Mobile information systems

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Abstract

This essay aims to analyze what significance mobility and mobile information systems have in respect to three aspects: work, communities and the individual. The aspect of work is discussed in two context: mobile action that information technology supports and mobile working in organizations.

Working environment where the intensity of mobility is high sets special requirements to the technology. For example, mobile field or service work has characteristics not present in office work. The technology supporting mobile action can't be designed with the same principles than stationary technology. Need for new interaction styles and context-aware applications are a challenge to information systems development.

Challenges are encountered also in organizations, as mobile technologies enables new ways of working. Mobility supports co-operation of members of organizations, helping to build up professional and social communities. Mobile workers may be categorized to consultants, inspectors and managers, and their tasks typically involve contacting colleagues, participating meetings, managing documents and retrieving information.

Mobile telematics has impact on society in municipal and state level. It also enables free-form mobile communities to born and act. By connecting people, mobile telematics may enhance democracy, but problems arise also. Possibilities lay in mobile teleservices that could be provided to citizens by society.

New technologies may accompany a change in humanity. No real answer exists to the question how the work and community aspects of mobile computing will influence on the individual's life. Mobile technologies have already affected the ways we socialize, but that is not all about the relationship between people and technology.

Content

1   Introduction

In recent years, much attention has been paid to mobile computing within IT industry. Successful mobile IT has been developed including mobile phones, PDAs (Personal Digital Assistants), communicators, and wearable computers. Mobility has been denoted as a whole new computational paradigm, in which processes migrate with users (Dearle 1998). Following the Internet revolution has even been said to be the wireless revolution (Hjelm 2000).
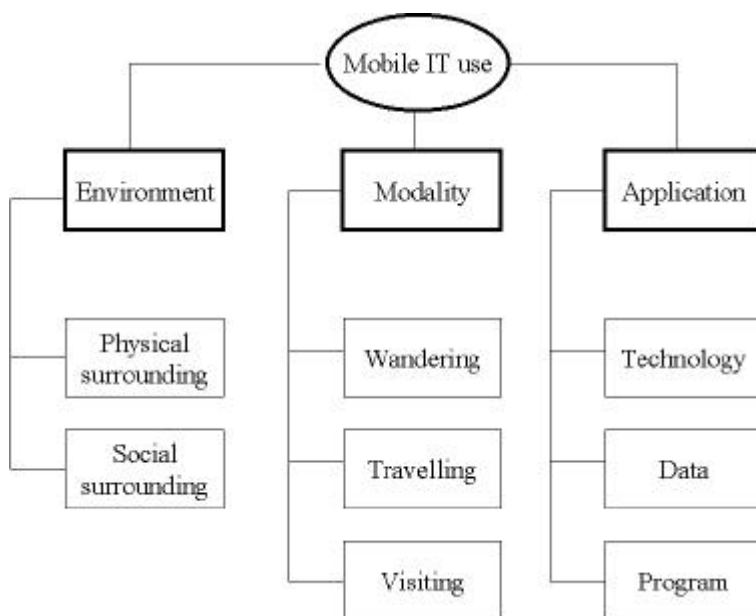
Kristoffersen & Ljungberg (2000) give several explanations on why mobility and mobile computing have increased. According to them, the reasons can be found from *society*, *organizations* and *tools*. The basic feature of modern societies is mobility – fifty years ago most people never left their hometown. In the context of organizations, one major reason to mobility is that most work in the modern corporation is becoming increasingly cooperative. Previously the organizational form was commonly bureaucracy that didn't promote cooperation. Another important factor is the emergence of service work as the main occupation in western society. As manufacturing takes place where the plant and equipment are located, a service encounter takes place where the customer is, which may differ over time. Yet another explanation is adoption of mobile phones, which are designed to enable people to be mobile without being disconnected. This has made new ways of working possible in many organizations.

1.1   Mobile informatics

Most of the research in the mobile IT field has so far focused on wireless communication and data processing technologies. The most fundamental attempts to conceptualize mobility in a larger sense has been carried out in Swedish Viktoria Institute. They have introduced a discipline called mobile informatics[1], a theory of mobile IT use (Dahlbom & Ljungberg 1998). Within mobile informatics, a reference model of mobile IT use has been developed to provide designers with a framework of concepts to understand how

[1] Informatics is study of information technology use, having the ambition to come up with new ideas of the use of IT (Dahlbom 1996). Departments of information processing sciences in Sweden has commonly changed their names to informatics.

people use IT in mobile settings (picture 1). In particular, the model reflects the ways in which using IT in mobile setting differs from using IT in stationary settings (Kristoffersen & Ljungberg 2000). The concerns in the model are environment, modality and application of mobile IT use, each of them having further details.

Picture 1. Reference model of mobile informatics (Kristoffersen & Ljungberg 2000).

The model in the picture 1 insists some ambiguity, because unlike the three modality boxes, the boxes under 'Environment' and 'Application' present dimensions rather than subcategories. The model also misses the element of intention, or working function of the mobile worker, yet the authors mention also that in their text. The most critical parts of the model in respect to mobility – and thus the key areas when considering how mobile and stationary use of IT differ – are physical surrounding, three modalities, and technology. The physical environment imposes important constraints of the mobile use situations where the surroundings are often not configured for IT use. Modality on its behalf is something typical to mobile use only. Finally, mobile technology is characterized by several constraints, which complicate both design and use of mobile information systems: limited computational resources; inherent vulnerability to security hazard, loss or damage; connectivity being highly variable in performance and reliability; and finite energy source.

1.2   Types of mobility

Mobile informatics distinguishes the types of mobility according to modalities: *wandering*, *travelling*, and *visiting* (Kristoffersen & Ljungberg 2000). Wandering means an activity characterized by extensive local mobility, e.g. an IT-support person spending a considerable part of her/his working day wandering around the building. Travelling is an activity that takes place while traveling in a vehicle, e.g. commuting. Visiting is an activity that happens in one place for a coherent but temporal period of time. An example would be a consultant who stays in a customer organization for a couple of days, before leaving to the next station. Typical technologies used in the different modalities vary. When wandering, one have no desk etc. where to put a machine, so handheld device is required. When travelling, some kind of surface commonly exist, at least one's lap, so also portable devices may be suitable. Visiting is the least restrictive modality, because a desktop computer may be used, too.

The modality-based categorization captures the intensity of mobility differentiating between highly or slightly mobile and stationary work; true, 'travelling' can be considered as bare transposition rather than a mobile work setting. This categorization is related to the degree of resilience with which a computer device can or need to be moved around with the user. A type of mobility hence mirrors how *terminal mobility* is added to *personal mobility.* Including even use of stationary technology within the concept of mobility, the view of mobile informatics is quite broad-minded. A stricter interpretation of mobility has e.g. Hjelm (2000), who states "laptops are not mobile". According to him, the criterion for true mobility is the capability to fluently use a computer without disrupting one's current activity.

Another useful classification might be between *local*, *regional* and *global* mobility (Kristoffersen et al 1998). This captures the range of mobile workers, which is meaningful when considering mobile communication issues.

1.3   Nomadic, ubiquitous, and invisible computing

Sometimes mobility entails nomadic computing, which according to Li & Leung (1997) means the ability of a user to access a user-defined set of subscribed services from any

currently available networked terminal, be it fixed or mobile, irrespective of geographical location. So, in terms of nomadicity, only personal mobility is relevant and terminal not. In the next chapter, some domains are presented where terminal mobility or move-ability is a basic requirement for work. Nomadic computing, however, aims to provide the user a consistent working environment with access to her/his usual resources anywhere and at any time. Such an environment has been called 'ubiquitous computing' first by Mark Weiser. He defines ubiquitous computing as enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user (Weiser 1993). According to Donald Norman, the method for invisibility is 'information appliances', tools designed to perform a specific activity, capable to share information among peers (Norman 1999). In words of him, the essence of the information appliance is feeling like a tool would be a natural extension of both the work and the person.

An example of a mobile information appliance is the "lovegetty" which, so they say, has became very popular in Japan. The device helps you find company. There is one kind for boys, another for girls. The device has three buttons, which specify in which ways you want to interact with others; do you want to have cup of coffee, go to the karaoke bar, or meet a partner. You turn on the lovegetty, press the desired button, and do what you ever want. If you meet someone that has the same preferences set, the device notifies you. This example, even if not very serious, proposes extreme task-specificity as the solution for mobile usability.

1.4   Our point of departure

In this essay, our aim is to work out how mobility and mobile information systems are dealt with in the current IS literature. Based on themes found during our literature survey, we ended up to focus on the question, what significance mobility and mobile information systems has in respect to work, communities and the individual. We were particularly interested in the prospect that mobility would mean something new to traditional information systems thinking.

The structure of this text conforms to our three themes. Mobile work is considered in the chapter 2 in the sense what requirements mobile work environment sets for IT us-

age. In the chapter 3, mobile work is examined in the organizational level. Organizational aspects of the chapter 3 are closely related to mobile communities and information society, which are discussed in the chapter 4. Then the status of the individual in the mobile world is weighted in the chapter 5. Finally, some discussion about our findings is presented in the last chapter.

2   Mobile action

Terms 'mobile information systems' and 'mobile work' are sometimes used more like as synonyms for portable offices and telework, respectively, meaning nothing more than using normal working equipment somewhere else than in the conventional office environment. For example, the definition of Puuronen & Savolainen (1997) for 'mobile executives' is that "executives are considered to be travelling or mobile when they are performing their duties outside their permanent office building". Higa & Wijayanayake (1998) define 'mobile worker' as "a worker who works at a customer's site or some other location chosen by him/her. Further, he/she works outside of the office three days or more per week. […]" These definitions are consistent with the travelling and visiting modalities described in the chapter 1, and the technology used in such settings is portable or stationary rather than mobile.

This chapter focuses the wandering-type mobility, that which Hjelm (2000) would say to be the "real" mobility. The section 2.1 describes settings of mobile work. The section 2.2 introduces some means for enabling mobile usage of information technology. The section 2.3 contains some discussion about information that supports mobility.

2.1   Settings of mobile work

In working environments where intensity of mobility is high, the requirements for IT usage are radically different from those for the portable offices. A representative example of highly mobile work is fieldwork, such as ecological and archaeological, researched e.g. Pascoe et al (1998). According to them, fieldwork in its most common form aims to record data about the environment that the user is exploring, implying the following characteristics for mobile usage:

- The fieldworker such as a giraffe observer will want to collect data whenever and wherever despite of whether there are any chairs or desks nearby, and whether they are standing, crawling, or walking.
- The user needs to spend as much time as possible in observing the subject, e.g. giraffe behavior, and to minimize the time devoted to interacting with the recording mechanism.
- During spurts of activity of the subjects, high volumes of data need to be entered very quickly and accurately.
- The users' activities are associated with their context such as location.

The first item in the list above entails that the hands of the fieldworker are often reserved to other purposes than interacting with the computer, e.g. holding instruments such as binoculars. Further, Kristoffersen & Ljungberg (1999) complement the characterization above with the notion that the task of the mobile user is often "outside" the computer – e.g. that of a maintenance worker of a energy company who is implementing new equipment in the field – as opposed to office work with tasks often "inside" the computer, e.g. manipulating a spreadsheet of writing a document.

2.2   Enabling mobility

Today's computers are designed on the premises of direct manipulation, with files and folders, drag and drop, and so on. Direct manipulation is an interaction style that demands high degree of visual attention of the user in respect to the virtual world inside of the computer. This is not suitable in the intensive mobile usage environment where interaction requires *indirect manipulation*. Experiments of indirect interaction style have been done with systems that need no visual attention of the user. An example of such system relies on only four buttons for user input and hands free audio for feedback. (Kristoffersen & Ljungberg 1999.)

Except usability, a reason for the demand for new interaction styles is the relatively low performance and bandwidth of mobile technologies in respect to fixed computing environment. So far those are not sufficient to state-of-the-art desktop applications. (Kristoffersen et al 1998a.)

Design of mobile applications often aims to *context-awareness*, the ability of application to extract, interpret and use situational information and adapt functionality to the current context of use. Examples of context information are (Korkea-aho 2000):

- Identity
- Spatial information (location, orientation, speed, acceleration)
- Temporal information (time of the day, date, season of the year)
- Environmental information (temperature, air quality, light or noise level)
- Social situation (who you are with, people that are nearby)
- Resources that are nearby (accessible device and hosts)
- Availability of resources (battery, display, network, bandwidth)
- Physiological measurements (blood pressure, hart rate, respiration rate, muscle activity, tone of voice)
- Activity (talking, reading, walking, running)

- Schedules and agendas

2.3   Information in support of action

Information systems deal with data that has organizational meaning – organization's universe of discourse. For example, the universe of discourse, or "the subject world" (Jarke et al 1992) for a banking system consists of customers, accounts, transactions, balances, interests rates and the like. The processes for organizational meaning have been worked out by Checkland & Howell (1998), from who is the title of this section borrowed. The picture 2 shows their model (the POM model), where individuals and group members perceive the data-rich wold selectively through their various taken-as-given assumptions. For the acquired perceptions, meanings are created inter-subjectively through the organizational discourse, yielding information and knowledge. Meanings then lead to assemblies of related meanings, intentions and accommodations between conflicting interests. Based on those assemblies, purposeful action is taken. The role of IT-based information systems is to support these organizational processes.
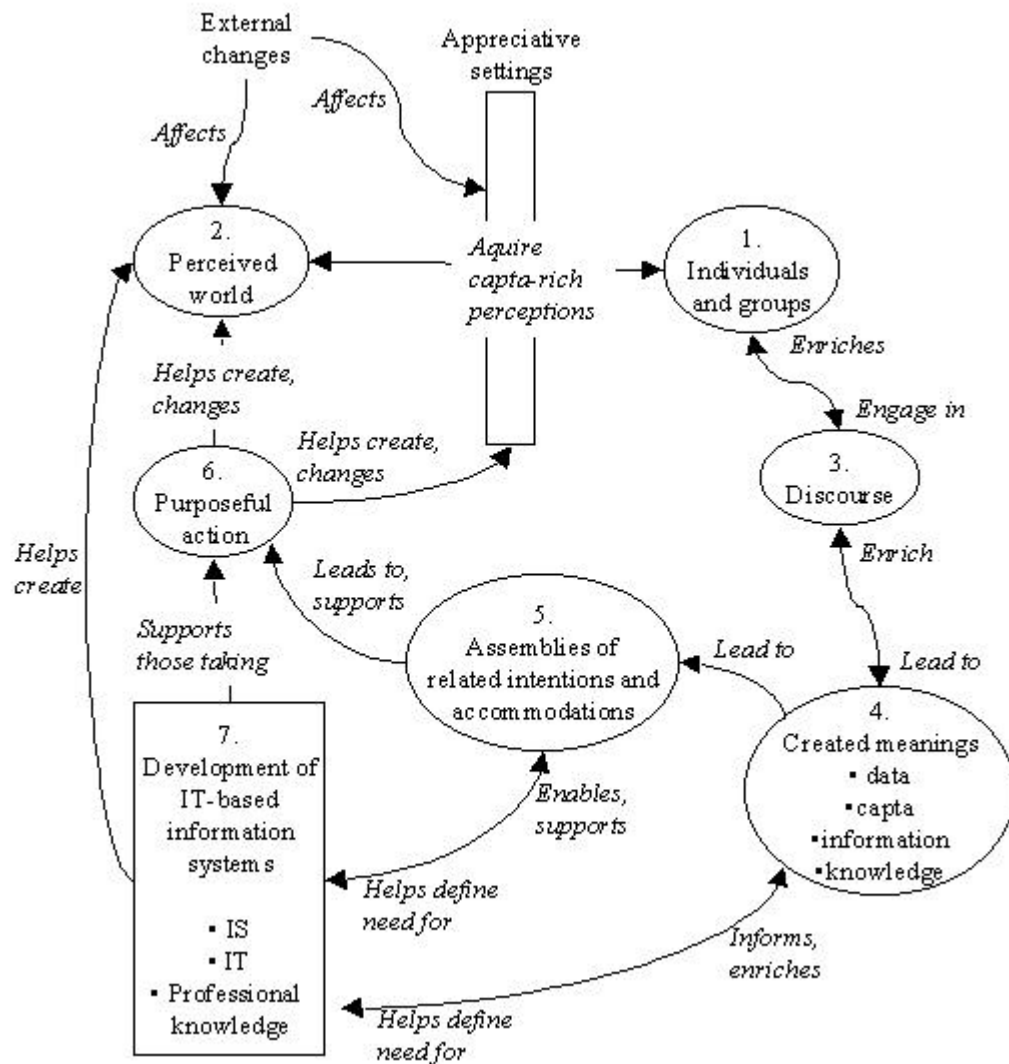
Picture 2. Processes for organizational meaning (Checkland & Howell 1998).

The element 2 in the picture 2 presents the perceived world consisting of data objects that are observed and manipulated by people performing purposeful actions and maintained by the information system. This is the case of traditional information systems. When information systems change from stationary to mobile, however, they can't be developed based on the organizational universe of discourse only due to the need for *situational information*. If imaging the work of ecologist, a piece of data such as "the mother giraffe bites 6 mouthfuls off acasia" belongs to surely different category than "while observing the giraffe family, the ecologist is intruding through a bushes with a telescope on the right hand and a PDA on the left hand". Both of the facts have meaning for development of the IT-based information system, yet the user is recording only the former.

Especially in the case of mobile context-aware applications, where situational information (e.g. location, temperature, presence of people) is processed by the system, the world of situational data consists a universe of its own, separate from the subject world. Information based on this world is not directly of organizational interest but for enhancing usability, thus involved in the support of the organization's purposeful action. The processes for organizational meaning are now partly double as shown in the picture 3 (elements 2, 3, 4 and 5).
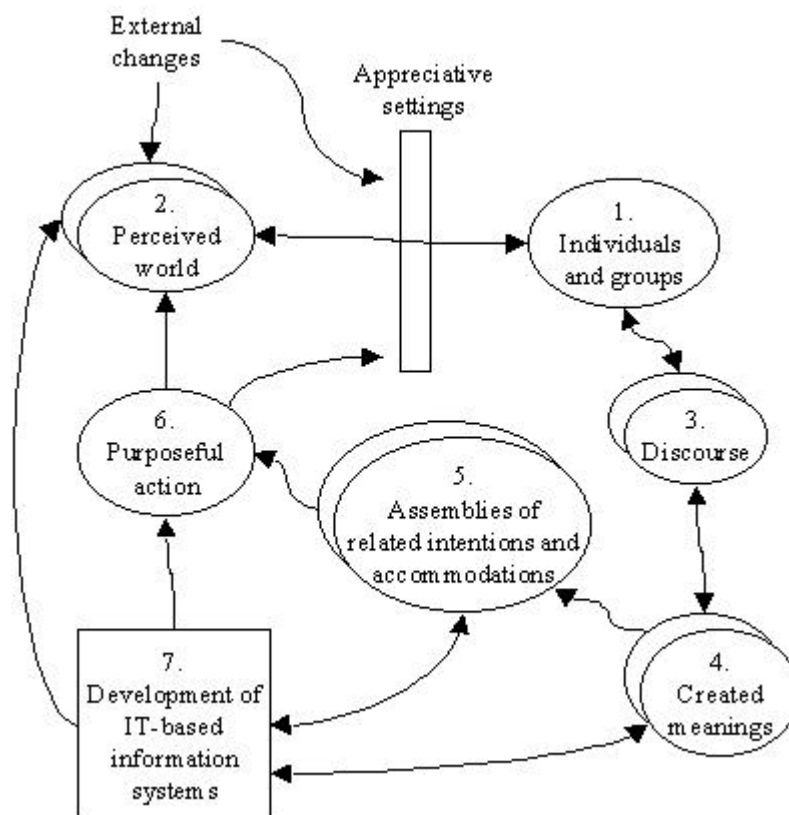
Picture 3. Processes for organizational meaning, when two perceived worlds exist. Based on Checkland & Howell (1998).

Jameson (2001) extracts four types of context- and user-related information relevant to adaptation of context-aware systems: information about the environment such as the user's location, the user's current cognitive and psychological state, the user's behavior with the system, and longer-term user properties. The last type of information includes

the user's objective personal properties, level of knowledge of particular topics, level of interest in particular topics, and perceptual and motor skills and limitations. Taking account of such kind of aspects surely sets challenges to information systems development. How does, for example, current methods support presenting geographical information? Professional knowledge demanded in mobile information systems development is not just technological.

3 Mobile work in organizations

In this chapter we will present generally changed situation in the work life focused on specific cases: where and when it is possible to work in generally. In this chapter we will present the concept 'mobile work' in several different views, what it means to individuals and the community or the society. We do not focus on mobile work technology specifically. In chapter 3.1 we will discuss a bit what kind of challenges mobile work will bring to us. In chapter 3.2 we will present the social aspects of mobile work. Additionally in chapter 3.3 there is a example case of journalist mobile work. In chapter 3.4 we try to find actors and features of mobile work. In chapter 3.5 we will present a though "anytime, anywhere". At the end of this chapter we summarize the concept mobile work; when it is possible and when it is not.

3.1 New challenges in work

According Kammer et al modern business model demand specific, new relationship to work. Specifically in Information Technology (IT) fast reaction to new challenges is very important. Accommodate to changing conditions and new technology and environment might need to abandon traditional work model or at least develop it to meet better new environment needs.

Special situations management will come along a very important part of development and on the other hand surviving. Special situations might composed e.g. following reasons: inconsistent data, very different tasks on current environment and work model, unexpected happenings and unexpected changes in work environment (Kammer et al).

Work models and procedures development and optimization might leads to very consequential changes but You must to be ready for these changes. At least You need to have a plan for these kind of new circumstances. The traditional model is very tight and inflexible and it might caused even impossible special situations management and/or fast reaction of these new circumstance (Kammer et al).

Changes naturally varies in different tasks and field of activities. There is no common suitable model for all situations. Rather we could say that accommodate to new situa-

tions fast and creatively, being flexible and willing to learn new things we could presumable benefit mostly e.g. new and developing technology (Kammer et al).

One of these new situations concerns work. New and very advanced technology makes possible to differ from traditional work model. 'Mobile work' does not bindd work to specific time or place. It like gives opportunity to work where it is reasonable and gives most profit; out of office, visiting client, exhibition, conference, home of people who needs caring of service or e.g. during way to work or in home.

According Chlamtac et al (1998) changes in work environment makes people to change their habits to work. Organizations have noticed that workers do not sit and stay in office to be productive. As a matter in mobility has been noticed to improve productivity and customer satisfaction. When realizing this new opportunity organizations have improved mobilization enabled solutions in their core networks and integrate those solutions as seamless as possible.

3.2   Social aspects of mobile work

Mobile work means that work is possible independent of specific place using information and telecommunication technology (ICT). Most surveys concerning mobile work have concentrated very tight on technology, usability or realibility. Mobile workers specifically have investigated quite little. Also an interesting survey target is how they work together and how ICT support their work and activities. Co-operation itself is not very important as a method to reach the goal; it is an important part on human beings normal social life. Human beings converse with each other and are usually social in their work and this seems to be the wanted way e.g. regardless of traveling (Bergqvist & Dahlberg 1999).

The mobilization of work cause changes in communities for both professional and social aspects. Additionally the mobilization of work bring new challenges to solve; how to share information, how to manage common general meetings, how to learn and maintain organization general norms and values? How to become a team or a community? Technology enabled certain phone or video conference, common document shar-

ing and reviews geographically different places but these fascinating features does not – at least so far- could not replace personal meetings (Bergqvist & Dahlberg).

It is very interesting to see, if there groves a new 'net generation' which does not need personal meetings or social contacts anymore or at least as much as nowadays workers do.

According Bergqvist & Dahlberg the social aspect of work and/or approach will cover a view of individual in professionally and socially. Thinking professionally important question is how to share information (explicit and tacit) and how the professional identity will grow up and how to maintain professional ethics. Thinking socially important question is how to become a member of group and how to build and maintain work communities.

Build-up the community in mobile environment

- How communities composed in mobile work environment?
- What means to the new member of the team to be socially accepted, can technology help?
- How people behave in new environment?
- How the interaction between the others will be handled in mobile environment and what is the role of technology?
- How the leaders will be elected?

Co-operations and information sharing

- How to create natural model for learning from colleagues?
- How to create happenings in where people can share and change experiences?
- How to create opportunities to tacit information sharing or communication?

Process optimization versus isolation and control

- How to organize co-operation
- How to plan reasonable and fair bonus systems?

3.3 Journalist mobile work

According Fagrell et al many happenings are specially and unique in certain way; they are not repeatable as such and they are not have been able to forecast. Making news and information spreading from this kind of happenings are very challenging task. Environment and specially the current situation make it challenging because it usually happens somewhere else than a studio. Usually there are colleagues and other specialists available in a studio ready to help and support e.g. sharing their information and knowledge. In fieldconditions situation is a bit different, support is not necessarily available at the very specific moment.   In the below there are few task which are important to take care to make sure of success:

- Collective: work is usually to collect things and put them together, discussions and co-operation with other people.
- Questions: one very important goal of work is to find the right context to issues.
- Time-dependent: making news and news generally cannot postbone.
- Unrepeatable: many issues happen and can be done only once.

NewsMate has developed as a prototype basis on earlier experiences. System architecture basis on client/server model. There are several kind of clients suitable for different terminals and situations. Terminals can be e.g. PC and Personal Digital Assistant (PDA) which can be used in outdoor mobile work. User Interface (UI) has same functionality in all environment and terminals. Limitations in usage caused at least currently technology because some things do not work well nowadays in mobile environment where current network and terminals capabilities are limiting factors.

The User Interface

Picture 4. A sketch of the principles for the user interface (Fagrell et al).

This kind of approach and new prototype (NewsMate) support well e.g. journalists mobile work. There will be short presentations of most important aspects:

Co-operation and support of other specialists is very important in journalists work. Earlier this kind of co-operation has not been possible – at least in this kind of shape and scale what current and new technology will provide. Knowledge center and specialists location is not so important than before and additionally the nature of speciality has changed. A specialist usually predict coming circumstances to generating and providing suitable open questions to suitable context. Additionally suitable background work is needed and it should be timing correctly.

Journalist connection to each other without dependence of time and place: A big part of total work will be done by integrating mobile and office work.

Provide general overview of current and earlier activities: general overview such as be aware what other has done is very important. Checking of different tasks and backgrounds from history-data (databases or diaries) is essential part of journalist work.

Use of electronic diary has been investigated during to co-operation and information sharing.

3.4 Actors and features of mobile work

Mobile work has certain specific benefits that traditional work model does not have. Work is not any more tight in specific place (a office) e.g. it is possible to use one's own organization information systems during visiting a client. It is a markable benefit e.g. in problem solving, productivity and quality of service.

As Kristoffersen et al (1998b) states mobile work can be categorized in certain roles or categories according work itself. There will be short presentations of some categories and criteria belongs to those categories:

- Consultants: usually travel a lot; different kind of happenings, conferences, exhibitions or visiting customers. Special needs could be named connects to one's own organization local network without dependency of current location.
- Inspectors: special case oilplatform. In very difficult and demanding circumstances on-line connection e.g. own organization server for checking, updating or retrieving information.
- Managers: travel a lot and thus are not usually in office. Despite of that the need of regular contact e.g. head office and possibility to access certain minutes and documents and/or even share them during meeting is essential demand.

Generally following actors are integrated those requirements:
- Contact to colleagues for getting and having information
This need could be continuing or temporal, fundamental is that when contact is needed it can be created seamless.
- Participating meetings
Possibility to participate meetings is extremely important also in case the physical presence is impossible.

- Documents (provide, retrieve, share)

Customer meetings minutes and documents should be possible to share in one's own organization very quickly and reaction of decisions made in those meetings could be the very basic part of fertile co-operation.

- Access to net (WWW) and/or databases for retrieving information

In service industry specially installation or maintenance person it is important to have opportunity to access own organization net or internet to retrieve missing or new software components.

Criteria for success in mobile work:

- It must be able to work with connect or without connect
- All devices in system must share the same information. Information synchronization is essential requirement in mobile environment.
- Critical application must be always available.
- Communication system must work seamless.
- Access to organization network services must work reliable.
- Security issues must consider very carefully.

3.5   Anytime, anywhere

The vision of global village where people interact with each others in anytime and anywhere is kind of vision of future. On the same time it can be seen clearly the increase need of traveling. As a matter in fact there is a special paradox concerning this: if global interaction and co-operation is easy and comfortable why people still traveling so much? A though "anytime and anywhere" traveling same time increasing does not match together. During the investigation of mobility there are generally concentrated mobile technology; life time of batteries, network reliability, speed etc. (Wiberg & Ljundberg)

On the other hand interesting approach is to investigate how the though of global village matches together with mobility.

The vision of "anytime and anywhere" basically means situation where people can act and work what ever needed without traditional boundaries (Wiberg & Ljundberg). Traditional boundaries or restrictions might be e.g. a work time between 8-16, a traditional office or a fixed network connected PC. When presenting this kind of case it might be useful to use following matrix:

	Same	Different
Different (Time)	Support for shift work, etc..	Email, etc..
Same	Meeting support, etc..	Video conferencing, etc..

Time / Place
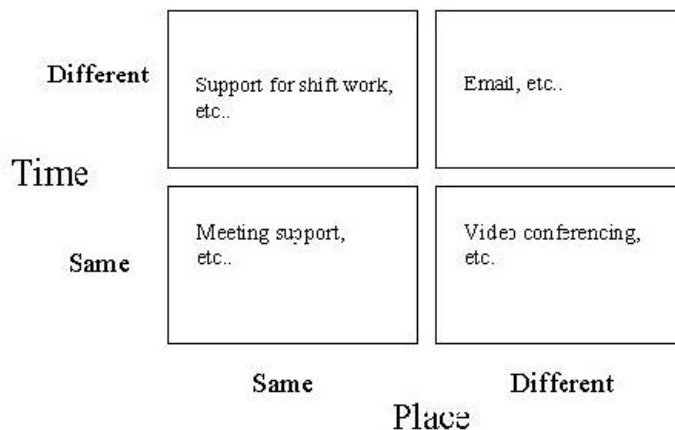
Picture 5. Different scenarios for groupware (Wiberg & Ljundberg according Ellis et al 1991).

Both work and free time has changed toward more and more mobile. One reason for this is that service industry has grown more dominating position in post-industrial society. Active service work happens usually in client premises and this is why it can be called mobile work. Another reason is increasing co-operation between organizations. The third –natural- reason is the huge increase of mobile phones. Mobile phone make certain independently of place possible and it also makes possible mobile work – at least in certain point of view (Wiberg & Ljundberg).

Despite of all this new technology human beings has a need to travel and meet each other. The reason is a social need on personal contacts with other people. In some positions and tasks and cultures personal contact and meeting is essential for co-operation beginning and current both party gaining co-operation continuing. Tacit communication

is everyday invisible activity which essentially need presence. Of course some activities and tasks demands traveling.

Mobility of work itself can be observed in different views. For some people movement in work is essential. For example in the service industry it is sometimes necessary to go toward the client. Additionally in health caring visiting patients' premises cause mandatory traveling. On the other hand in this case mobility gives much wider space to work and on the same time flexibility of work increases. A case history can be viewed remotely from databases. Secondly during the round it is possible to check the situation is there some places where does not need visiting. To other people traveling is temporarily, for example to salesman and consultant. This kind of voluntary mobility can of course means to share the work in certain parts where some part of work can be done in office and other part someplace else (Wiberg & Ljundberg). A typical example could be a family vacation. Parents can leave office work earlier and continue working during traveling e.g. on the train. Figure 6 presents a model of different tasks and their relationship and/or dependency time and place.

Place

		Independent	Dependent
Time	**Independent**	1. Anytime, anywhere: Tasks that can be done independent of time and place. They can be done anytime, anywhere.	2. Anytime, particular place: Tasks that need to be done within on a particular place but can be done whenever.
	Dependent	3. Particular time, any place: Tasks that can be done independent of place but at a certain time or in a certain order.	4. Particular time, particular place: Tasks that must be done on a particular place and on a particular time.

Picture 6. The theoretical framework of the study (Wiberg & Ljundberg).

New technology has increased the possibilities to work anywhere and furthermore the need of traveling has essentially decreased. Worker opportunities and freedom of decide one's own work habits (when, where, what) are totally new element in our society. On the other hand this has raised new challenges because this kind of freedom does not suite for everybody; somebody needs the familiar and safe office and people around before productive work is possible. To the other people isolation is a big relief which itself can be a way to new problems like a total isolation from other peoples e.g. personal contacts.

Like we have seen the vision "anytime and anywhere" has specific good features and it's own certain limits and deficiency. Generally work has –at least so far- it's own limits and restrictions and those elements successful management has direct influence to success. These elements are incontrovertibly e.g. aspects have direct relations to culture. Technical development has nevertheless brought new aspects to current working environment and those aspects increase worker possibilities to decide when and where to work. Anyway it is very important to realize that "anytime and anywhere" does not mean despite new technology provided mobile freedom "every time and every where" (Wiberg & Ljundberg).

4 Mobile telematics and communities

In this chapter we provide a discussion of impact of new mobility inside existing communities and possible new communities that are born as mobile telematics may enable people to communicate and form communities rapidly and less often guided by traditional means of interaction. We see mobility provided by wireless information systems as a tool for information society to take its next step forward.

4.1 Different communities, different views

4.1.1 Municipal view

In the past council or municipal aspect to information society commonly seems to have included an implicit view that IT is a compulsory and inevitable effort. This attitude combined with always present lack of funding may have reduced ability to discover new communal services that could have made citizens more equal or in the long run, saved money. Despite of this, many good projects have been carried out. In the beginning of the 90's projects in Finland began to increasingly contain mobility support. For example 1G cellular networks were utilized to connect multiservice vehicles to municipal information networks (MoniKuu 1993). Here some innovativity can be seen as access to local information service network was provided in a vehicle with postal services, on-line lottery and cabinet of medicines.

A project called "KuntaWEB 2002" might be starting in 2001. Its goal is to provide a municipal information center, local electronic message board and communal services on-line in areas of sparse population. Services would include education, telework, services for local industries etc. All these would be provided in www- and wap-formats.

Some real achievements could be reached in areas of sparse population by pushing municipal information to citizens and drawing them to local decision-making process. The upcoming push technology for mobile clients could thus be utilized also in a positive way – a common fear seems to be that push technology will be ruined by advertisements.

During late 90's some serious research has been done in area of making public transport more effective utilizing mobile technologies. The concept of on demand transportation commonly includes a fixed point where transport requests are handled and taxis or small buses as mobile units carrying customer identification and billing equipment. Transport requests are transferred to mobile units as orders are processed. These services are mainly aimed to elderly or people with disabilities. This possibly explains why clients aren't expected to enter orders on-line. Elderly people aren't yet expected to have any computers, not to mention mobile information devices.

4.1.2   State view

National security and possibilities for control and tracking are important issues when use and spreading of mobile devices' use are concerned in governmental view. As 3G mobile telephones will have positioning built-in, it will certainly became an issue of privacy and control. Positioning will certainly benefit parents of young children. GPS-positioning devices and phones are already available embedded into kids' toys.

But government / police gets a powerful tool of control through this development. What about potential criminals? If one uses his/her cell-phone, police will be able to make route charts and discover plans etc. If one doesn't use the phone authorities will notice that something might be wrong. By use of mathematic algorithms authorities could make profiles and put phone users to specific groups and evaluate their value and possible risk they might cause to the society. U.S. government has already obliged network operators to present this positioning information as requested (Johansson et al1999).

Mobile operators have this information always at hand. What uses they will invent to this information? Will we like these uses or are cell-phone users about to be spammed? Will laws develop to protect citizens from mobile operators despotism? Or are we just expecting high ethics?

In the late 90's Finnish cities began to install cameras around cities to protect citizens and some questions arose if this was only for good sake. Will tiny cell-phones be installed in the urban environment to provide authorities with audio feed of the same district?

4.1.3 Internet communities

Internet and its accompanying networks have given birth to a broad range of on-line discussion boards, forums, chats and newsgroups. These services provide their members with virtual communities that are often easy to enter. Barriers of traditional communication and peoples limitations don't follow from real life (in all aspects) to these virtual meeting places. Mobile internet could extend some of these communities to the mobile era. The idea of various chats has already proven somewhat popular. But interestingly enough, the formation of mobile groups has seemed to be based on real life relationships whereas internet communities are mostly based on similar hobbies, attitudes etc.

4.1.4 "Pure" mobile communities

It might sound strange to ask why most mobile communities are "local". Development to SMS exchange and mobile calling from using wired networks is so self-evident. This is mainly a reference to the progress that can be seen among young people. But how will these things be in the future? If enormous raise in mobile networks' use announced by mobile operators happens, it'll surely need new communities, that is, new actors need to be brought virtually together. Increasing advertising can hardly be enough.

Some new communities that could be formed are those where people with vehicles with people or goods transport facility meet people who need transportation services. These would include casual travelers, parcel services, transport companies, taxis. When freely formed, these communities would surely be of great interest to the authorities.

A wide field will also be that of bringing together people with some telematically announced similarities. When combined with positioning this could be used for services that notify immediately when someone interesting is nearby.

An article in Business 2.0 (McLaughlin 2000) mentions two new services that aim in creating new communities around SMS-messaging. *Quios* is a service with wide variety of channels containing sports, news, regional travel, etc. Content is provided by the subscribers and partly by commercial services with suitable material. *Upoc* is a similar

service with areas for celebrity sightings, jokes, movie ratings etc. Also a channel for those interested of last minute tickets is planned.

The big question is: What are the communities that are formed in the time of 3G networks. Something from Internet communities mixed with current mobile features and something new? But is there something new?

4.1.5 Work communities

Issues relating to mobile work and work communities are covered in chapter 3.

4.2 Emphasis on democracy

Mobile information systems may enable people to participate more in communal decision making. Some expectations have been directed at televoting, which might eventually turn into mobile voting. Honkasalo (Honkasalo 1999) refers to writings that declare information networks as tools that might make real civic society possible by increasing direct democracy. This process must be supported by societies support for telematic applications.

To make televoting and increase in communal information sharing possible, an equal or at leas decent possibility to access information using digital media must be provided. This could mean that governments should retain some direct power in these issues by owning operator shares and using owner's power to secure nationwide coverage of both wired and wireless networks.

It's also important so see possibilities to support elderly and disabled people in adopting mobile media. By innovative services these groups could became even more integrated to the society and the quality of their lives could be improved. A widely discussed issue has also been that of individual's time. Employers are feared to take over employee's free time. But it should be also watched that the community leaves everyone their own time when needed. And that isn't particularly an issue of active communication but also one of tracking and monitoring. It's about control.

4.3   Mobile teleservices provided by society

There are several services with potential benefit of mobile networks' features that the government and municipalities could offer to their citizens in the future. Some of these services would be public, some directed to specific target groups.

In the area of mobile medicine intelligent clothing with physical sensors could let medics monitor patients more effectively and in 24-hour basis. Hospitalization wouldn't be needed so often. This would benefit both society and individual. Mobile telemedicine is also commonly associated with location tracking, which is considered particularly useful in emergencies but will probably help people with physiatric problems.

Mobile shopping is also something for society to take use of. As car parking payments are commonly a business controlled or done by authorities new mobile phone based payment methods are not to be forgotten here. Also instant public transport payment agreements are mentioned to be among public services (Ekberg et al 1997). This refers to a situation where location based system is used to tell and authenticate which public service is nearest to the person agreeing to pay suggested payment.

Mobile learning can complement distance learning by adding repetitions to exercises. Mobile studying is certainly an area to be explored.

5   The individual in the mobile world

The development of mobile information and communication devices and services has been, and still is, a technology driven effort. Often in practice mobility and wireless solutions mean additional constraints, compared with the more conventional stationary approaches, in e.g. the availability of power (electricity), processing power (CPU cycles) and memory (both processing and storage space) and data communications (radio frequencies, signal strength, bandwidth) etc. To solve these problems, and/or to deal with the unsolvable ones, new technologies are constantly engineered.

Yet the human element is usually present, and seemingly clear, in the developers' minds. It is commonly envisioned how mobile ICT will liberate us from the constraints of time and space, giving people the freedom to choose where, when and how to do whatever they are to do.

In the previous two chapters, we have learned how the mobile technologies may be effective from an organizational viewpoint – both in private companies where people work and in societal level regarding the communities we live in. Here the focus is on the individual – after all, at least according to (our) western individualistic view of the world, that is what it comes down to.

The question is how the use of mobile technologies for work and societal purposes relates to life. This is of course too broad a question and as such almost meaningless. By looking at the issue from the point of view of user-centric design, it becomes more concrete. To design for the (potential) users, the designer must have at least some sort of an understanding of them (as humans). And, it can be argued, to design well, a good understanding is needed. So designing mobile technologies – not only considering the constraints on the technological front, but having the users' needs in focus – requires understanding how the different aspects of living dealt with earlier (work, society (, and others too…)) are combined in the individual human being. Mobile information and communication technologies are important here because of their potential to blur to traditional borders of e.g. work and home (see Ch3, p. 14), lessening the meanings of clear distinctions in physical space, e.g. the concept(s) place (and time).

An interesting challenge might be to look at the motivations driving the development. While individual freedom and, to put it short, good life are naturally presented within the visions for "the mobile world", the everyday reality might be a different story. From a business point of view, efficiency and cost-benefits are sensible goals. Interestingly, use of mobile ICT is reported to help reaching that too (see Chapter 3). Must this be a tradeoff between individual freedom (for example, not having to answer work related calls when not *at work* – traditionally meaning the office building – not to mention *at home*) and organizational efficiency? This is of course a classic dilemma associated with these technologies – e.g. with Internet-connections at home and mobile phones (everywhere), which many prefer to use for work instead of having to be at a certain place every weekday from 9 to 5. But it might be interesting to take a look further how these things actually affect life.

In this paper, the focus has deliberately been on so called utility services of mobile information technology, i.e. applications that are useful for some purpose - or, as often formulated in information systems research, are used to do work. Often, however, mobile information and communication devices are used for quite different purposes, common examples from GSM phone use being keeping in touch with the family and friends - socializing. Or as the Japanese i-mode success stories now so enthusiasticly cited, and enthusiasts in several Finnish start-up companies too would demonstrate: mobile gaming is it! Some experts in these new fields even blame the Finnish IT business for being blinded by the b2work applications - thinking of the market for the Nokia Communicator for example - and emphasize that mobile computing must, first and foremost, be easy (cheap) and fun.

What does this tell us? A critical thought could arise along the lines of seeing mobile gaming as a symptom of the societal (welfare?) disease called boredom, and for worryingly short attention spans and impatience. Or what should we really think of scenarios where the mobile phone operators expect to make enough money to pay back their billion mark/dollar/euro loans as soon as the 3G networks are in place from people watching micromovies at the bus stop (when waiting, say 5 minutes) and then participate in their favourite on-line gaming communities for the 15 minutes during the bus-ride (before getting home and logging on from a cheaper cable connection)?

5.1   From man-machine interaction to integration?

The arts and sciences related to user interface design as academic disciplines are often called human-computer interaction (HCI) and man-machine interaction. Another interesting way to look at is the theory of socio-technical systems, where the otherwise common tool-view of technology (e.g. simply considering its' utility) is abandoned, and people and technology are viewed as (interacting, even inseparable?) parts of the same system. This easily makes sense when thinking of organizations and work - it's even quite difficult to think of simple craftsmen such as blacksmiths or artists' such as sculptors without their hammers, not to mention more modern (e.g. computerized) practices, but coming down to the level of individuals as humans it becomes different. As people leave their hammers and computers at the workplace and go home, and later sleep at night, are they still partly technological?

The two berries?

- The relationship between humans and technology

- When these (here in the pic) have matured? .. and grown together

- Not similar, but symbiotic?

    - convergence?

- Technology as the soc.subconscious?

Elaborating this context, would it make sense to talk about man-machine integration – understanding people and technology as parts of the same system? Thinking of recent developments in mobile ICT, like wearable computing, this is perhaps not so far-fetched as it first may sound. In the Paula-project at the department of information processing sciences at the university of Oulu the experimental mobile user interface is actually the hand of the user – with no external devices except the camera for machine-vision (Book of Visions, 2000).

Users can act within the virtual service interface naturally without other people even noticing it. The ultimate goal being that advanced mobile services can become extensions to our natural senses and thus enriching our life.

Figure 2.1.1.1: A novel metaphor for and sign language framework for personal mobile broadband user interfaces enables deviceless communication. (Courtesy University of Oulu, Paula Project)

5.2 The living environment

Examining the environment people live in helps to understand their humanity. The living environment in "the coming mobile information society" may be characterized from several perspectives – the reference model referred to in chapter 1 divides it to a physical and social dimension, for example. A brief examination of these dimensions follows.

5.2.1 The physical environment

In the physical dimension this comes down to perception and senses, which connect people with the physical world of photons (light, seeing), mechanic vibrations (sound, hearing), materials (touch, feel) and others (smell and taste being not widely used in ICT). For example a current mobile phone is a physical device (material) that people can hold in their hands and to their ears, both transmitting (receiving and sending) audio (mechanic vibrations) and showing additional information on a display (photons). In addition, the mobile phone is capable of connecting the base station via a radio link, thereby accessing a (global) network to connect to other nodes in other locations, bridging those faraway locations to share some of their physical reality. Hence the environment (that the human experiences) is not totally tied to a place, and can be shared

with several places. Along these lines, a classic (McLuhanian) interpretation of media technologies describes familiar technologies, such as TV and telephone, as extensions of human senses, enabling to see (eye) over vast distances or discuss (mouth, ear) with people far away.

Another way to look at mobile connectivity (in the physical dimension) is the different scales or levels of networking, as the Book of Visions by the Wireless Strategic Initiative of the European Comission puts it in its MultiSphere reference model (BookOfVisions). These six levels are: Person area network (PAN), Immediate environment, Instant partners, Radio accesses, Interconnectivity and finally Cyberworld. As shown in figure x below, the individual is in the middle with all the (wearable computing / media) devices, connected with other devices nearby, and with some people nearby as well, and then with the radio link to the global network and different databases, avatars and services there.

1.5.6 MultiSphere Level ⑥: CyberWorld

Book of Visions 2000 – Version 1.0   Page 7

This model has been developed to serve as a common reference for the different technology developers throughout the world (or Europe at least), to have a common language. A critical analysis of the model, with implications to the actual ways these technologies are developed, would be interesting (but none are known of / developed here yet).

5.2.2   The social environment

Unlike the physical environment, the social world is not directly observable. The focus of this paper, and of the original authors presenting the reference model referred in chapter 1, has been the social conditions regarding mobile work. This includes power structures, team organization etc. Thinking of humans in general, there is of course much more to sociality and socializing than work. And mobile technologies, especially mobile phones, have already proven significant in a wide range of social purposes – dating and match-making services being perhaps the extreme. Along with the developments in information and communication technologies may be fundamental changes in what we understand as social human beings. For example the concept of a friend was brought up in an interesting light in a recent TV-documentary about ICT use in Japan, where a teenaged girl was asked about the number of her friends and the reply was 200-300 – meaning the amount of names she has in the phonebook of her mobile phone – while her mother had probably counted the four-five close friends she has. Even the concept of a family has been speculated to go under change these days, but a thorough exploration of these issues is outside the scope of this paper, and it would probably be too early to tell anyway.

5.2.3   A holistic view?

The separation of the physical and the social, presented in the reference model referred in chapter 1 and dealt with above, reminds of the typical (western) dualistic division between body and soul. A holistic view of humanity would, on the contrary, emphasize their inseparability. Lauri Rauhala's holistic view of humanity has been used to interpret "living on the Internet" before (Pihlanto, 1998), and might be of interest in this mobility approach too. In Rauhala's theory, people exist as bodily, conscious and situationistic beings. Situationistic means being related to everything there is in an individual's live, i.e. in the situation, which is conceptualized in the consciousness. The body is of course a necessity in this. The use of information and communication technologies – e.g. conversating with other people on-line or exploring virtual realities – affects the conceptualizations of the world that the individual has, therefore influencing the overall behaviour (Pihlanto, 1998). With mobile technologies, this link is expected to tighten so that

the technologically mediated world would be almost always present, constantly affecting actions, and also contextualised to fit the situation at hand.

5.3   People, technology and freedom

The relationship of people and technology is an age old question in human history, dealt with in several popular mythologies by figures such as the wax-winged sky-flying too-close-to-sun-going Ikaros and fire-from-god-stealing Prometheus of the Greek and, more recently, Frankenstein and all its variations (e.g. the Terminator) in western literature and cinema. This ancient European skepticism (or even fear) for technology has been even characterized as a significant difference when compared with the embracing American approach – most visibly seen in the recent discussions concerning direct gene manipulation based biotechnologies (Glenny 2001) – although this stereotypical continent/nation-based view is not that good a way to look at the issue [2]. Perhaps a more sensible way to look at people's attitudes towards technology is the *digital divide* to *havs and have-nots* i.e. recognizing different statuses individuals have. To put a long story short (i.e. grossly simplified), people vary in their opinions and ways of use of technologies, and for some it is an empowering force and for others, perhaps even, slavery.

A way to find an answer to the questions that arose in previous chapters concerning social influences of mobile ICT, whether it blurs the boundaries of work and home so that individuals suffer in the face of increase in organization efficiency, and whether it's a new way to impose stricter government control, is to ask: who gets to choose? Freedom (and even the level of human development, e.g. as measured in the UN index) can be defined as having options. As long as people themselves can choose about their use of technology, e.g. when to have the alarm on in their mobile phones and when not, it is easy to see it as a liberating force (although there are dangers too, like the possibility of social isolation mentioned in chapter 3), But freedom of choice can be illusionary – e.g. a choice is a non-choice when it's a question of making a living and therefore having to accept work conditions that might be seen as inhuman (see e.g. http://www.nikewages.org/). Interestingly, the attitudes towards technology have been

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[2] Thank you for mr. Heikki Kortti (currently heikki@hi.is) for pointing this out in his analysis of the Wired article in private e-mail correspondance

interpreted as being central even in historical revolutionary events, such as the May of 1968 in Paris and elsewhere (Feenberg 1999, p. 21).

Let's summarize the question of freedom after Habermas' media theory: "the central pathology of modern societies is the colonization of lifeworld by system", i.e. the growing influence of rational institutions such as markets and administration on every-day communicative interactions, such as education, child care and public debate, is the cause of problems (Feenberg 1999). This media theory, where the original medium was money (a simple protocol: buy or not) and later power (obey), has been extended with technology: "technologizing a domain of life opens it to economic and political control; technical control serves system expansion without itself being a medium" (Feenberg 1999, p. 170). In the visions for mobile information systems (technology, society), this expansion is expected to reach previously untouched areas. But does this have to be the apocalyptic dystopia it sounds? Intriguingly, Habermas contrasts the "system" with linguistic communication – which is exactly what a lot of the new (mobile) information and communication technologies are about! This way, could the mobile technologies, that allow us to communicate with each other independently of time and place, in fact help to deal with the "central pathology" Habermas criticized in the first place?

6   Conclusion

Despite increasing mobility within organizations and society, the research of mobile computing has so far been almost exclusively technical. Those involved in mobile information systems sciences often emphasize that the current development of information systems has been stationary biased with the focus on stationary work and traditional computing. The stationary bias appears at least in the desktop metaphors of graphical user interface. Even suitable for office, they purely satisfy the needs of intensively mobile work where the user often has other activities simultaneously with interacting with the computer. Designing mobile information systems requires thinking new interaction styles, such as indirect manipulation. Also vehicles for thinking situational information are required in order to adapt the system to the context of the user.

Mobile work in its best is freedom from traditional work environment and e.g. technological restrictions, supporting interest groups, work community and social contacts. For mobile work to be successful, working should be possible both connected and unconnected. In addition, all devices in a system must share the same information and information must be synchronized. Other criteria for the success are availability of critical applications, seamless working of communication systems, reliable access to organization's network services, and careful consideration of security issues.

Along with increase in mobile use of IT, new communities arise. These communities can be virtual but may end up in more real communities as wired Internet has shown in some occasions. If authorities end up being innovative in use of mobile IT, new communal services can be invented, elderly and disabled people may became more equal, and medical services can be improved by real-time monitoring of patients and by location-based services. Also improvements in local decision-making process are possible, if participation is enhanced as mobile citizens can be reached.

At the same time, society is faced by huge responsibility as mobile networks offer new methods for control. A public discussion is needed if laws should be passed to restrict monitoring or give the state additional tools for control. It could be discussed if employers' right to intrude into employees' private life should be restricted. It should be made

clear to the general public, what are operators' rights to utilize location information as well as other possible information they are able to collect based on subscribers' whereabouts. Control over emerging "pure" mobile communities will probably be something that will be used to push laws that can reduce individuals' rights.

Elaborating the individual's point of view, it shows that the mobile information and communication technologies may accompany a great change in humanity. The visions related to work and societal aspects of mobile computing rise many questions, where there are no real answers yet how it all will influence our lives. As previously often clearly place-bound aspects of life, such as work and home – or perhaps public and private – may blur with the always-on ubiquitous global connectivity, these are not small questions.

As with technology in general, besides great hopes there is also fear, but still the human side remains a marginal issue in practice when the actual development efforts are looked at. Yet the use of mobile technologies has already affected very human concepts for some people, e.g. how they/we socialize and even what they/we consider a friend. Also with the advent of wearable computing, bodily interfaces and sense-extending seamless user-interfaces, the age-old questions about our relationships with technology are timely as ever. As our living environments change, so do we – but the physical dimension of telecommunications are easier to grasp than the not so directly observable social one.

Perhaps the question of freedom can still be put clearly: who gets to choose? As the mobile technologies are still strongly conversational, about people communicating with each other in human languages, instead of bland consuming of ready made products or just performing dull repetitive tasks for industrial manufacturing purposes, there seems to be a lot of space for our independent actions.

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