

Exploring mobile CSCW

Five areas of questions for further research

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Abstract

We report ongoing research in search of characteristics of mobile work and use of mobile ICT (information and communication technologies) to support such work.

Based on an explorative case study of the work of mobile service technicians at Telia Nära, we outline five areas of questions where mobility changes fundamental aspects of the work. The areas concern both individuals as a professional and as a social being. The professional aspects include sharing knowledge, explicit as well as tacit, forming a professional identity. The social being aspects include becoming a member of a social group, and maintaining the community.

Keywords: Awareness, CSCW, Community, Co-operation, Co-ordination, Introduction to social groups, Mobile work.

1. Introduction

The recent technical development has made it possible to work at a distance. Wide dissemination of mobile phones, increased capacity of computer networks, integration between telephony and computer systems are factors that work together to facilitate mobile computer supported co-operative work (Mobile CSCW).

So far, most studies of mobile work concern the technology such as mobile networks, RPC (Remote Procedure Call), ATM, Satellite systems etc. or usability and reliability aspects of PDA's (Personal Digital Assistants) and other handholds. To mention but a few: small keyboards, limited battery life, unreliable network connections, varying channel coding and characteristics, volatile access points, risk of data loss, portability and location discovery (e.g., Bhagwat and Tripathi 1994, Dearle 1998, Francis 1997; Imielinski and Badrinath 1994; Satyanarayanan 1996). As Dix and Beale (1996) claims, Mobile computing consistently fails to live up to expectations. Early adopters complain about the size and resolution of displays, awkward input devices and limited bandwidth (Kristoffersen et. al, 1998) (Varshney, 1999).

However, when introducing mobile technology in collaborative settings there are a lot of social and professional aspects too to consider. This paper reports a part of an ongoing empirical research project in search of social and professional characteristics of mobile work and IT use to support such work.

Based on an empirical investigation of mobile service technicians at Telia Nära, we below outline five areas where mobility changes fundamental aspects of the social interaction. We present those areas as the start of a discussion on general question for further research

within the field of mobile computing which we find largely lacking as yet.

2. Definition of mobile CSCW

Mobile work is not equivalent with telework, but the two share some characteristics. Our definition of mobile CSCW (Computer Supported Co-operative Work) includes (1) Individual workers move among several locations, as required by the objects of activity being to at least some part located outside of the computer; (2) People working together may be physically separated. Let us at some length explain this definition. While telework means working at a distance from colleagues and/or customers, mobile work also imply that the location shifts during the work.

“Telework, broadly defined, means ‘working at a distance’: the person doing the work is at
- those who
use the work outputs. The most popular example is the person who works at home instead of commuting to a distant office. Another is ‘the mobile worker’ - one whose ‘place of work’ isn’t fixed at all, and who needs to be effective in a range of different work settings. There are some workers for whom mobility is central to their role - for example, field service engineers” (Dix & Beale, 1996).

However, this does not imply total independence of any place. In fact, mobility is often required by the fact that certain places have to be visited - it is hard to repair a telephone pole if you are not on the particular site.

There are several terms being used to describe almost the same kind of phenomena, like road warriors, local nomads, campus nomads (Kleinrock, 1996), or just nomads (Dahlbom, 1998).

According to Kleinrock (1996), Nomadic computing and communications will dramatically change the way people access information- and a paradigm shift in thinking about applications of the technologies involved. It exploits the advanced technologies of wireless, the Internet, global positioning systems, portable and distributed computing to provide anytime, anywhere access. It is beginning to happen, but it makes everything much harder for the vendors. The underlying mechanisms of nomadic computing and communications must support traditionally understood requirements of mobility, portability, and wireless communications, such as data transport, user authentication and privacy. There will also be new requirements. Among the most challenging are: 1) supporting the multiple roles desired by a user and dealing with varying sets of technologies, services and data, and; 2) configuring data to maintain critical content characteristics across the varying media the nomad encounters or commands as he or she moves about.

Our definition does not exclude these arguments claiming it to be something else, rather we just define mobile CSCW as 'working together at various sites with the use of mobile IT'.

3. Mobile Informatics

There is a research area under the name of Mobile Informatics (Kristoffersen et al 1998). Mobile Informatics takes a step away from traditional Information Systems research claiming the need for new ideas and idea generation concerning innovation of IT use in mobile work.

The Mobile Informatics Group believes this challenge as fundamentally conceptual, rather than technical; "today's mobile computing paradigm simply does not meet the users' needs!" (ibid, 1998). Kristoffersen et al (1998) also presents three kinds of modalities of mobile work; visiting, travelling, and wandering. Visiting is working in different places for a coherent but temporal period of time, e.g., maritime consultants engaged in the classification of ships. Travelling is working while travelling in a vehicle, such as an airplane or a train. Wandering is working while being mobile locally, i.e., local, physical mobility of users, e.g., a distributed and mobile team of IT support staff.

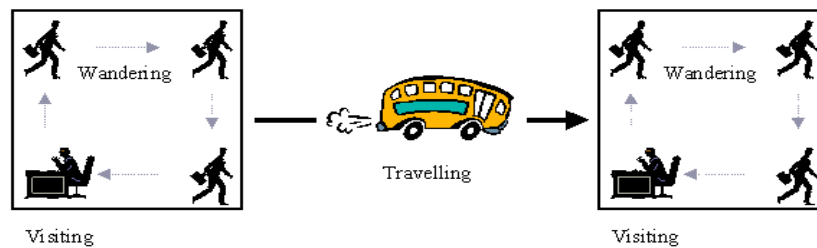


Figure 1: The three different modalities of mobile work (Kristoffersen & Ljungberg, 1998b).

Kristoffersen and Ljungberg, (1998) also claims mobile work and to be characterized by a very dynamic surrounding, high risks of technological breakdowns and where such a breakdown can mean that no work can be carried out at all.

However, there are even more social aspects of mobile work to consider beyond the individual user, like the creation of group mentality, group collaboration, conflict resolution, and organization of a mobile work environment. Clearly mobility puts new demands on IT support, but certainly also many areas of old research can be used for a start. One such area is that concerned with social aspects of work.

4. Research method: An explorative case study

We have conducted an explorative case study of the mobile CSCW. An explorative case study aims at exploring what is happening and how that is happening. As such, an explorative case study focuses on "what", "how", and "why" questions.

"If research questions focus mainly on "what" questions, either of two possibilities arises. First, some types of "what" questions are exploratory, such as this one: "What are the ways of making schools effective?" This type of question is a justifiable rationale for conducting an exploratory study, the goal being to develop pertinent hypotheses and propositions for further inquiry. However, as an exploratory study, any of the five research strategies can be used - for example, an exploratory survey, an exploratory experiment, or an exploratory case study. The second type of "what" question is actually a form of a "how many" or "how much" line of inquiry - for example, "What have been the outcomes from a particular managerial reorganization?" Identifying such outcomes is more likely to favor survey or archival strategies than others." (Yin, 1994, p.5).

In this initial study we aimed at raising as much questions as possible concerning mobile CSCW at the particular research site as a point of departure for further research.

Since our focus is on the first type of "what" questions we choose a qualitative approach. In particular, we used participant observation techniques and qualitative interviews to collect data.

Having transcribed the field notes, we started the coding of the empirical data. We went through the data, made notes, and labeled data of interest. The analysis of the empirical data aimed to identify different areas of questions for further research into the area of mobile CSCW. In total we identified five areas of interest for further research.

Having identified the areas we summarized our questions according to each topic. In this paper these topics and questions are outlined. We have also tried to relate the identified areas to other relevant issues currently discussed in the area of informatics.

We do not claim the findings of these five problem areas characterizing mobile work from the case of Telia Nära as covering all aspects in need of more research. Our belief, however, is that the meaning of being and working together as a group is challenged and changed due to the special and challenging conditions of being able to, and sometimes forced to, work 'everytime, everywhere'.

5. Research site: Mobile CSCW at Telia Nära

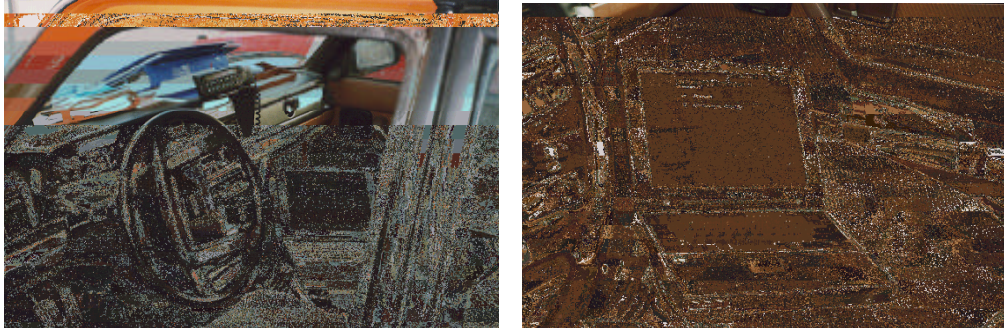
Telia Nära is part of Telia, the government owned telephone operator in Sweden. Telia Nära is divided into 35 market companies each containing the three divisions; (1), Service, Service technicians serving the telephone network (2), Support, a call center and, (3) The Store. This project has focused on the part of Telia Nära in Umeå, Sweden, providing service to Telia's customers, e.g. part one (1). The service technicians fix problems like cable breakdowns, overhearing on the lines, etc.

The service section has recently gone through a reorganization including providing the technicians with advanced computer and telephony technology, and introducing a new economic incentives system. The new IT makes the technicians completely mobile; every information they need can be accessed from the car. Similarly, anybody who wants to pass information to them, by telephone or computer, can reach them in their cars.

The goals of the reorganization have been; (1) closer customer relations, (2) JIT (just in time) delivery of parts and services, and (3) route minimization by use of mobile IT.

The IT at Telia Nära can be divided into three different but fully integrated systems. (1) The Car systems with terminals at all times connected to the Service call center downtown over a radio LAN. The cars have systems to support scheduling of activities, putting work on waiting lists, search the telephone network for errors, get in contact with the other cars, redirect missions to free cars if something unexpected occurs, etc. The technicians can, for example, search for errors over the telephone network from the customer's site. The new IT also makes it possible to plan the route for the day at home and reschedule it during the day. It can also be used to order parts needed to be changed at the customer's site and plan a route for the day in an optimal manner. (2) The cellular phones receiving SMS-messages from the Station, telling of breakdowns in the telephone network. The SMS message contains information of the customer's telephone number, so the technician knows where the customer is located. It also contains information about what kind of problem there is from the description given by the client. The SMS-system is connected to the mobile car system, so the short description using

SMS (short message service) given over the cellular phones can be further investigated by consulting the car system, and (3) The Station systems needed to receive calls from phone customers needed help, scheduling of those, and resource allocation among the cars, i.e. where to send which car.



Picture 1: The pictures shows the interior of a service car with the mobile system installed.

Being mobile at work is crucial for the technician's ordinary work, from the way they plan the route for the day or scheduling a whole week to carry out specific service activities at a customer's site. However, the technicians need to deal with many other problems related to the mobile nature of their work. We have identified five areas of socially related problems concerning making a work site function smoothly. The problems are related to, or affect, both the quality of work, the efficiency of the route planning, and social aspects of the work situation.

6. Five research areas of mobile CSCW

Socially related problem areas of mobile work grounded empirically are not very much considered in the field of mobile computing. Most research is concerned with resolving technical issues in communication and data processing (Mobicom 1997). Successful networking is often seen as just a question of meeting technological requirements (Kleinrock, 1996).

But networking is also a social activity (Ljungberg, 1997). Not only is co-operation often necessary to accomplish tasks, but work is also a part of people's life. People work not only for money. People do socialize at work, and would be expected to want to find ways to do so even if their work includes a lot of travelling alone.

Based on the findings of our case study, in this section we outline five problem areas of mobile work including social aspects. We raise some questions that we think need further research. The areas include social aspects of work concerning the individual as a professional as well as a social being.

6.1. Membership in mobile groups

Dahlbom, (1998) describes a trend in the new information society towards a higher degree of "nomadcity", e.g. by the use of new information technology be able to move around and work wherever we are independent of time and space. However, not even nomads are eremites. They live in groups, they are social, both in work and for pleasure.

Today's mobile workers are of the first generation. They have learned their work in a group, and they have moved towards mobility and separation. Perhaps the next generation mobile workers will be born into mobility. On their first day at work, they will be put in a car alone.

In the case of Telia, they cannot bring a tutor along even if they wanted to and the company found it worthwhile; the second seat in the car is occupied by the computer equipment.

There are different ways of becoming a member of a professional community at work; by working side by side on a task, by socializing in the coffee room, by having a tutor during the first time, etc. But how to do that alone in your car? You have a phone, but who to call? And talk about what, when you don't know anything about your work mates, and can't give it a soft start by listening in for a while before saying anything? The newcomer is left with the initiative; this is not the way introduction to social groups typically works.

The study of Telia Nära shows that forming and maintaining the 'horde' takes a lot of social effort and new comers find the climate quite rough in the beginning. However, there is possible to see how actions are taken all the time by the individuals in the group and together creates the community.

The "horde formation" activities must probably have some support also in a mobile environment. There is some research on formation of communities in the electronic environment (Parks, 1996), but this research concerns people visiting interest groups by their own choice and will. Forming professional communities at work is somewhat different; this is an issue that should be investigated closer.

- How are hordes formed initially?
- What means are there for a new member to become socially integrated? Can technology be of any help?
- How do people behave to circumnavigate the obstacles imposed by the work organization?
- How is interaction with the others within the group initiated and maintained in a mobile setting?
- How are leaders selected? Do other factors determine social status than in office or workshop environments? Is, for instance, mastery of the medium a factor?

6.2. Co-operation and knowledge sharing at a distance

In the area of CSCW, co-operative work has often been defined as the relationships among the agents formed through planned structuring, deliberate discursive action, as opposed to spontaneous linking, such as in a market (Lyytinen & Ngwenyama, 1992).

Studies of computer based communication have shown that even straight communication similar to common everyday 'face-to-face' communication is very hard to establish and maintain, so what about co-operation and collaboration?

"In face-to-face conversation, co-operation between interlocutors is constantly monitored by a series of fine adjustments, turn-taking and reciprocal corrections..... Instead, in CMC (Computer Mediated Communication) the collaborative framework is very weak; it lacks the possibility of real-time confirmation of its participants' intention to collaborate".
(Mantovani, p. 102)

However, the study of the service technicians at Telia Nära shows that there is a need of new ways of defining mobile co-operation. Mobile workers often work alone and co-operation is seldom characterized by two or more people working on the same task. Rather, mobile work is a matter of co-ordination of activities, formal and informal meetings, and is very much structured as a market place. The mobile work is remote, decentralized, and highly individual rather than stationary, centralized and shared common task related.

Learning to do the job, and incorporating new knowledge into your repertoire, are to a large extent done by watching others work, discussing with others, and listening to others discuss. Only the second of these three ways is open to the lonely technician out in the wild, and only on his own initiative. He was alone also before, but the opportunities to discuss what he just had done and what he next was going to do have been reduced. This was what was done during the frequent encounters at the Station. One issue is then, how to maintain and develop professional knowledge when on the road all the time:

- How to create natural opportunities to learn from colleagues?
- How to create forums for sharing experiences?
- And, perhaps the hardest part: How to cater for sharing of tacit knowledge, e.g. know-how knowledge?

6.3. Customer service & co-ordination

The explicit goal at Telia Nära is to create a more customer centered organization. This is to be achieved by making it possible for a service technician to solve a problem completely during one single visit at the customers' site without having to go back to the central Station downtown for checking a cable, etc. To achieve this, a specification of materials needed must be complete, and material must be readily available.

As for the first point, (1) there is no systems support for checking in advance the problem at the customers site. The success entirely depends on the ability of the person at the Station to determine this during the telephone contact with the customer. As for the second point, (2) one feature of the reorganization is the abolishment of local storehouses, leaving any material that is not regularly carried around in the cars a matter of ordering from a supplier. This means that at least one day of delivery time in the case the supplier is not local. Another aspect (3) of customer service is the competence of the serviceman. Even though there is a minimum knowledge shared by all, inevitably some people become more of specialists in a certain field of expertise, or in the situation of a certain customer. Maybe the mileage minimization principle should be complemented by the "right man at the right place" principle?

- Obviously, the quality of work at times depends on other factors than rapid presence. How can an incentive system be constructed so as not to support the relatively simple measurement mileage minimization at the expense of other, perhaps more important, factors pertaining to good quality service?
- The mobile work is organized so as to reduce the dependency on the Station. But other factors, such as the location of customers, the need of a certain expertise, etc, may be important for being able to do a good job. How do the mobile workers handle such situations?

- Several technicians might be involved in helping a customer. How do they co-ordinate their work with each other? How do they appear as a group to the customer so as to provide a good service?

6.4. Process optimization vs. isolation and control

This problem area is threefold; (1) The mobility among the Telia Nära technicians was introduced in order to reduce mileage; people should not have to go to the Station at all, and tasks should be assigned so as to reduce transportation.

In the past, people traveled because they had no choice. If they wanted to transact business or converse with friends they had to meet in person. However, transportation costs made certain meetings and activities prohibitive. A long series of technological developments -- including the railroads, automobiles, and the telephone -- have aimed at lowering the costs associated with transaction and conversation. Computer-mediated communications through integrated systems of mobile IT and centralized stationary systems, like databases, etc. are just the most recent development in that progression.

At Telia Nära, the new system meant the feeling of being alone and left out was apparent strong among the technicians. When working together, there was a feeling of being part of the team. The new system means people mostly work alone, sharing experiences and communicating on how to deal with upcoming problem situations over the phone.

Secondly, (2) the mobile workers feels there is a competition going on between them and the Station expressing itself for example when the workers at the Station feels like they have some spare minutes, they start going error searches etc like they where doing before the new system was implemented causing conflicts by malfunctioning communication with the mobile workers.

So, while solving the problem, of optimizing work by letting the service technician take a larger responsibility, a third (3) problem seems to have been created. The mobile workers runs into problems of getting a feeling of working together with the rest of the group and maintain a good relation to the 'Station'.

There is also a measure of control. The economic incentive system for the technicians gives a premium to he who makes the highest number of repairs.

There seems to be some contradictions between optimizing processes and maintaining work satisfaction. While this is nothing new, the nature of mobile work seems to call for new remedies;

- How create co-operative work as not just co-ordination of individual tasks making it possible to carry out group work being efficient and optimized as well as satisfactory?
- How should economic incentive systems be designed from the conditions of being mobile, e.g. maintaining work satisfaction etc?

6.5. Maintaining the mobile community

There are many reasons for maintaining a sense of community among the staff. Common values are necessary for an ethically sound professional conduct. Corporate image may prescribe a common way of approaching customers. Quality demands may be dependent on the ability, and willingness, among people to share knowledge, tips, and promote quality standards. A general

feeling of community among people may create a positive internal climate; “We

Before the reorganization, the technicians met regularly at the Station. They went there to receive new orders, but at the same time the met other technicians, the Station staff, had a coffee and a chat. Now, they receive their orders at home in the morning. They are told by the managers to go directly to the customers, and the idea is to minimize the mileage and get the most out of the working hours. However, it appears people use the phone to arrange meetings; “Can we meet at... for a coffee at 10.30?” Some time is spent on such organizing of social events. They also still meet together almost every morning to socialize and exchange experiences. It appears “mileage minimizing” has a competitor: “social interaction optimizing”.

It was also clear that the phone where used frequently to maintain the group by frequently making very short calls concerning questions such as: "Which members of our group did you meet at the station this morning?", "Who were there yesterday?", "Will you be there later today and... should I or should you contact him/her to see if we should meet?".

Common standards are enforced and re-shaped by social interaction. One might wonder whether this quality of the interaction can be maintained by using technology.

- Suppose the company persists in enforcing the mileage minimizing principle, will people be satisfied with sitting in their respective cars drinking coffee and chatting over the computer network by means of some teleconferencing tool?
- How can people maintain social interaction in a very lonely mobile environment?
- Can technical tools be of any help?
- Can technical tools help to maintain the community by providing awareness of other group members and their current and previous activities?
- What about integrity aspect of such awareness tools?
- Can technical tools provide help for this shifting between the massive amount of short face-to-face meetings and their frequently computer-mediated and mobile phone mediated communication?
- How would such tool affect the communication pattern within the group? and finally,
- Is the social interaction optimizing principle so strong that the mileage minimizing does not work as assumed?

7. Discussion

We do not claim the findings of five problem areas characterizing mobile work from the case of Telia Nära as covering all aspects in need of more research. Our belief, however, is that the meaning of being and working together as a group is challenged and changed due to the special and challenging conditions of being able to, and sometimes forced to, work ‘everytime, everywhere’.

By doing further research, hopefully principles like the one of ‘mileage minimizing’ will be found and possible to verify. We also expect to further research typical dimensions of CSCW such as collaboration, communication and co-ordination; individual versus co-operative work as well as differences in synchronous versus asynchronous communication.

8. Conclusions

The nature of mobile work puts old CSCW issues, like co-operation, co-ordination of work, etc. back in light but in a somewhat different light due to changed preconditions of the work.

Our case study has revealed that there are social factors pertaining to the quality of the work as well as to the work situation of the technicians that seem not to be adequately catered for the way work is currently organized.

We have identified five areas, where the technology alone cannot help. We suggest those areas must be more researched in order to assess the dignity of the problems, if technology can be employed to remedy, if there are ways of organizing work that ensures that, for instance, the mileage minimizing principle is not enforced at the expense of the social optimization one or the “right man at the right place” one.

To fully make the dream of mobile work come true the non-technical aspects of mobility as it is ‘in the wild’ must be taken into serious consideration.

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