INF5260 Mid-term Report

# Mobile Work – Mobile ICT Supporting Secondary Work

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## Contents

# 1. Introduction

This paper uses three separate case studies to explore an often overlooked aspect of designing mobile systems: the fact that many mobile workers have a primary activity that does not include the use of computers. The use of mobile information devices is at best a secondary activity and the design of such systems must take this into account.

Nurses, home-helpers, construction workers, electricians, drivers, all these, have primary working activities that do not depend on ICT. For example, nurses and home helpers primary activity is to nurse sick and take care of people in need of nursing, while the main task to construction workers is to build houses, buildings and constructions, and, of course, the drivers primary task is to drive. Strictly speaking, the majority of these workers do not even need information technology to perform any of their working tasks. But, mobile ICT might be useful if it supports or enhances communication, collaboration, and the primary activity.

By turning our attention towards supporting the secondary activities we want to make developers and system designers aware of issues that may be important in the design of professional systems using mobile information devices.

Professional use of mobile phones is often associated with status and white-collar work. Many of the advertisements for mobile phones show people in business suits at airports and in meetings, busy making deals and arranging their appointments. These are typical representatives of users with a primary activity that often relies on the use of information devices (See (Bergman 2001) for a definition of information devices). Our case studies show that other users may have an equal benefit from the use of such devices as the discontinuities are often costly and time-consuming.

By examining three different occupations, each with different mobile patterns and working tasks, we examine the understanding of context of use of mobile ICT. The three occupations are:

- Nurses
- Home health-care
- Construction workers

First, we will take a close look at the term ”mobile work”. Mobile patterns, primary and secondary working tasks, communication and collaboration will be issues that will receive a lot of attention. Efforts in understanding the mobile work will both be based on literature study and our own experiences and knowledge about the occupations in the study.

# 2. Theory

## 2.1. Mobile work

Mobile work is far-reaching in many different business sectors and ICT has been used to support these workers. Mostly this applies for office workers who shift between different locations, like consultants, lawyer, salesmen, agents and similar. In these cases, laptops, PDA's and mobile telephones are often used. Less ICT had been used among mobile workers that have their working field outside an office. Examples of such workers can be carpenters, electrician, installers, plumbers, ship surveyor, drivers, nurses and home-helpers. These kinds of mobile work are required by the fact that certain places have to be visited, e.g. a ship, a hospital or a building site.

Some effort is used on structuring and understanding mobile work and ICT, e.g. different frameworks are suggested. Julsrud (Julsrud et al. 2002) emphasize three conditions: the working tasks, mobility and existing habits and use of ICT. Lyytinen and Yoo (Lyytinen and Yoo 2002) emphasize four levels: individual, team, organisational, and inter-organisational. All levels comprised of both service and infrastructure development. The model of IT-use in mobile settings as Kristoffersen and Ljungberg (Kristoffersen and Ljungberg 1998) emphasize environment (e.g. physical surroundings, organisational constraints), modality (e.g. stationary, walking, wandering, travelling or visiting.) and intention (e.g. supported by technology –data and application). Despite of this effort, we see a need to develop a framework that focus on mobile works that work outside an office. In these cases Julsrud's conditions seem to be to superficiality when understanding mobile work, Lyytinen and Yoo focus to much on services and technology, and Kristoffersen and Ljungberg model of the "wandering" is to narrow.

Below is an illustration of how we have started to structure the information of mobile work. For each case study, e.g. nurses, home health-care, construction workers, we aim to understand and discuss them based on this structure. As a result of this, we will be in position to identify advantages and disadvantage with this structure.

The structure focus on mobile work and divide it into primary and secondary activities. Next, it focuses on the context of use, which is further divided into mobility, knowledge types and novices of ICT. These information types are explained on a general basis in this section, while next section, the presentation of the case studies, are focusing on real examples from practice.

| | Nurses | Home Healte-care | Construction |
|---|---|---|---|
| **Primary**<br>-work processes<br>-complex problems<br>-lack of information<br>-work of quality | | | |
| **Secondary**<br>-work processes<br>-complex problems<br>-lack of information<br>-work of quality | | | |
| **Context of use**<br>-mobility<br>-knowledge types/ prosesses<br>-ICT literacy | | | |

## 2.2. Primary and secondary activities

A primary activity has a direct association with the primary objective of the work, while a secondary activity has a more implicit or indirect association with the primary objective. Secondary activities are often supportive of the primary activity.

Activity may be viewed at different levels of detail and what is the primary and secondary activities might therefore change according to the perspective.

Secondary activities are of particular interest in those cases where the primary work does not require assistance from a mobile information device, while some of the secondary activities do. Secondary activities are sometimes associated with discontinuities (Gershman, McCarthy, and Fano 1999) and bridging these discontinuities may be important to the overall performance of the primary activity.

## 2.3. Context of use

Due to its very nature, mobile settings are challenging many topics. An important start could be to understand and specify the context of use in mobile work. Context might be any information that can be used to characterise the situation of an entity, where an entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and the applications (Dey 2001). In other words, context of use includes users, tasks, equipment (hardware, software and materials, and the physical and social environments in which a product is used (ISO 1998). In this study, the context of use at a general basis, could be specified to include mobile workers that work outside the regular office, mobile services supporting tasks like communication, collaboration and knowledge processes. In addition, the workers have different degrees and patterns of mobility, they work in different degrees of exposed working environment, they will use small devices and many of the users are novices of ICT.

The different cases have different context of use. However, they seem to share the following characteristics: mobility, large diffusion on tacit knowledge and the users are ICT novices. We will shed some light on these issues in the following.

### Mobility

Mobility implies that work activities are performed at different locations throughout the day. We do not consider mobility as a question of distance travelled to perform the work activity, but recognizes the fact that the worker is not stationary, at her or his desk with fixed infrastructure.

### Tacit knowledge and work that is based on experiences

To support knowledge processes with ICT it is important to structure the different knowledge types and the knowledge processes (Alavi and Leidner 2001; Fagrell et al. 1999; Kucza 2001).

Below is a description and examples of different knowledge types as Alavi et al. (2001) classify them:

**Tacit knowledge:** Knowledge that is rooted in actions/ activities, experiences and engagements in a profession or a specific context (Polanyi 1966). This could be related to cognitive or technical tacit knowledge. An example is a process that requires a high degree of experience and creativity where the worker grasps and feels how to carry out the activity. Tacit knowledge is hard to communicate or distribute to other, and often, tacit knowledge is learned though performing or action.

**Explicit knowledge:** Knowledge that is expressed/articulated and generalized. An example is a clearly described process that states how to perform it. This could be based on a formal education, books, quality or work procedures, or similar. Often this type of knowledge is written and it can be communicated without actually having to perform or experience the knowledge.

**Individual knowledge:** Knowledge that is created and inherent in a person. For instance it could be an activity that just one person in a company knows how to perform it. Often, this is a type of tacit knowledge.

**Social knowledge:** Knowledge that is created an inherent in a collective actions of group. An example is knowledge of how a team of people work and collaborate in curtain cases. Often this is a type of tacit knowledge.

**Procedural knowledge:** (Know-how) Knowledge about how to perform a process that is to be carried out. For instance this knowledge is communicated through routine work or how to administer a particular drug.

**Others:**
Know-about – declarative knowledge, for instance, knowledge about which tool to use or what drug is appropriate for an illness.
Know-why – causal knowledge, for instance, knowledge about why a tool works or understanding why the drug works.
Know-with – relation knowledge, for instance, knowledge about how a tool works together with different kinds of materials or understanding of how a drug interacts with other drugs.

Know-when – conditional knowledge, for instance, knowledge when to use different types of tools or understanding when to prescribe the drug.

Alavi's (ibid.) review shows that a lot of theory exists on knowledge management. But they claim that little empirical work has been undertaken. They raise a lot of research issues and questions. Examples are follows: "*What conditions facilitate knowledge creation in organisations? What incentives are effective in encouraging knowledge contribution and sharing in organisations? How can knowledge be effectively transferred? For all of these questions, how can IT enhance the knowledge management? "*

By considering this research agenda, we find many issues that could be evaluated further. First, the mobility requirements entails that the "expert" cannot be replaced by an "expert system" for organisational memory. People are mobile for good reasons, and thus it is important to focus on supporting knowledge workers, rather than replacing them (Kristoffersen and Ljungberg 1998). Second, it is important to understanding the practical work; people are often working in groups, and thereby have a learning process, often by watching others work and discussing with others. How to create a natural opportunities to learn from colleagues? How to create forums for sharing experiences (Wiberg and Grönlund 2000)?

Third, understanding that ICT can be viewed as a communication medium (Crook and Light 1999; Lilja and Lindström 2002).

Fourth, how is it possible to measure the impact of introducing mobile computing within knowledge processes (Lyytinen and Yoo 2002).

Fifth, collaborative tasks, related to both learning and executing, will foster challenges involving interaction between multiple participants.

Sixth, virtual teams and virtual workspaces, the "House of Services" is a way of putting technology to form an infrastructure for virtual teamwork, and these services have to support the "distance factor". The distance factor includes the speed of exchange physical (information) objects, complexity of data/rich communication and the quality of communication. Line (Line 1997) claims that it is not realistic to expect people to use computers and networks for everyday and critical communication if the following factors are note satisfied: ubiquity, concurrency, stability, conceptually simple and user-friendly. Virtual Workspaces, Christiansson (Christiansson 2003) recommends that ICT must not be regarded as one of these tools that we only have to learn to use but as an integral part of the company and project knowledge management system.

#### ICT literacy

ICT literacy is used to describe the skill level of employees regarding the use of ICT as a tool. In all three cases, a common denominator is that employees are normally not expected to have IC skills. Their primary work does not require ICT skill in itself, but secondary work will be more effective and of better quality, if the employees use ICT.

# 3. Case studies

## 3.1. Nurses

#### Introduction

This case examines mobility among nurses, secretaries and physicians at the surgical department at the University Hospital for North-Norway (UNN). More specific, we try to investigate if we can improve collaboration and coordination among healthcare

professionals by using mobile information technology? If so, what are the critical factors? Which activities are suited for computer support?

This case is based on ongoing work with the UNN. Topics for discussion are: "Unwanted" mobility caused by an attempt at bridging discontinuities, problems with using modalities of mobility (such as local, micro, wandering, etc) as a means for providing inputs for systems design for actual applications, identifying and ranking primary and secondary working activities and finding out how these activities might tie up human resources (vision, hearing, hands, fingers, attention, etc).

#### Primary activity

Primary activity is to prepare the patient for surgery, provide care, assist patient while at the hospital, provide information to patient and next of kind, report on work and inform on any important observation or event related to a patient, and medication.

Artefacts have specific use, related to medical process or documentation.

#### Secondary activities

Secondary activities may be handling logistics, make and receive phone calls and messages – make sure they are passed on to the appropriate person, report or retrieve information, keep stock of inventory and fill up supplies, etc.

Secondary activities are often created by discontinuities in primary activity or a result of trying to bridge a discontinuity.

Artefacts serve a more ad-hoc use: typically bits of paper to make notes and reminders.

#### Context of use

Mobility is an inherent part of most nursing activities.

Nurses move from one patient room to the next and to and from the HQ.

Situation with patient requires full attention to patient and responding to the needs of the patient.

Most human resources are in use: hands, arms, torso, hearing, seeing, speech, and other senses + cognitive processing of all inputs.

Must be able to mix everyday conversation and language towards patients and then process and interpret this into medical context and report in medical language.

Many nurses have a lot of experience with technology, but still feel alienated by computers and remain sceptical about using them.

#### Research Methods

Interviews, observations, participatory design and implementation of two applications, as well as development of a prototype application, supporting secondary activities aiming to bridge discontinuities in primary work activities.

### 3.2. Home health-care

#### Introduction

Home health care is also a typical example of a mobile work force with limited ICT-skills. Like most professions, ICT may improve both communication and quality of work. To overcome barriers caused by skill level the work force must go through a training program. An alternative strategy is to use technology that is already known by the work force.

Use of mobile phones has had an explosive growth. Recent reports show that 86% of the population use personal mobile phones. This implies that most persons working within the home health care sector are mobile phones users.

One hypothesis is that mobile phones have a lower user threshold than more advanced technologies, like Personal Digital Assistants (PDA's). If the hypothesis is true, is it then possible to utilize current functionality of mobile phones in the home health care? One problem is the limitations on screen size and input mechanisms, which excludes use of applications that require large amounts of textual input.

### Primary activity

Primary activity for the team is to provide home health care for clients within a geographical area. Home health care includes different tasks. Some tasks must be handled by distinct personnel categories. Nurses perform medication and other medical treatment, while nursing assistants take care of personal hygiene, cleaning, shopping etc.

Teams are loosely coupled, which implies that individual members perform their tasks in different geographic locations.

Similar to the previous case, artefacts have specific use, related to medical process or documentation

### Secondary activities

Secondary activities are coordination, reporting, ordering specialist services, and training.

Again, secondary activities are often caused by discontinuities in primary activities or as a result of trying to bridge discontinuities.

Similar to previous case, artefacts serve a more ad-hoc use: typically post-it notes, binders etc.

### Context of use

Mobility is an inherent part of most home health care activities. Clients normally live in their own homes, and are not mobile.

Situation with patient requires full attention to patient and responding to the needs of the patient

Similar to previous case most human resources are in use: hands, arms, torso, hearing, seeing, speech, and other senses + cognitive processing of all inputs

Must be able to mix everyday conversation and language towards patients and then process and interpret this into medical context and report in medical language

Home health care workers normally have limited experience with technology.

### Other characteristics

First, some typical characteristics of the home health care are identified and listed. The hypothesis is tested by interviewing home health care employees. To support the hypothesis, a small prototype has been developed, and this is used throughout the interviews. This prototype includes registration of visits, team functions, and the possibility to order specialist services.

Some characteristics of the home healthcare profession

***Individual service provision***

The home health care sector provides a set of services. Current best practice is to list these services in as part of a service declaration. The service declaration tells clients and relatives what quantity and quality to expect.

The services will be different for each client. Some activities are directly related to the client (medication, personal hygiene); other services are related to the client environment (cleaning, shopping).

***Multiple professions***

Multiple professions are involved in the service provision. Registered nurses take care of medical problems, while assistants take care of personal hygiene and cleaning. In addition, specialists are used for some activities like rehabilitation, hairdressing, manicure etc.

***Work organization***

The workers are organized in loosely coupled teams. A loosely coupled team are working together to reach some goal, but they do not normally work on the same thing at the same time.

***Mobile work force***

Home health care is mobile, since service provision takes place in the client homes. The health care work force is visiting several clients every day.

***Use of ICT***

Service provision does not relay on ICT use. ICT may be used to improve communication and quality of work, but is not critical to the service provision itself. The work force has limited ICT skills.

***Challenges***

The lack of ICT skills and the fact that ICT is an option imposes certain challenges:
Motivation for ICT use
User friendliness

Motivation for the use of technology must be present. The most important factor is to provide supportive functions that are regarded as useful by the work force. It is also crucial that the application is user friendly. The work force should be able to use the application with only a limited training.

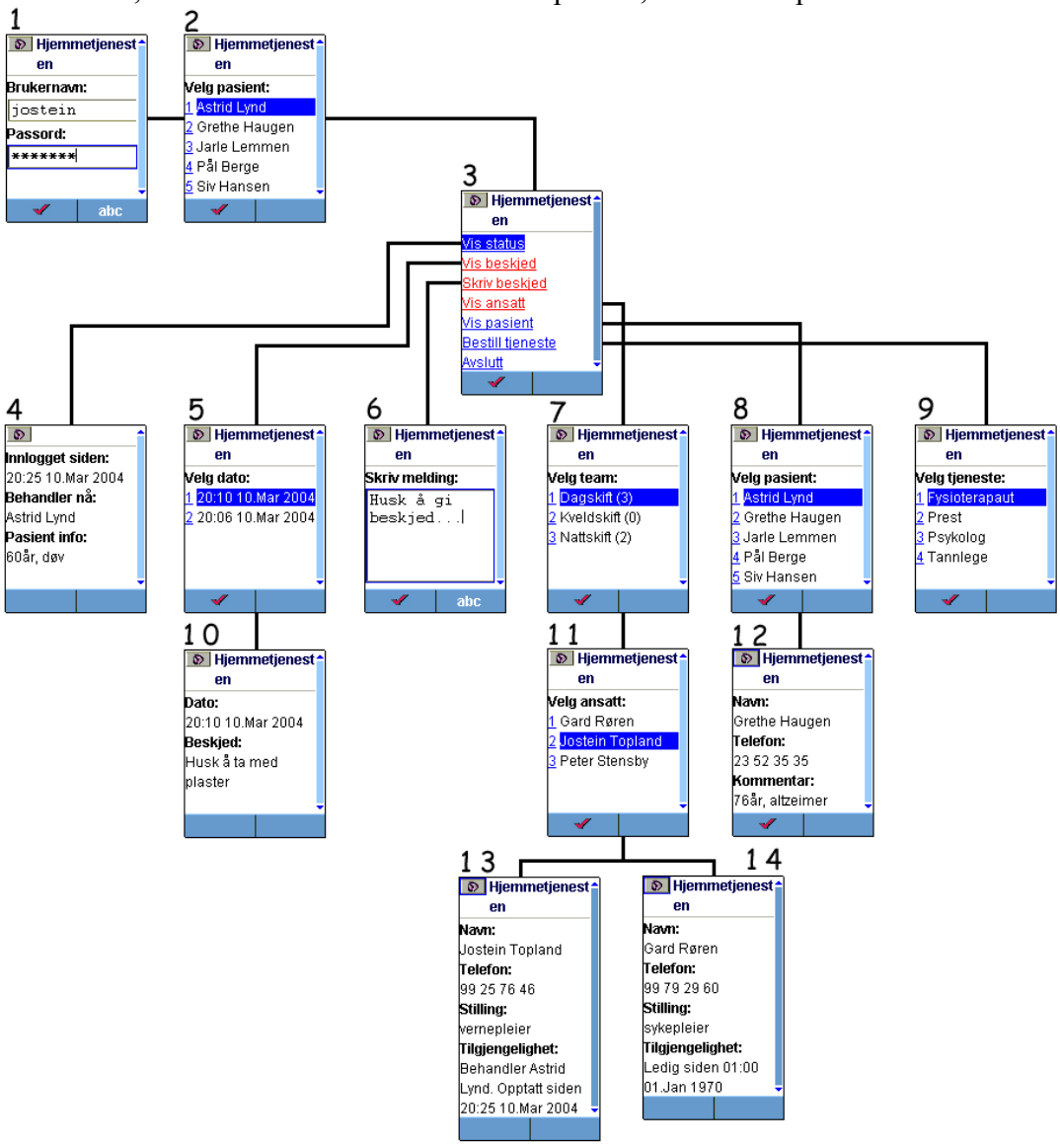
***Possible use of ICT***

Most municipal home health care providers use ICT for administrative planning. Such systems make it possible to make daily detailed work plans for each employee. The requirements of the individual patients are based on administrative decisions.

Since the teams are loosely coupled, it is necessary to have some kind of mechanism to inform the other members on status. The normal way is to have some kind of meeting before work starts, and some kind of meeting after work is finished. ICT may be used to facilitate such transfer of knowledge among team members.

***The prototype***

The illustration shows the different functions of the prototype. The main menu (3) includes menu entries for showing current status, write and read messages, show other team members, show information related to the patient, and order specialist services.




## Research Methods

Research methods include interviews with home health care personnel, home health care management, prototype development, and observation of prototype usage and follow-up interviews.

## 3.3. Construction workers

In this case the main focus will be on the knowledge process among construction workers at a building site. The aim is to discuss the following question:

*How can mobile computers support and improve the knowledge processes of the construction workers?*

This section is gives an introduction to construction and to describes examples of primary and secondary activities. Furthermore, the context of use is presented with respect to mobility, knowledge types and novices of ICT.

## Introduction

Residential construction in Norway is a sector where competition and efficiency are on the daily agenda. Efficiency within construction meets many of the same challenges as in other manufacturing sectors. Examples are serial length (the length of the production set) and adjustments to the area/space, switch-over between series/production sets, choice of material alternatives and the degree of standardisations, judgment between large-scale operations and tailoring for a customer's personal requirements, and communication problems between different professions during production, e.g. concreters, carpenters, electricians and plumbers. Compared to other manufacturing, residential construction is still marked by small amount of series, low degree of standardisation, custom-made requirements, and a large diffuseness of competence and qualifications. In general, manufacturing is supported by ICT to a large extent. However, residential constructing is just supported by ICT in some areas. ICT is supporting the projecting and the design process in construction, but little ICT is supporting the work and the production at the building sites. Developing ICT to support the construction workers will influence their work and bring out new opportunities.

## Primary activities

A construction worker's primary activities are to do carpentering (e.g. hammering, sawing or measuring) that directly involve construction of the desired building or object. To support primary activities within construction, the workers use a (pistol) hammer, a saw, screwdriver, or an inch rule. This equipment could be powered by electricity or not. At the moment, we find it hard to support primary activities with mobile ICT.

## Secondary activities

Examples of secondary activities within construction could be to report a problem, status or an issue to the foreman, to go and get some building materials or tools, e.g. handling logistics, to search for information, to prepare an electrical tool before use, to discuss a drawing together with colleagues, to perform quality assurance.

## Context of use

### *Mobility*

The workers at a construction site almost move constantly, e.g. their work is very physical. They move inside the building they are building and between different sections in the building. Also, they go between different buildings. Sometimes they go to the construction hut to communicate with foremen. Also they go and get materials or tools that sometimes are placed outside the buildings and other times are placed inside different sections in different buildings. They frequently move between different buildings. During working hours they rarely leave the construction site.

### *Knowledge types*

During a field study in construction (Skattør 2003) it became evident that a large diffusion of tacit knowledge (Alavi and Leidner 2001; Polanyi 1966) among the workers existed, and that the work was heavily based on earlier experiences. The study also showed clear traces of individual, social and procedural (know-how) knowledge, and more sporadic traces of declarative (know-about), causal (know-why), conditional

(know-when), relation (know-with) and pragmatic knowledge[1] which is useful knowledge or best practice for an organisation. A lot of the critical knowledge is "stored" in the drawings (Skattør 2003) and the communication of this knowledge is therefore critical. At the same time some distance and boundaries between the designers/architects and the contractors/construction workers exist in constructions (Bowden 2003; Skattør 2003).

Fagrell and Kristoffersen (1999) are pointing out four different aspects related to knowledge processes in mobile work that is electrical workers in Sweden. They structured the processes into a knowledge management system consisting of: *sharing, indexing*, *diagnosing* and *foreseeing*[2]. All this aspects was also found among construction workers (Skattør 2003).

***Novice ICT users***

Within construction quite little ICT are used. Exceptions are mobile telephone (Julsrud et al. 2002; Skattør 2003) and radio/walkie-talkie (Bowden 2003B; Skattør 2003).

Since site personnel are ICT novices there is a preconception that unless hand-held computers are found to be usable for them, the uptake of these new systems will be slow regardless the benefits available to these individuals and the project team as a whole (Bowden, Thorpe, and Baldwin 2003).

## Research Methods

In order to facilitate a rich and extensive data collection, the study is based on an ethnological approach. A mixture of qualitative techniques like observations, interviews, workshops, meetings, paper reviews, and other information sources like working process documents, checklists, and similar. The study has taken place at construction sites, e.g. particular behaviours in mobile work must be understood in their settings.

## Possible use of mobile ICT

In contrast to primary activities, many of secondary activities might be possible to support with mobile ICT. At this stage of the study we see the two large areas of utilisation:

1) **Communication and collaboration** between the project and the production. As mentioned, a lot of critical knowledge is "stored" in the drawings and at the same time some distance and boundaries between the designers/architects and the contractors/construction workers exist in constructions. In general, in current construction projects there is a little communication and knowledge sharing between the project life-cycle phases. ICT might be a major element that allows seamless information between the phases. Improved communication in a life-cycle phases through visualisation. Since communication between the construction parties relies mainly on drawings and specifications, visualisation makes communication more effective and accessible.

2) **Knowledge and experience retrieval, storage, and transfer**. For instance reporting problems or issues. If a carpenter discover that it exists errors in the drawings, defects with the materials, something is missing or consumed, errors in construction, these issues could be registered on a handheld and reported. Use

[1] These terms of knowledge types are referring to the work of Alavi et al. 2002.

[2] Fagrell and Krisoffersen (1999): ***sharing*** - several parties exchange knowledge, ***indexing*** - one party explains to another which knowledge to retrieve, ***diagnosing*** - two parties make sense of a situation, i.e. how it should be interpreted, ***foreseeing*** - one party or more uses knowledge to project the future.

of past knowledge in new development. In construction, it is essential to rely on past project knowledge and information when dealing with new projects.

# 4. Discussion

## 4.1. Use of Embodiment

The fieldwork study of Fallman (Fallman 2003) uses embodiment to explore the use of mobile information systems in industrial assembly sites. Embodiment, described as "*the property of through one's body being manifest within the world and hence inevitable a part of it*", is used to create support system prototypes for the assembly workers.

The fieldwork study took part in manufacturing units for Volvo Trucks and Volvo Cars. The prototype consisted of an arm-worm PDA that had both context aware[3] and context unaware functionality. The prototype allows the service technicians to locate spare parts, identify and get information about components, and access to component vendors by working as a phone containing an address list of the vendors.

The work differs from many previous CSCW works, which focus on white collars workers. Service technicians work is situated in the physical world. Through their findings, Fallman argues that the use of embodiment allows the service technicians to continue to collaborate in a way that is in line with their current work practice. By using an arm-worn intimate system, the technicians are permitted to continue in the same physical sense as they are used to and at the same time get access to computational services and information.

This study is of particular relevance for our cases. Our cases all describe physical workers, and the use of embodiment seems like a sound approach for introducing mobile ICT for construction workers, nurses and home-care. In a way, one can also argue that Fallman's prototype helps the service technicians with their secondary activities. Their primary activity is to manufacture components, not to call vendors and locate spare parts. However, as the study make no such inquiries; this might seem a little speculative, as we don't have intimate knowledge about what really are the primary and secondary activities of service technicians.

## 4.2. Janus-faces of mobile ICT

When ICT is used in the secondary working activities, one should be aware of the possible "Janus-faces" (Arnold 2003) of mobile ICT. Arnold uses the notion of a "Janus-face" (after the two-faced Roman Deity) to describe ironic, perverse and paradoxical performance of technology. Arnold argues that technology in one way can be a blessing and in another (unintentionally) way can be a curse. Mobile phones are pointed out as one such technology. Arnold gives many examples of Janus faced properties of the mobile phone; it gives us a high degree of independence, freedom and flexibility – but it's also a leash as we're always available. It brings us closer to friends, family, etc – but also separates us, as we'll never need to meet them face-to-face.

Thus, the Janus-faced properties of technology are an important factor to regard when designing mobile ICT systems. This should be considered especially when the mobile ICT is supposed to help you perform activities that are defined to be secondary of your work. E.g. the annoyances of being constantly available might have a distressing

[3] Context defined as the physical location they were operation at - detected by the use of RFIDs

impact if it disturbs the activities defined as primary. The Janus metaphor can be useful in finding other paradoxes when designing mobile ICT systems.

Arnold draws on various philosophical theories on his work. Substantive approaches, determinists, social construction and network approaches are discussed in terms of their capacity to account for generalized examples of irony and paradox.

Of special interest is the substantive theory of Feenberg (ibid.).

The substantive theory claims that technology's design will fundamentally change the way an organization or culture operates. Thus, applying this theory to mobile worker, mobile ICT will fundamentally change the way workers work. I.e. it will fundamentally change the way nurses nurse or construction workers do construction work. However, Feenberg's theories involve more than substantive theory and by using it, we should also include instrumental and critical theory. Although interesting, even using only substantive theory will be a too big task for this work as it probably would require a long time of observations before and after mobile ICT was introduced to the mobile workers.

## 4.3. The Roles of Space and Place

Harrison (Harrison and Dourish 1996) emphasises the distinction between space and place and while they is aim at informing the design of virtual spaces for collaboration there are some issues that are of interest in discussing how to inform the design of mobile systems for professional use.

Space is the physical structures and artefacts, while place is defined to include the cultural meaning and use. "*Space is the opportunity; place is the understood reality*" is their underlying principle. As space becomes place through the use by its occupants through time, they warn of the significance of this when designing virtual space and expect it to become a virtual place. They also points to the interesting observations that places exists even without space; as in newsgroups and chat rooms.

### Space, place and mobile information devices

There are at least two different questions that become interesting in this discussion of space and place:

- How does a mobile information device affect the culture and "rules" of a place?
- How does acting in a mobile "place" affect participation in virtual places?

The first question is familiar in public places such as cinemas and restaurants, where it is generally not accepted to use a mobile phone or mobile information device. Other places have changed cultural value as mobile information and communication technology has provided access where they otherwise would be isolated. Airports, cars, commuter-trains, and hotels have become extensions of work places through the use of mobile phones and portable computers. This tie in with (Kakihara and Sørensen 2001) and their notion of work taking place in new contexts.

Studying the first question may inform systems design in that there are places where the use of mobile information devices is accepted, but there are other places (it might even be the same physical space, but in a different context; making it a different place) where these devices are not accepted. The way the mobile information devices affect the rules of the place might be important in the design of mobile systems. (Kakihara and Sørensen 2001) points out how the new information and communication technology provide new degrees of freedom in terms of organising work and activity; spatial, timely

and contextual freedoms. Mobile information devices may challenge the way we organise work and leisure even further as especially the spatial and contextual freedoms are greatly expanded by these devices. How this affect actor's participation in virtual places such as corporate information systems is important to understand when designing mobile information systems.

## 4.4. Expanding the view of mobility

Kakihara & Sørensen (Kakihara and Sørensen 2001) adopts a quite different view on mobility. They are not concerned with mobility of artefacts or users directly, but rather on the new degrees of freedom in organising activities afforded by information and communication technology and mobile information devices.

The new degrees of freedom in organising activity are spatial, temporal and contextual.

Telecommunications and information technology has made distance less important in many cases. This allows a spatial freedom in how work activities are organised. Your colleague may be in the next room or hundreds of Kilometres away. Asynchronous technologies, such as email and the web, allows a temporal freedom making it possible for teams working together in different time zones around the world. As the spatial and timely freedoms are exploited we work and collaborate in new contexts. This is the contextual freedom afforded by ICT.

In his recent book, "Smart Mobs" (Rheingold 2003), Howard Rheingold predicts: "*The "killer apps" of tomorrow's mobile infocom industry won't be hardware devices or software programs but social practices. The most far-reaching changes will, as they often do, from the kind of relationships, enterprises, communities, and markets that the infrastructure makes possible.*"

When designing ICT systems most of the attention is usually devoted to the design of the technical components of the system. The new degrees of freedom described by Kakihara & Sørensen are often not considered when developing a new ICT-system.

In light of primary and secondary activities these perspectives might be of interest as the cases we present all are mostly autonomous in their primary activity, while it is precisely the secondary activities that link them with the other parts of the organisation. Analysing and finding ways to exploit the freedoms of spatial, temporal and contextual organisation of the work activities might uncover new and important uses of mobile information devices.

## 4.5. Anecdotes and sub-cultures

Howard Rheingold (Rheingold 1999) reflects how the Amish people are selective on which technologies to adapt and which to reject. In the Amish community the collective is favoured to the individualistic ideal of the outside US culture – this is used as an explanation for their choice of technologies to adapt and to reject.

The Amish communities make use of anecdotes to explain the stance of the Bishops, personalising and making the explanations hard to question or oppose. Howard Rheingold chooses to focus on the phenomenon of being selective to technology and use this to raise some important questions on how we accept new technology in modern society.

One of the strengths of a closed religious society, as the Amish, is their authoritarian structure, which allows clear and common values and rules; making it possible to have a small group of people discuss and enforce their assessment of each issue at hand.

There are at least three different ways of responding to this article: One is to reflect on the way individuals or organisations make choices on which technologies to adapt and to evaluate this against the values held by the actor. Another way of looking at the article is to note how anecdotes are used to explain and establish a perception of a technology.

Finally it is possible to discuss how technology sometimes contributes to a sub-culture that is hidden and that breaks the rules of the community (this is particularly interesting as this is the main theme of Howard Rheingold's book "*Smart Mobs*" that came out later than this article). Notice how connecting to the public electricity lines or telephone lines carried a great symbolic value of being connected to the outside world and was also a give-away on who were connected.

In the case of studying the nurses the first theme was often discussed and there seemed to be a slight difference between those who were open and eager to adopt technology and those who were sceptical and felt that computers were in great contrast to the values of Nursing. There seemed to be a generation gap between older and younger nurses, where the former would be more sceptical and the latter (especially males) were more favourable (there were few male nurses and no older male nurses, so it was impossible to investigate the gender aspect on this issue). Requirement processes, related to implementation of health-informatics systems, seem to rarely focus on cultural issues and evaluate known consequences of a technology against the values of each place (Harrison and Dourish 1996) and situation.

The use of anecdotes is a powerful technique and has recently gained attention from researchers such as Jonathan Grudin (Grudin and Pruitt 2002) and consultants as Alan Cooper (Cooper 2000). Anecdotes may create a positive or a negative attitude towards the implemented technology, but is often overseen by developers and consultants as a tool in the implementation phases.

The final issue is on the creation of subcultures as a response to the enforcing of rules or technologies. In the case of the Amish people it seemed that mobile phones were creating subcultures among Amish population participating in several aspects of the post-modern world in opposition to what is likely to become the advice of the Bishops (at least if we are to stipulate from the attitude to telephones and the Internet). We find similar situations in healthcare where General Practitioners are using their mobile phone instead of the radio for the Norwegian Health Services Radio Net, an old-fashioned system with an unfamiliar interface, disobeying procedures of the AMK-centres (emergency centres responsible for coordinating everything related to emergency situations). In the case of the nurses we had to make the system be able to provide several different interfaces allowing different technologies be used by different users; paper, PDA, or PC-terminal.

## 5. Further Work

So far we have found a lot of issues for further research. The ongoing work includes sorting out which issues to elaborate, clarification of terminology and going through more discussions to clarify how mobile ICT can be exploited for the occupations described in our cases.

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