications equipment for work coordination, and the bicycle messenger has to move to a different area in order to listen and talk over a distance.

10. *He is engaged in communication with people in the physical proximity.* This is frequently observed, and the conflict is usually resolved by gesturing to the "local" party, or sending a short message on the radio.

A bicycle messenger manages these situations in various ways. He can slow down and reduce speed, move to another place more suitable for radio communication, and arrange the cables and communication equipment properly on the body and clothes. Since the activity of talking and listening on the radio network is of crucial importance, the bicycle messenger finds ways to get back into communication mode if there is a communication breakdown in the situation.

The main issue here is not to point to challenges in communicating over a distance, but to identify and describe the relationship between the bicycle messenger and the environment in all types of situations encountered in work. If we compare the use situations listed above with related use situations, for example mobile telephones inside a car, we see that most of the challenges listed above do not exist. Consider also the use of a mobile telephone in an office setting, where there are different challenges present.

The finding presented here shows that when the user is biking he is aware of the air; the air is therefore visible. Since the air is a condition for the possibility of using the mobile telephone, this condition is important and hence disclosed so that it can be taken into account during everyday use by the bicycle messenger.

In sum, *the environment is seen during the everyday use of equipment by bicycle messengers.* The user positions himself and his equipment appropriately, adapting to the

air. In this way, the air is visible during use situations and bicycle messengers have an awareness of ways to managing the relationship with the air that are suitable for communicating over distances.

You can learn something from everything, the rabbi of Sadagora said to his hasidim. Everything can teach you something, and not only everything God has created. What man has made has also something to teach us.

What can we learn from a train? one hasid asked dubiously.

That because of one second one can miss everything.

And from the telegraph?

That every word is counted and charged.

And the telephone?

That what one says here is heard there.

-Martin Buber

8 Discussion of findings – visibility in use

In this chapter, I discuss the findings from the empirical case. The findings pertain to the question concerning the human–equipment relationship, and ways to describe this relationship in order to understand the use of equipment in specific situations. Three different findings about how equipment is visible to the user are discussed. First, in what way is the equipment in actual use visible for the bicycle messengers? When a bicycle messenger is actively engaged in an exchange via the mobile telephone the equipment itself is visible for the messenger. This finding leads to the discussion about visibility of equipment in use.

Second, the selection of appropriate equipment when the user is confronted with several alternatives is carried out by bicycle messengers on a moment-to-moment basis. A discussion of the ways of selecting equipment in various situations is discussed as the second finding.

Finally; the use of equipment in the broader context of use is discussed. What parts of the environment, situation or circumstances are seen by the bicycle messenger while using equipment? This leads to the discussion about the view of the situations from the perspective of the messenger within them.

8.1 Relationship between user and equipment

The first finding addresses a central phenomenon within HCI – namely the relationship between a user and equipment in use. This is presented and examined in the following subsection.

8.1.1 Visibility of equipment in use

As the previous chapter indicated, the use situation for a bicycle messenger is different from the situation when a user is seated in front of a desktop computer. First, bicycle messengers use and interact with multiple devices in various situations. Second, the environment of use is always dynamically changing for a bicycle messenger, whereas when using a desktop computer the environment is more stable.

It was a recurring theme from the empirical observations that during the use of equipment, the bicycle messengers were aware of the equipment they were using, and hence that the equipment was visible for them and part of their activity.

“I and the bicycle are one.”

The bicycle messenger and the researcher were biking together side by side, and the equipment in use was working in accordance with our expectations for how the equipment should work. The equipment was present, and there were no disturbances or breakdowns in the situation, it was not missing, nor were there any obstacles in the street or other places in the environment.

There were also other indications that the bicycle messengers were aware of, and actually articulated something about the way they experienced equipment during engaged use. For

example, a bicycle messenger told me after a breakdown situation with the radio (loss of network connection):

“When the network connection is broken – I am totally lost.”

When talking about this situation afterwards, the bicycle messenger told me that he is very much aware of the radio and mobile telephone equipment while biking. During a breakdown situation, it was obvious to him that the equipment that was faulty or missing was visible as an object that turned out to be an obstacle for proceeding with the job. He was then able to search out and identify the fault, resolve it, and continue with his work. During a breakdown situation, the bicycle messengers were quick to observe, identify and isolate the equipment that was faulty so that they could proceed with the task at hand.

Another bicycle messenger told me that he was aware that the network connection was stable at certain places, and that there are weaker network connections in other places. With the awareness of the signal strength at various places, he was able to avoid disruptions and breakdown situations with respect to the wireless connectivity effortlessly by moving around them. For example, he said while walking out from a lift:

“...this lift is a Faraday’s cage.”

He told me that sometimes, being aware that there is limited wireless access inside lifts, he runs up the stairs if it is important for him to stay connected on the radio network. For example, if he were searching for the right address or waiting for a person to call, he would stay out of the lift in order to keep connected to the communications network.

The interaction that goes on between the bicycle messenger and the equipment are dynamically changing with respect to how the equipment is seen and hence become visible. In some situations, the equipment is visible as an external, isolated object. In other situations, the bicycle messenger is with the equipment having an awareness of it that also makes the equipment visible to him, but not as an external, isolated object.

Again, when the equipment is working according to expectations, it is visible as a kind of awareness.

8.1.2 Understanding use – visible equipment in use

Two different ways of seeing equipment in use were observed. In some situations the equipment was seen as an external, isolated object. For example when the equipment was faulty (e.g. a cable was broken), missing (e.g. the bicycle was stolen), or something else was in the way (e.g. a door could not be opened in order to proceed with delivering a packet) it was seen as an isolated and external object with some identifiable properties and behaviors. In these situations, the bicycle messenger was able to point out the reasons for the breakdown and suggest how to go about resolving it. When the equipment is visible as an object in this sense, it is here called *object visibility*. Object visibility is used as analytical notion in order to talk about another type of visibility that stems from circumspective use.

When the equipment was working as expected, the way of seeing the equipment was different. It was not invisible at all times as many other researchers have claimed. Neither was it seen as an “isolated object” with properties and characteristics. The utterance “I and the bicycle are one” indicates that there is a different relationship between the user and the equipment in use than the traditional “subject – object” relationship. This is what is called *circumspective visibility*, and is a main finding of this thesis.

The utterance “I and the bicycle are one” indicates that the bicycle messenger is aware of the equipment in use. The equipment is visible to the bicycle messenger as part of the use situation he is involved in. The equipment is not seen as an external object, but as equipment that is in use as part of an activity. Also, the equipment is not seen in isolation from the use situation. It is part of the situation together with other equipment in use.

An analysis of the use situation when a bicycle messenger is riding a bicycle can be described in terms of a subject (the bicycle messenger) relating to an object (riding or using a bicycle) in a situation (on a street, carrying a packet). The sentence “I and the

bicycle are one” is hard to explain analytically, since this implies a distinction between subject and object. Analytically speaking, the bicycle and the bicycle messenger are two different entities, the one characterized by the term user or bicycle messenger, and the other characterized by the term bicycle or equipment. However, in use situations like the one mentioned above, the messenger is expressing no such distinction.

The bicycle messenger, during engaged use, was aware of the equipment in use, and also uttered something about the equipment in use while actively using it. A central argument of this thesis is that it is not a necessary condition that there is a disruption or a breakdown situation for equipment to be visible for the user. Circumspective visibility is a different kind of visibility than object visibility.

The bicycle messenger is in a state of being “in-the-world” among other people and equipment while delivering packets. A phenomenological account of the situation is required for providing a richer understanding of the use situation. Although it is possible to describe the “user” and a “piece of equipment” and the interaction between the two, according to Heidegger this is not the way in which a user is in-the-world primordially. When biking, the bicycle is not seen as an isolated piece of equipment apart from other equipment. The bicycle is in relationship with the asphalt on the road, the curb line, the bicycle repair shop, the air pump and many other related items that are required for a well functioning bicycle. The way in which equipment is linked together is explained by Heidegger (Heidegger, 1962) with the term *equipmental nexus*; that is, in an actual use situation there is no such thing as an “isolated piece of equipment”.

The primordial relationship between the user and the equipment is enacted thorough the use of the equipment in everyday life. The bicycle messenger is using the equipment in-order-to achieve something or do something. For example, he is using the bicycle in-order-to move to a place and deliver a packet. Similarly, he is using the radio in-order-to talk with a colleague, for example, to find some information about a delivery site. In an everyday use situation, the focus of attention is on the in-order-to, i.e. what the bicycle messenger is about to achieve during the use situation. The equipment, as seen by the

bicycle messenger, is part of a larger frame of activity where there is also other equipment present, either directly or indirectly. Therefore, it is possible to say that the equipment in use withdraws into the background for the bicycle messenger, where there is other equipment already present.

Heidegger distinguishes between two distinct modes of relating with equipment. In the first mode, the equipment in use is ready-to-hand (*zuhanden*), and in the second instance the equipment is present-at-hand (*vorhanden*). When equipment is present-at-hand, the equipment is seen as an isolated, external object. When the equipment is ready-to-hand, the equipment is part of a situation that the bicycle messenger is in together with other equipment. Hence, it is not seen as “isolated equipment”, and it is not “external”, since the user is part of the situation together with the equipment in use. These two different modes of being in relationship with technology have been identified by many researchers within HCI and CSCW and written about extensively (Winograd and Flores, 1986; Ehn, 1988; Dourish, 2001).

In this thesis, I am concerned with the use situation when equipment is ready-to-hand, i.e. when the user is familiar with the situation and things are working according to expectations. The excerpt “I and the bicycle are one” indicates that the bicycle messenger actually sees the equipment in use in a particular *non-detached* way. He and the equipment in use are together in a way that enables him to see it in a specific way. This way of seeing equipment is described by Heidegger as circumspection (*Umsicht*).

The description that equipment is withdrawing from the focal attention of the user does not mean that the use of the equipment is a blind activity. The bicycle messenger does indeed need to use the bicycle very carefully in order to operate in the streets among other moving entities like automobiles and pedestrians. It is incorrect to say that the equipment disappears for the bicycle messenger, since it is indeed present for him according to the way he operates it.

The equipment is, during everyday use, present and visible for the bicycle messenger through circumspective use. The equipment is seen as part of the *equipmental nexus*, and is part of the *practice of using* the equipment. This distinguishes it from object visibility in two important ways.

1. The equipment is seen together with other equipment in use (as part of the equipmental nexus).
2. The equipment is seen in the practice of being involved in a use situation.

Heidegger explains circumspection as a kind of *awareness*. It is not something that is present sometimes and not present at other times. Circumspective use is guided by a kind of *overarching awareness* that enables the bicycle messengers to engage actively in the situations that evolve or unfold as they go about picking up and delivering packets.

The way of viewing a use situation guided by the sight of circumspection is that there is a kind of awareness in using the equipment based on a *familiarity* with previous ways of doing so. The user and the equipment are part of a situation where there is already an understanding of the situation of use with the equipment in question. The circumspective use enables the user to hook onto this pre-understanding and negotiate a use situation so that the equipment is used in order to do what the bicycle messenger is about to do. In sum, the equipment has neither disappeared, nor is it invisible for the user, even though it has withdrawn into the enabling background.

8.1.3 Comparison to related research – equipment in use

There is an increasing body of research inspired by phenomenology about the ways of relating with technology. Don Ihde has described different relationships with technology through the framework of phenomenological relativity (Ihde, 1990; Ihde, 1986). The notion of embodiment relationship, hermeneutic relationship and alterity relationship are suggested as ways of being-in-the-world with technologies.

According to Ihde, the embodiment relationship is not restricted to the visual sense. The same structural feature of embodiment is present for all the human senses in the way that

equipment “withdraws” from the user. The embodiment relationship is found for both simple technologies like eyeglasses, hearing aids or the blind man’s cane and complex technologies like the automobile. The telephone in use falls into an embodiment relationship, according to Ihde; if it is working as expected the apparatus itself withdraws into the background (Ihde, 1990).

Ihde does not discuss what “withdrawing” into the enabling background means in actual use. For Ihde, the concept of “embodiment relation” seems to be used in order to discuss the amplification/reduction structure present in all technology use. The way of experiencing the “transparency” of technology in embodiment relationship is not discussed further by Ihde. He is primarily concerned with the questions regarding the history of technology and the science of technology, and not explicitly with investigating the actual present-day technologies in use.

Fallman has applied the perspectives provided by Ihde in order to discuss the use and the design of wearable computers (Fallman, 2003). However, neither Ihde – nor Fallmann have an explicit discussion about visibility in use. Both authors assume that when interacting with equipment through the embodiment relationship, the equipment withdraws from the attention of the user into an enabling background. The ways in which the equipment is visible for the user in the enabling background are not elaborated.

Dourish (Dourish, 2001) introduced the notion of “embodied interaction”, based upon a phenomenological inquiry into HCI. He describes the phenomenon of social computing and tangible computing, and proposes a conceptual framework for how the user interface can move into the background without completely disappearing (Dourish, 2001). He notes that the “idea of the invisible interface is too simplistic. It frames interface interaction as an all-or-nothing issue” (ibid). Hence, his is a call for an inquiry into situations of use when the equipment is apparently invisible.

Embodiment is, for Dourish, the common way in which users encounter physical and social reality in the everyday world. The importance of direct engagement instead of

abstract reflection is central for understanding embodied interaction. Dourish distinguishes between inhabited interaction in the world and disconnected observation and control, and he states that this is at the heart of embodied interaction. He explains that as users engage in the world and act through technology that has become ready-to-hand, the technology itself “disappears” from our immediate concerns (Dourish, 2001). However, the way of relating with equipment that has apparently disappeared is not discussed any further by Dourish.

Dourish builds upon the work of Winograd and Flores (Winograd and Flores, 1986). In the seminal work “Computers and Cognition”, these authors introduced for the first time the phenomenology of Heidegger into the field of computer science and HCI. Winograd and Flores were the first researchers who introduced the two modes of relating with equipment using the terms ready-to-hand and present-at-hand for the field of HCI. They stressed that breakdown situations are valuable resources, in order to be informed about use, since in the use situations when equipment is present-at-hand the equipment is visible to the user as an object with properties that can be reflected upon.

In Scandinavia, Pelle Ehn (Ehn, 1988) was the first to follow this up and he introduced notions from phenomenology into the Scandinavian tradition of systems design, i.e. participatory design. Dourish, Ehn, Winograd and Flores elaborate upon breakdown situations, and talk about the valuable insights that can be learnt from such situations when non-functional equipment becomes visible as objects. This has been, and is continually an important area for investigating and understanding the use of computers. Most users, engaged in real use situations want to avoid breakdown situations, but for research into the use of technology the breakdown situation can be valuable. For example, breakdown situations can create opportunities for creativity (Fischer, 1994). However, neither of the above-mentioned research discusses the kind of visibility that everyday, engaged use of computers is endowed with.

The input of psychology has been influential within HCI. Norman (Norman, 1988a) has investigated and described ways of interacting with “everyday artifacts” like doors and

cars in order to inform the field of HCI. In the tradition of user-centered design, he promotes an approach to design where the requirements and interest of the users are taken seriously. He makes the observation that when a user wants to write something, he is interested in writing, and not in using the computer or the word processor. From this, Norman argues that the computer should fade into the background, disappear and in the end become invisible for the writer. While this might be a noble goal for design, it comes with some conceptual problems. If the computer or the interface to the computer becomes “invisible” for the user, it is not possible to use it at all, since it is not there for the user. It might be that Norman meant something else than “invisible” by the notion of invisible, but then I will proceed to argue that we need to search for other more descriptive concepts.

Norman has also been an advocate for promoting visibility in “the interface”, but for other reasons than those mentioned above. During the transition from command-based interaction, towards the graphical user interfaces, it became possible to make information visible in the interface (Norman and Draper, 1986). Based upon the notion of affordance by Gibson (Gibson, 1979), he promoted making elements in the user interface visible. Norman interprets visibility in the interface broadly, in that it possible to facilitate visibility also using sound (Norman, 1988a).

Hence, Norman conceptualized the interaction with computers and everyday objects as making the interface sometimes visible, other times invisible. The perspective of circumspective use opens up for a different perspective on the relationship between the user and the computer in that there is not an either/or issue at stake, i.e. either visible or invisible. What the circumspective use perspective promotes is describing a kind of *awareness in use* that goes beyond the visible-invisible dichotomy.

Shneiderman (Shneiderman, 1992) has advocated “user control”, i.e. to let the user be in control when using computers. In particular, he has raised the issue within the context of the ongoing debate as to whether intelligent agents or other forms of automation at the interface should be pursued. One way of facilitating user control is by making elements

in the interface, and their actions visible to the user. Hence, Shneiderman stresses the importance of not “hiding” functions in the computer, but making them explicitly visible for the user to perform his activities. In addition, he stresses the importance of visible feedback in order to support control. The objective of user control can be met by different strategies, where making information visible to the user is one option. According to Shneiderman, and in line with Norman in this respect, user control is a question about designing interfaces where information is either visible or invisible.

The debate about user control was initiated in the context of desktop computing and the use of stationary computer interfaces, where both Norman and Shneiderman have made significant contributions. The slogan Direct Manipulation and WYSIWYG promotes awareness about what should be visible and what should be hidden in the interface. If the designer wants to hide some of the complexity of the interface, this might come at the cost of reducing user control. However, when computers are embedded into the fabric of everyday life, with computers “everywhere”, it is hard to locate “the interface” in the first place, and also to design for less or more user control. When the interface is spread out through the environment, there simply is not “an interface”, as is the case with desktop computers. A dominant way of thinking about the computers within the ubiquitous computing paradigm is that it becomes so embedded into the fabric of the everyday with the effect that it becomes invisible for the user.

Weiser and Brown describe the human ability of being informed without being overburdened (Weiser and Brown, 1997). Equipment can be described as *calm technology* if the user experiences calm while using it. The calm computing proposal focuses neither on the technology nor on the user, but the relationship in between the two. The relationship between a user and the technology in use is described as what matters when concerned about the design of technology. This view corresponds to the perspective held by this thesis.

The way users attend to, and are attuned to, technology is at the heart of calm computing. When attuned to something, it is in the periphery of attention (Weiser and Brown, 1997).

When attending to something explicitly, it is in the foreground. By placing things in the periphery, it is possible for the user to be attuned to many more things than if everything was at the center of attention. The periphery “informs without overburdening” the user, and hence leads to calmness as an important design principle. This is in line with what Polanyi describes as focal and peripheral awareness (Polanyi, 1983).

Related to the notions of center and periphery is the notion of *foreground* and *background*. The notion of background channel is emphasized in the theory of tangible bits (Ishii and Ullmer, 1997). When interacting with tangible user interfaces, the background channel conveys information from a digital environment. This information is peripheral to the user’s awareness, or, in other words, the information is in the background. Within tangible bits, the background channel is static and permanent and there is no explicit explanation of movement between what is in the foreground for the user and what is in the background. The background and foreground notions are spatial metaphors applied for discussing the interaction between the user and the digital environment. This is different to the notion of circumspective use, in that there is no explicit dichotomy describing either center/periphery or foreground/background. Circumspective use is a perspective on the use situation from the “inside” of the situation, as it unfolds over time during use.

The psychologist Csikszentmihalyi described the characteristics of situations when people perform at their peak. He calls this optimal experience, and being in a flow state (Csikszentmihalyi 1991; Csikszentmihalyi 1996). To “be in the flow” is characterized by a high degree of concentration in achieving a clear goal in a situation where there is a balance between being bored and being overwhelmed by anxiety. People in flow are in control of their environment by receiving rapid feedback so as to evaluate their progress. Many different activities can lead to “being in the flow”, and examples from climbing and music performance are often listed. However, also routine work may be conducted while in the flow. The particular relationship with the equipment in use during such use situations is not discussed primarily within the literature on Flow.

While the concept of “flow” might sound similar or related to circumspective use, there are also some important differences. While circumspectively using equipment, there is not a prerequisite that there is an optimal experience. It is furthermore possible to be both anxious and bored while using equipment. While engaged in using equipment, it is possible to move in and out of the flow state, whereas while using equipment it is always with circumspection, or a kind of awareness. Circumspection is not something that is present in some circumstances and not present at other times – it is about various *degrees of awareness in use*.

Kluge, in his thesis “Progressive interaction design for the metamedium; an investigation into interactive meaning making” (Kluge, 2005) addresses the field of HCI and tangible computing. Kluge promotes “interactivity” as the primary subject to be studied and argues that the relation between human and technology cannot be accurately understood by elaborate investigations limited to the human, the technology, or the content by themselves. Kluge followed up the work of Svanæs (Svanæs, 1999) who investigated seven important contributions to the HCI field, and drew the conclusion that the field at present can not provide a deep understanding of the nature of the interactive experience. The main reason for this, according to Svanæs, is the ignorance of the role of the body in human-computer interaction. This is an important insight, since the body is indeed present in all interactive experiences. However, neither Kluge nor Svanæs addresses explicitly the visibility of equipment in use.

8.2 Selection of appropriate equipment

The second finding is about the situation when selecting equipment for a particular task with alternative technologies available for the user to choose from. In this case, my data shows there is an ongoing negotiation *in situ* where the user is selecting the appropriate equipment for the task at hand. The finding presented in this section is about this selection process and how alternative equipment reveals itself.

8.2.1 Visibility of alternative equipment

When a bicycle messenger is approaching a delivery site with his bicycle, there are many activities going on at the same time. In some situations, the bicycle messenger is parking the bicycle outside the building, locking it – and then proceeding by foot inside the building. In other situations, the bicycle is carried into the lobby of the building. If the lobby is attended to by guards, the messenger may ask the guards to look after the bicycle while he walks into the building and proceeds either by the lift or by the staircase.

What I want to address here is that the bicycle messenger makes conscious choices regarding the equipment to use among a set of alternatives on a moment-to-moment basis. He arrives by way of biking, and then proceeds inside the building by way of walking, using the elevator, staircase, hallway or escalator. This selection of good enough or *appropriate equipment* has been a recurring theme throughout the empirical investigation, and it shows that the bicycle messenger does some sort of deliberate choosing of equipment for moving around. Another similar situation is seen when the bicycle messenger is roaming between biking in the street versus biking on the pavement. In some situations, he chooses to use the pavement instead of the road in order to facilitate moving swiftly and safely ahead towards the delivery site. In yet other situations, the bicycle messenger roams over to public transportation devices, such as the underground, then bringing the bicycle aboard.

The bicycle messenger's goal is to move towards a specific place, and he does this in various ways by selecting appropriate technologies. I am here interested in discussing the

selection process, i.e. the way in which the bicycle messenger engages with the various technologies and selects among the alternatives available to him. There are obviously many different reasons for selecting the equipment in question: personal preferences, effectiveness, efficiency, cost and so forth. I will not discuss or speculate upon the personal reasons for selecting equipment, but rather focus upon the observation that there is a selection process going on *in situ* among a number of options.

The observation that the bicycle messenger is selecting appropriate equipment is not limited to equipment for moving around. There is also a large variety of communications equipment. One condition for the possibility of picking up and delivering packets is that the bicycle messenger has information about the name and address of the companies requesting his courier service. There are also here various strategies or ways to reach this goal. The bicycle messenger actively selects among the various alternatives present to him on a moment-to-moment basis.

The mobile telephone and the radio equipment are the most frequently used communications channels for communicating with the dispatch center. However, in some situations, the bicycle messenger also uses a public telephone, or he borrows a telephone from one of his customers. In yet other situations, the bicycle messenger cycles in person to the dispatch center and receives the pick-up and delivery information on a sheet of paper or jots it down himself on a piece of paper. This illustrates that there is an ongoing selection process among various alternatives presented to the bicycle messenger.

The finding that will be discussed here is to what extent alternative equipment is visible to the bicycle messenger in a use situation. This is a contrary position to the view that the use of familiar technologies is a “blind” activity and that the equipment has disappeared and is invisible to the user.

8.2.2 Circumspective use – visible alternatives

I argue in this section that the use of equipment is guided by the sight of circumspection, and that this awareness makes it possible for the bicycle messenger to choose the

appropriate equipment required for the task at hand. In use situations when there is no explicit breakdown (equipment missing, faulty, or in the way), *alternative equipment is present and visible to the user by circumspection*. However, the equipment in use, and the alternative equipment for use, is not visible as external, isolated objects to the bicycle messenger. The equipment is visible *by an awareness that is always present*, and this awareness guides the selection process. Hence, the selection of appropriate equipment is not a blind activity where the equipment in use and the alternative equipment are invisible for the user. If the use of equipment were a “blind activity”, and the chosen and the alternative equipment were invisible for the user, how would it be possible to select equipment?

The use of equipment is guided by the goal of the activity, something that the user wants to achieve. This is called the “in-order-to” in the terminology of Heidegger (Heidegger, 1962). For example, we use pen and paper in-order-to write, footwear is used in-order-to keep warm and comfortable, a bicycle is used in-order-to move swiftly and lightly through the city, and a telephone is used in-order-to communicate with friends and colleagues. According to Heidegger, the use of equipment is primarily in-order-to achieve something (ibid).

The bicycle messengers use communication terminals and services in-order-to be in touch with the dispatcher and to exchange information pertaining to the pick up and delivery of packets. Hence, there is a linkage between the use of the equipment in any situation, and the in-order-to that the user is about to do or achieve. In addition, Heidegger adds that there is also a for-the-sake-of-which (Heidegger, 1962) that can be linked to the in-order-to. The bicycle is used in-order-to move through the city, for-the-sake-of being a bicycle messenger. This way of viewing the activity of use is fruitful for understanding the equipment and its use. When using everyday, familiar equipment like footwear, bicycles or mobile telephones, there is no explicit reflection upon the in-order-to and the for-the-sake-of-which. However, this does not mean that the activity is a blind one, nor does it mean that the equipment is invisible for the user.

When shifting from using one kind of technology to another for the purpose of the in-order-to, there is a selection process going on. In the previous section, we stated that the equipment withdraws into the enabling background together with other equipment (equipment nexus) and practices during everyday use. The sight that guides the use of the equipment is that of awareness or circumspection. If there were no “in-order-to” that were guiding the actions, the use of equipment could be described as a “blind” activity, where it was not possible to know what to do next. The argument here is that the activity of use is *not a blind activity*, and hence there is an active engagement in the use situation in order to select the appropriate equipment for proceeding in-order-to do the task at hand.

Another way of describing the in-order-to and the for-the-sake-of-which is to introduce the concept of *user need*. There are some inherent challenges of talking about needs in general and user needs in particular, since they are often found to be elusive and hard to define e.g. as described in Max Neef (Max-Neef, 1991) and later by Shneiderman (Shneiderman, 2002) and Rosenberg (Rosenberg, 2003). The dilemma is that what one person describes as a need might not be described as a need for another person since there are no fixed definitions, or general accepted notions of what constitutes a “need”. However, the ways we think about needs are important for the understanding of the use of technology. Max-Neef introduces the term “satisfiers” in order to make the connection between the need and the way in which the need is met. Rosenberg talks about separating the need from the strategy that is applied in order to meet that need. I argue that the perspective of separating a need from the ways in which the need is met is important for understanding the selection of appropriate technologies. This perspective suggests that a need is not linked to any specific technology or piece of equipment per se.

The way we think about user needs is at the core of understanding the use of equipment. I claim that to separate the user’s need from any specific technology is a fruitful way of addressing the relationship between needs and technology. By separating the two, we are in a better position to see and reflect upon the alternatives available, i.e. the alternative ways of getting the needs met. By the sight of circumspection, the bicycle messenger

selects among the various alternatives presented to him. The need for moving can be met by selecting the bicycle, elevator, footwear, pavement, public transportation and so forth. Correspondingly, the need for communicating can be met by using the mobile telephone, radio equipment or a paper record. Hence, with this perspective in mind, it does not make sense to state that the bicycle messenger needs a bicycle, a mobile telephone or any other equipment. It will make sense to state that these technologies are *potential ways of facilitating the process of getting the need for movement met*.

This separation between user needs and the way of meeting the needs is important, since it opens up the *consideration of alternatives*. In the case of bicycle messengers using the bicycle in-order-to move from a pick-up location to a delivery location, we can say that there is a need for movement present. *By separating the need from the way in which the need is met, it is possible to see the various alternatives that are present for getting the need met*. The bicycle messenger can meet his need by using the bicycle, footwear for walking, public transportation and many other possible alternatives. It is by circumspection that the bicycle messenger selects the appropriate equipment for the specific situation.

The selection of equipment for communicating over distances can be described in a similar manner of *user need* and *selection strategy*. In order to get information about a delivery job, the bicycle messenger has a need for communicating with the dispatcher. This need can be met by various strategies, e.g. involving the mobile telephone, pen and paper-based protocols, face-to-face communication and the open radio channel. *The selection of appropriate equipment for the situation is done by the bicycle messenger based upon his circumspection in the situation of use*. It is contingent, and decided on a moment-to-moment basis by the bicycle messenger.

With circumspection, the bicycle messengers have a kind of awareness of the situation, and by this awareness they are able to select the appropriate equipment for meeting the need. In the use situation when the equipment is ready-to-hand, the equipment in use is visible by the sight of circumspection. When there are multiple technologies available,

the question of which alternatives to select is also visible for the bicycle messenger. It is my claim that the selection is based upon an awareness of the alternatives available, and that this awareness emerges from the circumspective use that the bicycle messenger is engaged in.

The awareness of the in-order-to, and the underlying need the bicycle messenger is addressing, i.e. delivering a packet or communicating with others, guides the bicycle messenger in selecting the appropriate equipment. By being both aware of the need and the equipment available, the bicycle messenger is able to go about the work of selecting appropriate equipment in the situation without being disrupted.

The for-the-sake-of-which is also related to the selection of equipment. According to Heidegger, as referred by Dreyfus (Dreyfus, 1995), an activity can be purposive without the actor having in mind a purpose. In a skilled activity like biking, the biker does not require an explicit goal. Heidegger uses the term 'for-the-sake-of-which' to call attention to the way that an activity makes sense in the long run, i.e. a long-time perspective relative to a human lifespan. The bicycle messenger would not be a bicycle messenger if he had selected the automobile as equipment for moving around. Being a bicycle messenger, like being a father or being a teacher is not to be thought of as a specific goal that can be achieved. To be a bicycle messenger is more a self-interpretation that informs and guides the activity of moving around. In the terms of Heidegger, the use of the terms in-order-to and for-the-sake-of-which for a bicycle messenger could be something like: I move through the streets, with a bicycle, *in-order-to* deliver a packet, *for-the-sake-of* being a bicycle messenger.

This way of viewing the selection process is important for a proper understanding of the area of ubiquitous computing and HCI, since there are currently many different computing technologies available for addressing similar human needs. Furthermore, the conditions for the possibility of selecting computing and communication equipment has changed as many more alternatives are present today than ever before in the history of

HCI. With the concept circumspective use, it is possible to view and discuss the alternative strategies of meeting needs.

8.2.3 Comparison to related work – alternatives and selection

To consider all possible alternatives in carrying out a specific task is not what happens in actual decision making, according to March and Simon (March and Simon, 1958), since there are infinite possible alternatives in any situation. The term *bounded rationality* or *limited rationality* is applied by these authors in studying decision-making processes in organizations (Simon, 1997), where the individual actors have a *bounded* view of the potential alternatives. According to March and Simon, this is a characteristic of all decision making processes – decisions are made based upon a limited, or bounded view of the possible set of alternatives. “Most human decision making, whether individual or organizational, is concerned with the discovery and selection of satisfactory alternatives; only in exceptional cases is it concerned with the discovery and selection of optimal alternatives” (March and Simon, 1958). In other words, a criterion for decision making is “good enough” or “satisfying” in most cases. The word “satisfice” was coined by Simon (Simon, 1996) as a portmanteau of "satisfy" and "suffice", and he pointed out that the human being does not have the resources to maximize fully.

To make a decision involves making a choice from a number of possible alternatives for achieving a goal. The task of rational decision making is to select the alternatives that result in preferred consequences. Simon divides the decision making process into three steps: 1) identifying and listing all alternatives, 2) determining all of the consequences resulting from the alternatives and 3) comparing the accuracy and efficiency of the consequences. However, Simon notes that any individual or organization attempting to apply this model in a real situation would not be able to comply with the three steps completely. It is not only unlikely to be able to identify all the alternatives; it is even less likely to know all the consequences that follow from them.

What Simon proposes is that a human being striving for rationality assumes he can isolate from the rest of the world a closed system containing a limited number of variables and a

corresponding limited range of consequences. For measuring the correctness of decisions, two major criteria are used 1) the adequacy of achieving the desired objective and 2) the efficiency with which the result was obtained.

In the literature about problem solving and bounded rationality (Newell and Simon, 1972; Simon, 1996) Simon was not specifically interested in the day-to-day “use” of personal equipment, where choices are made on a moment-to-moment basis for what equipment to use. The *circumspective use perspective*, and the view of selecting alternative equipment by the sight of circumspection, is therefore different from the *bounded rationality* perspective. The bounded rationality perspective on decision making is a rationalistically motivated, albeit bounded, process where there is an ongoing cognitive process of *detached reflection* about alternatives and corresponding consequences. The circumspective use perspective, on the other hand, is about *awareness and comportment towards a situation*. The alternatives, and the consequences of the alternatives, are not listed and deliberated as explicit alternatives during the activity of use; they are seen with the sight of circumspection in the moment of use.

Gasser wrote an early contribution about computer-supported work (Gasser, 1986). He distinguishes between computing work and routine work. His starting point is that most computer work serves as resources or indirect tools to support other kinds of work. For example, to use a computer for communicating over a distance is conducted in order to exchange information with another person. The use of computers presumes the existence of other work, namely the *primary work* of the computer user. Hence, the use of computers is embedded in a context of many other tasks, where computing itself is usually a resource supporting the other tasks accordingly. Gasser introduced the notion of *computer work* and *articulation work* in addition to the primary work in order to discuss a new type of work based on computers in organizations.

According to Gasser, work is a contingent process. It is not possible to predict the entire range of contingencies that people in organizations encounter in daily work. When contingencies are faced, people use various strategies for addressing such situations.

Workarounds are one of the three strategies applied when faced with contingencies, in addition to the strategy of *fitting* and *augmentation* (Gasser, 1986). Working around means using a computer intentionally in ways for which it was not designed, or simply avoiding computers by *relying upon alternative means* of accomplishing work.

The way in which alternative technologies are visible for the user are not discussed explicitly by Gasser. Hence, the perspective on integrating computing work and routine work is not about the individual user and the ways in which the alternative equipment in a use situation is visible to him. In this respect, it differs from the perspective of circumspective use, since circumspective use is about a kind of awareness in the work situation involving the use of computers. Nevertheless, Gasser's work is an early contribution to describe the use of computers (in organizations), and largely provides similar perspectives to my own.

Shneiderman discusses his own use of computers, having found that it was easy to interpret the usage in terms of *satisfying his own needs* (Shneiderman, 2002). He states that he uses computers to support relationships with family, friends and colleagues, for example. He then discusses four basic needs, proposing a taxonomy of needs that the use of computers can support: gathering information, collaborating with colleagues, designing interfaces and distributing ideas. Later, he develops this into a process model: 1) collect information, 2) relate (communicate), 3) create (innovate) and 4) donate (dissemination). The challenge with any such design principles based on the underlying needs is that it is possible to propose and apply all sorts of principles because they are so general. For example, another person could say that the need is to calculate and simulate.

According to Max-Neef (Max-Neef, 1991), there is currently no generally accepted taxonomy of needs available, albeit there have been many attempts to develop one. However, it is possible to examine, observe and talk about human needs – without there being any agreed upon definition. By being engaged in exchanges about what the human needs are, and the possible strategies for getting the needs met, new alternatives emerge. The mere *awareness of needs* makes it possible to get to know alternative ways,

strategies or satisfiers that are selected to facilitate meeting the need. Therefore, the discussion that Schnederman is engaged in is important. Being open to the possibility of getting needs met in various ways, with various types of equipment, gives a sense of freedom to the user – the freedom to choose among the possible alternatives that a use situation opens up.

8.3 Use and the environment

In the first section, the human-equipment relationship was the object of investigation. In the second section, the focus was on the relationship between the user and the selection of alternative equipment. The focus for this section, the last, is the relationship between the user and the environment in which the use takes place.

There are indeed many notions to describe the environment of use, such as context, situation, circumstance, environment, setting and milieu. When the computer moves out of the office and desktops and into everyday life, questions about the situation of use come to the fore since the new environment is dynamic and interdependent with use.

8.3.1 Visibility of the situation

When a bicycle messenger is using the radio in-order-to communicate with the dispatcher, he is actively interacting with the microphone and the loudspeaker. Hence, the use of the mobile telephone can also be seen as the use of the microphone and the loudspeaker. These two components of the mobile device constitute parts of the user interface between the bicycle messenger and the terminal, and through these components the user is able to interact with the telecommunications services in question.

In the context of using mobile devices while moving around, I have observed situations in which bicycle messengers face challenges in using the telephone and radio for communication over distances. The user had to negotiate with the environment in order to be able to use the equipment purposefully. Some particular situations identified during my participant observation are of particular interest. These were presented as a list of ten use situations in the previous chapter.

If the bicycle messenger is not able to listen to the dispatcher because there is too much noise from the car traffic surrounding the biker, he takes appropriate action and moves to a place where it is possible to listen. In other words, the bicycle messenger becomes aware of parts of the use situation, i.e. the noise level surrounding his body. When the bicycle messenger is aware of this, he can actively position himself in a place more appropriate for continuing the communication with the dispatcher.

The finding pertaining to the visibility of the environment can be summarized as follows: The environment is seen during everyday use of equipment by bicycle messengers. The mobile telephone user positions himself as well as his equipment in relation to the air.

The apparently invisible air is thus seen through these everyday use situations and bicycle messengers have an awareness of ways to negotiate the relationships with the environment that are suitable for communicating over distances.

8.3.2 Circumspective use – the environment

The description in the previous chapter indicates that while using equipment, more than the equipment is seen by the user. Also, an aspect of the environment in which the equipment is used is present and visible for the user by the sight of circumspection. For example, to be aware of the air is important for the bicycle messenger, since it affects the use of the telecommunications equipment in various ways. When a bicycle messenger is in a noisy place, he needs to use the equipment in a way that enables him to communicate with the dispatcher and he might change the position of the equipment in relation to his body or moves to a place with less noise. Without this awareness, how could bicycle messengers manage to use the equipment while biking in the first place?

The human-equipment relation involves more than the human user and the equipment in use; it also involves the immediate environment. Using a mobile telephone, for example, always takes place in a specific setting, i.e. time and place. The characteristics of the place and time of use influences the use, and the use influences the place and time. When

the air is too polluted for the bicycle messenger to breathe and talk properly, he might move to a different area in order to breathe and use the radio, actively positioning himself in relation to the air.

Heidegger tells us that the user and world are not two separate and distinct entities but only one, resulting from the involvement in the world (Dreyfus, 1995; Heidegger, 1962). In the activity of using equipment, the user, the equipment and the environment of use are not three separate entities. By using equipment in-order-to do something, the *user is with the equipment in a specific environment*. This very being-with the equipment always involves being present somewhere, i.e. in an environment.

This involvement in the world is based upon the understanding of being “here”. This is challenging for a rational science, since we are very much used to separate the “self” and the “environment”, a separation that Heidegger argues is primordially not there while engaged in everyday activities. This separation is, however, valuable for analytical purposes and research, but Heidegger’s main point is that the primordial understanding of being-here involves no such distinction.

Being-in-the-world involves being in a specific place, together with relevant equipment and other people (Dreyfus, 1995). What does it then mean to be in a specific place? In what way can we describe the environment of use in which the bicycle messengers are present?

I argue in this section that the engaged use of equipment discloses something about the environment to the user of uttermost importance to him. The part of the environment that will be discussed is *the air*, and the way of observing and being aware of the air is through *circumspective use*. The bicycle messengers are on a moment-to-moment basis engaged with the equipment, and through circumspective use they adapt to the environment by taking corrective actions in-order-to deliver and pick up packets. When using mobile telephones while biking, a bicycle messenger’s awareness of the influence of air on his actions and goals is of crucial importance.

The air is disclosed to the bicycle messenger through the actual use of the mobile telephone, albeit not as an external object that is isolated from the bicycle messenger. Parts of the environment are disclosed to the bicycle messenger and this can be understood with the concept of circumspective use.

8.3.3 Comparison to related work – use situations

There is an increasing body of research describing and analyzing the context of use. Since any computer use is situated, it is challenging to present an accurate definition of what constitutes the context, or situation of use (Dahlbom and Mathiassen, 1993). The perspective of circumspective use presented above emphasizes that parts of the environment are disclosed for the user in the activity of use.

In her seminal book, and critique of the HCI field, “Plans and situated action; the problem of human machine communication”, Lucy Suchman, (Suchman, 1987), criticizes the “planning model” of human computer interaction. The planning model was the dominant way of thinking about interaction with computers originally proposed within AI. Instead of analyzing the exchanges between a single user and the machine according to a predefined plan or action sequence, she also investigated the exchanges taking place between users (in her case novice operators of photocopier machines). Traditionally within HCI, only the interaction between the user and the machine had been the object of study.

By empirically studying the user of photocopier machines, and the way of interacting with the machine, she made an important contribution to the social aspect of HCI by stressing that the *situation of use* has to be considered when investigating human – computer interactions. The ways human operators were talking together while using the copier machine were described and analyzed. The information that was shared between the operators and the information that was exchanged between the machine and the operators was analyzed thoroughly in this empirical study, and the finding was that the social aspect also matters. Suchman suggested that both the human exchange and the

exchange between the humans and the machine have to be considered in order to understand and make sense of the use situation.

The main question addressed by Suchman was whether during purposeful human actions with machines, does the plan comes first – or does the actual manipulation and *situated, contingent use* come first? She argues that any course of action depends upon the specific material and social circumstances of the situation, and not primarily upon a predefined plan. However, Suchman does not consider the physical or material environment of use explicitly. Her empirical study was conducted in a closed laboratory setting, and hence no real use situation was studied. She limited the description of situated actions to the exchanges between the users involved with the copy machine. This is different from the perspective of circumspective use. Circumspective use also describes the way users are, and become, aware of the physical environment, such as for example the air messengers interact with. Also, the technology investigated, referred to as intelligent copying machines (a kind of computer-controlled machine), is different from the mobile technologies studied in this thesis. The concept of circumspective use can be applied in order to investigate the parts of the environment that become visible for the user as a result of moving about, which was not discussed by Suchman.

Another influential ethnographic investigation about working with machines is “Talking about machines; an ethnography of a modern job” by Julian Orr (Orr, 1996). Orr has investigated and described the way field service technicians work when repairing and servicing copy machines. Also, the social environment of the repair personnel is investigated as part of the work that is being studied. This research addresses the way the technicians both interact with the machines by, for example, listening to the sound of the machine, but also the way technicians “talk about machines” with other technicians. The technicians share stories about specific machines, and are involved in a triangular relationship: technician, customer and machine. Hence, the work with the machine also involves work with other technicians and the customers.

Diagnosis of the faulty equipment is described as happening through a narrative process, and the outcome of this process is a coherent rational description of the troubled or faulty machine. One main point that is drawn from this is that the knowledge about the machines is a socially distributed resource that is primarily stored and diffused through an oral culture. The situation with the machine is hence extended also to include the social situation of use. However, the specific material or physical environment was not discussed. In this sense, it differs from the perspective of circumspective use, since circumspective use is also about the proximate, physical or material environment of the user; this is a dynamic context.

This perspective of “conversation with the material of a situation” (Schön, 1983) has been influential in order to describe and understand design processes from a language game perspective. By observing various design activities in design studios, Schön investigated the ways in which designers are in a “conversation” with the material of the situation. This can be described as using the materials of the situation with circumspection. He was inspired by, among others, Wittgenstein. Schön investigates the design process as such and not a use situation with equipment.

Agre discusses the “context of awareness in computing” (Agre, 2001a), by the notion of practices, architecture and institutions. The use of wireless information services, like the cellular telephone, is breaking down the traditional mapping between institutions and places according to Agre. Even though context has a physical, architectural aspect, most aspects of context are also defined in institutional terms.

Agre highlights that the use of computers is part of many human practices, involving various institutions. He discusses the context of use on a macro level, where the concept of the institution is central. The practice of visiting the theater, the institution of the theater, and the architecture of the theater is used as the main example for illustrating the interrelationship between practices, institutions and architecture. The use of the cell phone in a theater loosens the traditional mapping between activity and place. While visiting the theater, it is also possible to look up the latest sports results and talk with the

broker or attend a school meeting by way of a mobile device. This differs from the perspective of circumspective use, in that the circumspective use is a perspective for investigating and describing what parts of the external environment are visible for the actual user in the situation of use, with no explicit link to the institution hosting the activity. There is no link or reference to the architecture wherein the use takes place by the notion of circumspective use.

In order to observe and describe the situation of use, Winograd and Flores (Winograd and Flores, 1986) point towards the value of breakdown situations. When there is a breakdown, the situation of use is “lit up” so that the user, and the researcher, can see it more clearly. Whenever there is a breakdown, the *nexus of equipment is revealed to the user*, so that he is in a position to make appropriate actions in order to continue with and accomplish the given task.

According to Winograd and Flores, breakdowns cannot be avoided, but it is possible to be aware of them by designers and users. This is an important insight, especially for designers engaged in a conversation for possibilities for breakdowns to be avoided. In “non-breakdown” situations, according to Winograd and Flores, the user should operate and use the computer without being aware of formulating and giving commands (Winograd and Flores, 1986). For example, in the everyday use of a word processor, there is a network of equipment including arms and hands, a keyboard and other devices mediating between the words and the screen. According to Winograd and Flores, none of this equipment in use is present for the user while using it, except when there is a breakdown. If, for example, a letter fails to appear on the screen, the keyboard may emerge with the property “stuck keys”. In the non-breakdown situation, the network of objects and properties do not exist according to them. This way of interpreting readiness-to-hand is different from the perspective of circumspective use, where the equipment in use, the alternatives and the situation of use are there for the user to draw on. Even though the enabling background is taken for granted, it is there for the user by the sight of circumspection. Hence, the way Winograd and Flores describe non-breakdown situations or the ready-to-hand relation with equipment is different from the perspective of

circumspective use. Circumspective use is a kind of awareness while using equipment and this awareness is not limited to the specific equipment in use but also includes the environment of use. The awareness of the use situation is not on external, detached objects like in a breakdown situation, but on the contingent, unfolding situation of which the user is part.

Endsley (Endsley, 1995) uses the notion of “situational awareness”, based upon empirical findings from the activities in control rooms. This research is from the cognitive science tradition, and the work is oriented towards avoiding catastrophes while operating machines in a control room environment. The circumspective use perspective is different in that it is not limited to any specific use situation, and also does not regard the awareness of use as mainly a cognitive phenomenon.

In the research area of context aware computing (Moran and Dourish, 2001), the sensing and utilization of context information are important topics for “improving systems”. To use context information to facilitate and mediate communication between people is described as context-aware communication (Schilit et al., 2002). Information about the individual user’s location, environment and social situation can be used to initiate and facilitate the interaction between people. The classification into degree manual/autonomous context acquisition and the degree of manual/autonomous communication action are two important dimensions in context aware communication.

According to Schilit et al (Schilit et al., 2002), a goal of context-aware computing is a system that refuses to ring your phone at the opera unless it is the babysitter who is calling to say your kids just set the house on fire. While this can be a laudable goal for designing context-aware systems, it is also problematic. It assumes that the “context” of use is something that can be captured and stored by a computer, and then the context information can be utilized in order to facilitate “improved” performance. This view of the context is radically different from the perspective of circumspective use, in that in the latter it is *the user* who is *aware* of the situation or the context and not the machine, computer or sensors. When capturing “context” information and digitizing it, as proposed

in the context-aware computing area, this very action alters the situation for the user, and hence he is in a “new” context. The “context” that is captured, digitized and used by the computer is now part of the “new” context that the user is involved in, altering the user context as it were. Computers that “know where they are” (Weiser, 1991), or computers that are “aware” of the context is perhaps only semantics; and what is actually meant is something different. With accurate positioning systems and advanced sensor systems, computers can get input data about the location and environment, and this can indeed assist the user in getting to know where he is, and what actions are possible for him with the computer however.

8.4 Summary

This section has discussed three findings of my empirical research pertaining to the phenomenon of visibility in use. The argument is that through *circumspective use*, the user is aware of the relationship with the equipment in use, the alternative equipment and the environment.

First, the phenomenon of the human-equipment relationship was addressed with respect to the visibility of equipment. Then, the phenomenon of situations when users select among various equipment was discussed. Finally, the environment of use was discussed with respect to the visibility of the environment.

The concept of circumspective use goes beyond the dichotomy of “visible” and “invisible”. Circumspective use is a kind of awareness of the situation, based upon the primordial understanding of being “here” in the situation. Circumspective use is not something that is present sometimes and non-present others. Circumspection is the very condition for the comportment that users have towards the actual equipment in use, the alternative equipment and the environment.

We shape our dwellings, and afterwards our dwellings shape us.

-Winston Churchill

9 Limitations and directions for further work

In this chapter, the shortcomings and limitations of this study are outlined. Based on this, some suggestions for further work are proposed. It is also suggested that the concept of circumspection can be applied in order to inform design.

9.1 Limitations and shortcomings

This thesis is placed within the tradition of *interpretative studies*, and such studies have the character of propositions that need to be reinforced, modified and supplemented by additional studies. This case study was about a real-life setting, where the situations of use are uncontrollable, and hence cannot easily be reproduced as such.

The type of use that was investigated in this thesis is seen to have some *generic characteristics* as a use process. For example, the use of digital technologies outside the confined environment of the office or home, with multiple technologies in use simultaneously, is today more and more common. This points to the relevance of this study for the field of HCI, since the situation of use that has been examined is very much a real-world phenomenon. However, the activity of use can be interpreted in different ways, from different perspectives and each way might lead to different results.

One possible limitation regarding the general validity of the findings is the fact that the bicycle messengers are a “unique group of people”, different from all other users of mobile technology. Can we expect to find similar findings if other user groups had been chosen, or do the results obtained in this study have limited relevance to other groups? Various studies, of different user groups in different settings can be conducted in order to find out more about the generalizability of the results.

The main object of study has been the relation between the user and the equipment in use. In other words, it is a study on a *micro level*, where the unit of analysis is the individual user, the equipment in use and the situation of use. It could have been possible to study the relationship between the user and the equipment in use also on the meso level (community) and the macro level (society). The selection of the micro level can be seen as a limitation of the study, since organizational and societal characteristics are not discussed. If the relationship between the users and the equipment in use were studied from the perspective of the organization or from the perspective of the society, different results could emerge.

The interpretive study is based upon a *phenomenological attitude*, as described in the method chapter. Phenomenology is one of many perspectives within HCI that are applied in order to understand and make sense of use activities and use situations. However, there are other theoretical perspectives and theoretical traditions that could have been applied as well in order to investigate the phenomenon of human-equipment relations. Cognitive science and distributed cognition are two candidates for other theories, concepts and perspectives. Anthropology or ethnography also provides concepts that could provide new perspectives from which the phenomenon of use could be studied. Different findings and results would have emerged if these other perspectives had been applied.

The main method for studying the activity of use in this study has been *participant observation*. This is one way for getting data and information about the phenomenon of use. To the best of my knowledge, there are few instruments available for studying the phenomenon of real use, since use involves both human beings and equipment in an unpredictable environment (dynamic context). In addition, there are specific usability methods for investigating human computer interaction within laboratory settings as opposed to “in the wild”. If the study had been confined to the laboratory, again, different results could have emerged.

The results are not “final” in the sense that there is no more work to be done regarding the relationship between human users and equipment. For the three findings presented

and analyzed, there are possible ways to continue examining and exploring the phenomena even further. In the next section, some suggestions for further work are outlined.

9.2 Directions for further work

I believe that the *phenomenon of use* is an important phenomenon to study in the western world today for two reasons. *Firstly*, everyday life involves using equipment in order to work, play and live. Computer use is today not confined to the office or the research lab, but is increasingly part of the fabric of everyday life. This makes the study of use an important phenomenon in itself, since it is about our everyday activities.

Secondly, if we as researchers take the study of use seriously, I believe this can give us information for us to act upon, and make the world a better place. In this thesis, the case of bicycle messengers has been studied in order to understand some of the ways of being in relationship with equipment in situations of use. In addition, the research has pointed towards the way alternative equipment and the environment becomes visible to the user. I believe that if we conduct thorough investigations of use, *guided by the concept of circumspection*, this can foster a greater awareness of the various conditions, characteristics and consequences that the use of equipment has. When the use of technologies is studied in this way, it is seen that there is a reflexive relationship between human users and technology; we shape technologies and the technology shapes us.

Tailored studies of the environment of use as dynamic contexts are a possible direction for further work. Not only the digital environments that we are part of, but the “whole” environment in which digital technologies is used pose significant challenges. A growing awareness that the environment in which technologies are used is important in order to make sure sustainable development can be reached (Stuedahl et al., 2008). The concept of circumspective use can be applied in order to guide such future studies.

The distinction between “virtual worlds” and “real worlds” has been influential for understanding the use of computers. This dichotomy is important for analytical purposes, in order to understand what is going on while using digital technologies as opposed to non-digital technologies. The concept of circumspective use could be applied for a study of the ways in which users are in “both” these worlds simultaneously, with various technical support such as social software applications and mobile technologies. This is a direction I am pursuing in a current project.

Another direction for further work is to look closely at alternatives that we are facing in terms of selecting everyday familiar technologies. It seems that there is a tendency to think in terms of a direct link between technology and needs. For example, to think of “needing a car”, “needing a computer” or “needing a mobile telephone” illustrates a direct linkage between a need and a technology. There are other ways of thinking about the relationship between a human need and specific technologies, and further studies about ways of linking needs and technologies is an important way forward. The underlying assumption in this thesis is that there always are alternatives to choose from, and that the awareness of alternatives can be *cultivated by the sight of circumspection*.

One specific direction for further work is to investigate in more detail the everyday choices that are made, i.e. the multiple *ways in which specific equipment is selected*. For example, we could identify and list the strategies employed in everyday activities. The second finding of this thesis is to describe an awareness of alternative strategies as part of the everyday use of equipment. To actively search for perspectives and methods for “*everyday choices*” could be based upon the concept of circumspection and needs. Today, multiple technologies are available for communication between people over distances; this topic is of keen interest in the HCI and CSCW literature. When communicating, it is possible to use sms, e-mail, instant messaging, social software programs (e.g. Web 2.0) or face-to-face encounters, for example. Little is known about in what ways the various alternatives are actually selected and strategies employed for meeting the needs. The outcome of such a study could be heuristics and methods (e.g. design principles) for describing the phenomenon of selection of everyday, familiar equipment.

In my judgment, this study shows that the relationship with technology, as an object of study itself, is both possible and valuable. The consequences of making the relationship with technology into a separate object of study as a meeting place between digital environments and human activity can be further explored in many directions.

9.3 Implications for design

This thesis has not studied the process of design or the creation of services or new artifacts in particular. However, it is possible to make some suggestions about design based upon the findings about the phenomenon of use in this thesis. What possible implications does the perspective and concept of circumspective use have for the design of new services and artifacts?

To move from findings and discussions about use, towards implications for design is a problematic issue, as described by many such as Kluge (Kluge, 2005) and Dourish (Dourish, 2006). Furthermore Ackerman discusses the “social-technical gap” by pointing to a gap between technical reach in the design process and descriptions of technologies-in-practice (Ackerman, 2000). He draws attention to design as a bridge between the possibilities of technologies, and actual work practices. The suggested implications for design will be suggestions based upon an understanding of technological feasibility and of the practices of use.

Bratteteig (Bratteteig, 2003) discusses the relationship between design and use within the Scandinavian tradition. Systems development is based upon both an understanding of the materials of design and the activity of use, and the relationship between design and use. Grudin (Grudin, 1991) addresses three important contexts for systems development projects: competitively bid projects, commercial product projects, and in-house/custom projects. These three arenas for developing systems are different in many ways, and the characteristics and conditions for the various contexts and actors involved affect the design process. The relationship between the potential users and the developers are

indeed different if commercial products are to be developed compared to, for example, competitively bid projects.

What we are talking about when we discuss design indeed depends on the specific situation or context that we are in. Norman is “a champion of simplicity” and the principle of “less is more” and “less is better”. However, he also acknowledges that “simplicity is highly overrated” (Norman, 2007), since in the context of product development “creeping featurism” is an important phenomena to look for. Hence, within an academic context of design, the principle of “keep it simple” might be important, whereas in the context of product development, the opposite might be the guiding principle. Design principles and design implications are associated with specific development contexts, i.e. the type of development project as described by Grudin (Grudin, 1991).

The three research questions that were discussed in the previous chapter will be the basis of the suggestions for three design implications. Note that these will be “suggestions” based upon an understanding of the relationship between users and equipment in use as discussed in this thesis only.

9.3.1 Visibility of equipment

New ways of working grow out of old ones (Suchman, 1994). To develop and design new technologies is, in other words, also to design new ways of working. Within the Scandinavian tradition and the participatory design tradition, a basic understanding is that *users themselves should be actively involved in the design process*. The main recommendation from this thesis is to continue this way of approaching the design activity. The actual users of equipment are engaged in many kinds of relationships with the equipment in use, and they use the equipment with circumspection. In order for designers to learn about actual ways of working and using equipment, the voices of the actual users must be heard. A suggestion for one way to get information about the use of equipment “out in the wild” is discussed in (Herstad et al., 1999a).

The “non-users” of equipment is a term to describe people who are not actively using equipment themselves, but are affected by other people’s use of equipment (Stuedahl et al., 2002). The voices of the “non-users” are not easily heard in design processes, but with the concept of circumspection it is possible to also make the non-users’ voices heard. One implication for design is to make the non-users of equipment visible in the design process.

Today we inhabit digital environments, by way of using equipment like mobile telephones and web services. If guided by the principle of making computers “invisible”, we start to inhabit an environment that is not there for the user to see. Instead, if the design of digital environments is guided by the notion that computers are used with circumspection, this can foster *user control* and *feedback*.

User control and *feedback* have been central design principles within the HCI tradition, as promoted by, for example, Shneiderman (Shneiderman, 1992; Shneiderman, 1983). When hiding functionality or automating processes – the recommendation is to be aware of the implications this has for user control. Interviews and observations of the ways in which new “designs” in the form of prototypes are important ways to find out if the user is still experiencing user control while using equipment.

With the perspective of circumspection, the user is always in some sort of *control* while using equipment. He is in control in the situation of use by *circumspectively using the equipment on a moment-to-moment basis*. One possible implication for design is to promote the value of *feedback* between the equipment and the user. The relationship between the user and the equipment in use is an active one, where feedback from the equipment is central to the user.

An example will illustrate a specific kind of user control that is observed by users of telephones. When person A calls person B, person B uses the notification sound (ringing of the phone) in order to become aware of what is going on. Person B is guided by his circumspection and is now aware that there is another person, Person A, who is making

use of the telephone service in order to get in touch with him. By attending to the telephone bell, person B is then in a position to answer the telephone, and by this activity establishes a voice connection with Person A. Circumspective use is about what happens in between the user and the equipment during the activity of use; i.e. it is not happening “in the equipment” or “inside the user”. The *design awareness* that the use of, for example, telephone services is conducted with circumspection can lead to sensitivity towards facilitating telecommunications solutions that let people communicate over distances with user control.

“Human-to-Computer-to-Human Interactions” (Clubb, 2007) describes the new internet and mobile methods of communications between people, i.e. that users interact with computers in-order-to communicate with other users. Computer-telephony integration (Herstad et al., 1997) is an important area for HCI, and will probably continue to be so for the next few years as computers are used more and more in order to facilitate communications between people. With the concept of circumspective use, it is possible to investigate and learn from situations when users are both with computers and with other people.

9.3.2 Visibility of alternatives

Equipment is essentially something that is used in-order-to something, achieve something or meet some need. Equipment is always part of an equipmental nexus, and hence is not isolated and external in the use situation during actual, engaged use. This thesis has indicated that users select alternative equipment by the sight of circumspection. This very observation can be used for suggesting ways of how to approach the design of new technologies, which will be outlined below. Some concepts are presented in order to facilitate talking about the selection process.

Stationary and mobile

Human users are by nature mobile, i.e. we are bodies that move from place to place. This does of course not mean that we are always moving around; in some situations we sit still, and users can hence be described as temporarily stationary or fixed in a position

(e.g. standing still). The development of computers and wireless access networks makes computers and services accessible while human users are moving around. What is seen today is that often mobile technologies are also used while the human user is sitting still, at the office for example, even when there are fixed telephones available. It has always been possible to use a radio while sitting and standing still.

An implication for design based upon *circumspective selection of equipment* is that users will select stationary or mobile technologies based upon the availability of the technologies in the situation of use. There is interplay between the mobile terminals that users carry with them and the fixed terminals in the immediate environment. A *designer awareness* of this interplay between the use of fixed and mobile equipment is suggested. The principle of *seamless* integration has been used as a guideline for this in the past, but this has not focused explicitly upon the seams between the fixed and mobile technology.

An example will illustrate this implication. Imagine that you want to go to the other side of town while sitting at the office. From your stationary computer you look at the timetable for the train, and then move by foot towards the train station. While moving, you realize that you are late, and invoke your mobile telephone in order to continue the session with the train service that was started at the office. Then again when you are at the train station, you can use the stationary, fixed displays in the waiting room for continuing the session, i.e. session mobility (Thanh, 1997). Hence, a design recommendation is to look at ways in which mobile and stationary equipment can be used in concert in order to facilitate meeting the user's need for continuous access to information.

Needs – strategy

The separation between needs and strategies for meeting needs can also be viewed as a design guideline. By being aware of the needs in the situation, it is possible to open up the space of possible alternatives for meeting needs during the design process. An implication for design is to be aware of, and find ways to learn more about the needs that

you want to design for. It is recommended to separate descriptions of needs from strategies to meet those needs.

Again, it is important to be in contact with the users in order to learn about their needs. By being informed of users needs, it is possible to move towards various solutions and state appropriate requirements for those solutions.

Multifunction v.s single function

Computers in which various functions, services and applications are integrated can be described as *multifunctional devices*. The desktop computer and the mobile telephone can be described as a multifunctional device. As an alternative, *information appliances* (Bergman, 2000) is used as a term to describe dedicated terminals with fewer functions, perhaps only one main function.

The selection of alternative equipment is done with circumspection. By being aware that the user is making a moment-to-moment selection of equipment, the concept of *multifunctional devices* and *single function devices* can be important. Following this, the concept of *variant curtailment* can be applied in order to think about the number of variants of technologies available in a use situation.

9.3.3 Visibility of the environment

The use of equipment takes place in specific places and at specific times. In other words, use is situated. The third question pertaining to this thesis that has been discussed is about the ways in which the environment is visible to the user while using equipment.

The research area of contextual computing is geared towards extracting information about the environment in order to facilitate informed systems. To use sensors in the environment and make information about the environment available in the system is often motivated by the goal of improving usability and systems performance.

Information and communications technology can be used actively in order to make visible or to hide information about the environment for the user. An alternative to making active use of the context information in the computer is to make situational or context information visible to the user during actual use. Two examples are provided below.

When purchasing goods, some information is made available to the user by the agent that is offering the goods. With information and communications technology, it is possible to make additional information available to the user, for example information about what other people have purchased the same system, what materials compose the product, how it is distributed, the history of the product, etc. What is suggested here is a general awareness about the possibility of making information available about the products and services to a larger degree than was possible with non-digital techniques. Modern mobile telephony devices have tremendous potential for being designed into “environment probes and scanners” for learning about the environment of products for consumption, for example.

When driving a car and looking at the speedometer, the driver gets information about the speed of the vehicle in relation to the street. Other relevant information could be presented, such as the effects of use on the air, the noise level from the car etc. The principle of making information that is “there” but not seen explicitly by the user is an important endeavor. This information can guide users in making informed choices of what technologies to use and what technologies not to use.

Being aware that it is possible to make information about the environment of use visible to the user is important in order to *facilitate learning*. In the activity of using equipment, the various characteristics, conditions and consequences of use upon the environment can be made visible in various forms to the user. This information might be used circumspectively by the user in order to continue using the current equipment, or in order to search for alternatives (Mørch et al., 2006).

This suggestion for design is about making visible the effects of the use of alternative technologies. With the awareness that there are always alternative ways of meeting needs, the consequences of use upon the environment is of value. If you have a need to go somewhere, there is usually the choice of moving by way of public transportation, bicycle, automobile, footwear or barefoot. The information pertaining to the characteristics and consequences of each strategy for movement can be made visible to the end user in order for him to be informed and to then make his decision based upon this information.

The moon and sun are eternal travelers. Even the years wander on. A lifetime adrift in a boat, or in old age leading a tired horse into the years, every day is a journey, and the journey itself is home. From the earliest times there have always been some who perished along the road. Still I have always been drawn by wind-blown clouds into dreams of a lifetime of wandering.

-Basho

10 Conclusions

The relationship between users and equipment in use is the unit of study in this thesis. The thesis is developed by empirically investigating bicycle messengers work and theoretical reflections on the way of relating with equipment in use.

In this chapter, the main results from the study are summarized. This includes conclusions regarding the three research questions. Theoretical implications are suggested as propositions for perspectives on use.

10.1 A summary based on the research questions

Three research questions were raised in the beginning of this thesis. They concern (1) visibility of equipment in use, (2) visibility of alternative equipment, (3) visibility of the environment.

This thesis argues through empirical and theoretical justification that the use of equipment can be viewed as an *activity where equipment, alternatives and the surrounding situation are visible for the user*. This is contrary to the perspective mainly held in HCI and CSCW that the engaged use activity is a blind activity, where the equipment has disappeared and is invisible for the user during everyday use.

The general argument is that the use of equipment is *guided by the sight of circumspection*, and the entities concerning use are visible for the user during the activity

of use. However, it is not visible as an external and isolated object as is the case during breakdown situations (Winograd and Flores, 1986). It is visible as part of the situation of use, and this visibility enables the user to do what is appropriate in the situation.

10.1.1 Equipment

The key to understanding the everyday use of equipment is found by investigating actual situations of use carefully. To look closely at the context of use and the whole experience of using equipment is central when the aim is to understand use activities.

The first question that was raised and explored in this thesis is about the way of relating to specific equipment during everyday use:

In what way is the equipment in use visible or invisible for the user during everyday use?

One perspective on the activity of using equipment is that the equipment in use is either visible to the user (e.g. after breakdown situations or during deliberate analysis), or the equipment is invisible to the user (e.g. uninterrupted everyday activities, flow). This perspective is questioned in this thesis, and a different perspective is proposed based upon the findings from the empirical investigation and theoretical analysis.

As to the situations when there is a breakdown (e.g. equipment is faulty, missing or in the way), or during deliberate analysis (e.g. design or repair), the empirical study confirms that the equipment is visible as external, isolated objects. This supports the perspective first presented in (Winograd and Flores, 1986) to the field of HCI and CSCW. When the work is disrupted in some way, the equipment becomes visible as an object to the user, and deliberate actions can be taken in order to get back into the work activities. This is called *object visibility* in this thesis.

However, according to the empirical findings, during use situations when there is no breakdown, the equipment can also be visible to the user, albeit in a different way than

with object visibility. For example, when a bicycle messenger parks his bicycle outside an office building, and proceeds by walking inside the building, the bicycle and the equipment for walking are visible to him, without there being any disruption or breakdown. Instead of viewing equipment as either visible or invisible during actual use, I argue that the equipment is always visible by the *sight of circumspection*. This perspective on use is named *circumspective use*. This term is adopted from Heidegger (Heidegger, 1962).

During engaged use the equipment withdraws into the *enabling background* of the user. Although many researchers have pointed out that this withdrawing makes the equipment invisible to the user, I argue that it becomes visible through the sight of circumspection. I do agree that the equipment is not visible as an object to the user when it has withdrawn.

10.1.2 Alternatives

The key to understanding the way alternative equipment is selected is to investigate carefully the ways in which equipment is used in everyday use situations. When the aim is to understand the way in which the selection of equipment takes place, to look closely at the context of use and the whole experience in using equipment is central.

The second question that is addressed in this thesis is about the way alternative equipment becomes visible to the user.

In what way do alternatives become visible, and in what way is the selection of equipment for use carried out and managed?

The first research question pointed towards a kind of visibility of equipment through circumspective use, and this visibility is also valid for the alternatives available for the user. The alternative equipment is not present for the user as external, isolated objects, but the *alternatives are present and hence visible to the user by the sight of circumspection*.

By investigating use situations, when the users are actively selecting equipment in-order-to do specific tasks, it is seen that the selection of equipment is guided by the sight of circumspection, i.e. awareness in the situation. The user has an awareness of the equipment in use, the alternative equipment and the in-order-to that he is engaged in. By this awareness, the user is able to select the appropriate equipment in the situation. Hence, the alternative equipment is not invisible to the user, but visible by the sight of circumspection.

10.1.3 Situation

The key to understanding the way the situation is present for the user is to investigate carefully the use situation. When the aim is to understand how the situation or the environment is seen by the user, it is central to look closely at the whole experience and the context of using equipment.

The third question that is explored in the thesis is about the way the situation, environment or the context of use is made visible for the user.

During engaged use of equipment, what aspect of the situation is visible to the user?

The actual use of equipment makes parts of the environment visible to the user. This is empirically investigated by looking closely into the ways in which mobile technologies are used by the bicycle messengers. By talking and listening via the radio or the mobile telephone, the bicycle messengers are actively “negotiating with the environment”. The way the environment is consulted is not in a detached, reflective mode, but through circumspective use. By circumspective use, parts of the environment become visible to the user, and this visibility enables the user to take the appropriate actions in order to proceed with the activity.

The environment is disclosed through the use activity, so that it is there for the users to act upon. The process of disclosing can be explained with the notion of *circumspection*, i.e. a kind of awareness in use.

10.2 Theoretical propositions

Circumspection is a theoretical concept that is adopted from Heidegger in order to describe the structure of the ready-to-hand. Hence, it is not a new concept as such, but it is a concept from philosophical inquiries into ways of being-in-the-world. It is a new concept from an HCI point of view and it builds on and extends previous work in this tradition.

Circumspection is proposed as a concept that can be used as a perspective for understanding and making sense of the use of equipment. Instead of viewing equipment as either “visible” or “invisible”, the perspective of circumspective use opens up the possibility of *degrees of awareness in use*. To avoid the complexity of enumerating the multiple, intermediate positions between “visible” and “invisible”, the activity of use can be described as a relationship between the user and the equipment in use where the user is always aware of the equipment in use. This awareness is not something that is present sometimes and not present other times; it is always there to various degrees.

Circumspective use covers the type of use activity that is called everyday use. Within phenomenological writings in HCI and CSCW, there is a distinction between “everyday use situations” and “breakdown situations”. However, when investigating actual use situations that bicycle messengers are engaged in, it is not always clear how to characterize the use situation as either an “everyday use situation” or a “breakdown situation”. More often than not, there is *an ongoing, moment-to-moment negotiation with equipment in use, alternative equipment and the environment* that takes place in-order-to proceed with the activity. What one person experiences as a disruption or a breakdown might not be experienced as a breakdown by another user; hence the distinction between “everyday use situations” and “breakdown situation” is contingent.

The perspective of circumspective use is applicable for investigating any use situation, without invoking the categories of “breakdown” and “everyday use”. By applying the concept of *circumspective use*, the situation can be analyzed in more nuanced terms regarding what awareness the user has of the equipment in use, alternatives and the environment in any given situation.

Based on this, the thesis suggests viewing HCI as a relational science neither focusing upon the user nor focusing upon the equipment, but focusing upon the actual and enacted relationship in between the two. This suggests a shift of perspective away from both *user-centered* science and *technology-centered* science towards a *relationship-centered* science. In other words, HCI as a relational science.

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