Wireless Enterprise Innovations: Raising Issues Of Temporality And Activities

Per Andersson, Mats Edenius, Christopher Rosenqvist, and Pablo Valiente
Stockholm School of Economics, Center for Information and Communications Research,
P.O. Box 6501, SE-113 83 Stockholm, Sweden, e-mail: Per.Andersson@hhs.se
(corresponding author)

1. Abstract

The overall research question guiding the papers' studies of mobility-in-use in organizations is: *How are different activities of temporality affected when organizations implement and use new wireless solutions in their intra- and inter-organizational work and how might these temporality dimensions be linked to each other and its further meaning in an organizational context?* The focus on "How"-questions signals an explorative, focus, where the aim is to develop knowledge on how different types of organizations adopt, integrate and use new wireless solutions. Empirically, the entire project that this paper is based on puts focus on 21 different enterprise industries and settings, grouped into eight identified "user environments" in the enterprise market for wireless services. The analyses of the enterprise markets studied have resulted in a set of models and conceptual frameworks, drawing on insights from in-depth case studies of wireless customer organizations, their users and their service providers. The paper discusses the widely and differentially used "mobility" concept. It puts aspects of temporality into the context of wireless enterprise applications and the connected mobility concept. It also elaborates on various conventional/general dimensions of temporality, followed by a discussion of potential effects on these temporal dimensions of wireless enterprise applications. The paper draws on, in a quite pragmatic way, empirical insights from the above described research project on enterprise customers of wireless solutions and the discussion is quite tentative. The paper is concluded with some implications for research and for management.

Key words: Mobile solutions, wireless technology, enterprise customers, mobility, work practice, organizing, temporality

1.Background: The Growing Importance of the Enterprise Market for Wireless Solutions

Based on a research project entitled "Organizations Implement and Use Mobile Solutions – Studies of the Enterprise Market for Wireless Services and Applications", a broad, long-term research program of user oriented, business development studies are introduced in the paper. The project and paper examines how firms and other organizations co-produce and create values from new wireless technologies and applications. This paper sheds special light on one particular issue linked to the widely used concept "mobility". We illustrate, from an empirical material, how temporality could be fruitfully discussed in terms of four activities to time; *synchronization*,

coordination, *sequencing*, and *differentiating*. By bringing in these activities into the discussion about mobility, technology and enterprise, we not only argue that mobile systems in enterprise will have effects on various temporal dimension of work processes, but also start a discussion about how different activities might be linked to each other and closely related to other temporal practices in the enterprise market for wireless services and applications.

Over the past ten years we have seen wireless services and applications flourish. Some examples; it is argued, that this development has great impact on the Enterprise market. Barnes (2003), for example, points at a radical impact of mobile computing and m-commerce on the enterprise market, implying that "wireless technologies have the potential to transform activities both within and between businesses" (p.342). Barnes, building on e.g. Wrolstad (2002) and other industry sources predicted that corporate demand was likely to drive the wireless market forward, and saw that many applications were developed for wireless enterprise computing. The use of new mobile applications would in turn generate major cost savings for the enterprises. Chen and Nath (2004) develop a framework for mobile business application arguing also that organizations that have successfully implemented m-business applications for their workforce have demonstrated that these applications contribute to organizations' operational efficiency and productivity. Glass (2002) is referred to, stating that the wireless business "removes costly and time-intensive delays from traditional business processes".

The prevalent discussion in contemporary research in the field could be summarized by Varshney et al (2004); "…an organization that is capable of harnessing the power of mobile technologies to automate its business and streamline business processes via mobile applications may reap the benefits of improved productivity, lowered operational cost and increased customer satisfaction. Wireless applications enhance mobile workers' productivity through improved decision making capabilities, less paperwork and reduced cycle times for transactions and billing" (p.356).

However, beyond such instrumental values we do not know very much about the real effects of using mobile enterprise solutions. This paper is an attempt to open this black box by discussing not only different instrumental effects of practicing mobile technologies, but to look at how the enterprise market is organized according to mobile solutions according to different temporal dimensions and some of its effects.

2.Research Background

In focus of the research project underlying this paper are different types of value creation processes, in the context of specific mobility solutions provided by new, emerging value constellations of firms. Empirically, the entire project that this paper is based on puts focus on 21 different enterprise industries and settings, grouped into eight identified "user environments" in the enterprise market for wireless services. The analyses of the enterprise markets studied have resulted in a set of models and conceptual frameworks, drawing on insights from in-depth case studies of wireless customer organizations, their users and their service providers.

The overall research question guiding the studies of mobility-in-use in organizations is: How are new mobile technologies implemented and used in different types of

enterprise organizations? The focus on "How"-questions signals an explorative, focus, where the aim is to develop knowledge on how different types of organizations adopt, integrate and use new wireless solutions.

Focus is on the effects on enterprise organizations' work practices, organizing processes, knowledge processes, and processes of business development, when implementing new mobile solutions. The mobile enterprise solutions in focus are often complex systems of hardware, software and services requiring adaptation and integration with already existing complex, back-office systems in the customer firms' organizations. There will be a 'supplier network' or 'value constellation', more or less formally cooperating, behind the mobile solution. The implementation can involve long-term efforts among the firms involved to stabilize practices and install new stable routines and structures.

Theoretically, the overall project connects several conceptual and theoretical areas: value and value development (e.g. Payne & Holt 2001), the co-creation of value in value constellations (Normann & Ramirez 1994), user involvement in development processes (e.g. Alam 2002), the handling of technology suppliers' and buyers' abilities and uncertainties during development and implementation processes (Ford 2002), and various aspects of the characteristics of the (mobile) "offerings".

This paper, which could be said to be one case study in a more encompassing project, brings up one particular issue connected to the widely used concept "mobility". We bring up for discussion one specific effect of wireless technologies in work practices within enterprise organizations and in work practices and interactions between the user organization and its counterparts:

> *How are different activities of temporality affected when organizations implement and use new wireless solutions in their intra- and inter-organizational work and how might these temporality dimensions be linked to each other and its further meaning in an organizational context?*

To limit the aim of the paper we will focus on two different effects inducted from our empirical material; how different temporal dimension are closely linked to measuring and timing practices. Next, and before approaching aspects of temporality in organizations implementing wireless systems, we briefly touch upon the widely and differentially used "mobility" concept. We thereby attempt to put aspects of temporality into the context of wireless enterprise applications and the connected mobility concept. After this, we elaborate on various conventional/general dimensions of temporality, followed by a discussion of potential effects on these temporal dimensions of wireless enterprise applications. Here, the paper draws on, in a quite pragmatic way, empirical insights from the above described research project on enterprise customers of wireless solutions and the discussion is quite tentative. The paper is concluded with some implications for research and for management.

3.Wireless Applications and Enterprise Mobility

Temporality is in this paper seen as linked to, even part of, the more widely used concept "mobility". One of the changes anticipated or actually seen in organizations when new wireless technologies are implemented is a shift in the "mobility" e.g. of work forces. Thus, there might, for example, be a shift in an organizational work force's movements in space and time. The mobility concept has become central in research describing the effects of new wireless technologies on the structures and processes of enterprises. The concept is not easy to catch and is closely related to the philosophical discussion on time and space and configured in place and space (See for example Case 1993, 1997, Tuan 1977).

The grand question about mobility and time and space has also been discusses and scrutinized by social scientists on a concrete level, frequently for more pragmatic ambitions. One such strategy to highlight the concept of mobility is to discuss it in terms of where different ICT-solutions are used. Kristoffersen & Ljunberg (1999; 2000), for example, distinguishing between different work forces using IT in different situations: while wandering, visiting or traveling. In their studies of mobile professional workers, Kakihara & Sörensen (2004) argued that the understanding of mobility could be understood better when analyzed along three dimensions: locational mobility (concerned with workers' geographical movement), operational mobility (concerned with workers' capability for flexible operation), and interactional mobility (associated with mobile workers' intensive and fluid interaction with a wide range of people).

Another mobility distinction is made by Luff & Heath (1998). Their often quoted paper makes a distinction between micro-mobility, local mobility and remote mobility, where the last denotes the situation when geographically separated people interact through the use of technology.

A third way to discuss mobility is in terms of centrality and dependency issues. Directly relating wireless technologies to "enterprise mobility" , Barnes (2003) for example develops a framework in three dimensions for understanding this type of mobility; Process, Market, and Mobility. The third variable, Mobility, "describes the level of geographic independence of enterprise workers, enabled by the wireless data solution"(p.344). Barnes describes the three dimensions of mobility in the following way:

> "The first level is 'transient', describing the basic support of employees as they move from one location to another. These employees are geographically tied to the locations between which they move. The second level is 'mobile'. Here employees have a much higher degree of geographic independence from the enterprise, and have geographic independence for prolonged periods of time, but they inevitably return to corporate locations to perform certain functions. Finally, the highest level of mobility is 'remote'. At this level, employees are almost completely removed from the corporate location, being empowered with a very high degree of geographic independence." (p 344)

Weilenmann (2003), on the other hand, observes in her focused discussion on mobility that the term, widely applied in association with information and communication technology, is used to describe very different things, beginning to pose the important

question: mobility of what? She distinguishes between the mobility of individuals, mobility of the setting, mobility of technologies/artifacts, and mobility of information.

More important for our discussion on temporality below she also stops at other important distinctions in relation to this:

> "Other distinctions which are important to make in relation to mobility are that between present (co-located) versus distant (remote), and synchronous and asynchronous. The primary form of communication is often considered to be face-to-face communication. In this form of communication, both parties of the conversation are *present* and can hear each other, thereby simultaneously 'sending and receiving information'. This is synchronous communication. Time is important here; synchronous communication takes place at the same moment in time."(pp.24-25)

Hence, technologies can change the temporal and spatial constraints on the transmission processes, and Weilenmann argues that "mobile technology radically changes the possibilities for interacting synchronously with distant others" (p. 25, see also Ellis et al (1991).

In line with e.g. Weilenmann, several authors criticize the narrow use of the mobility concept when looking at work forces as "only" dealing with aspects of remoteness from a specific geographical location (aspects of "space") or dependency issues (power). Instead they propose to highlight the dynamism of work as such. Kakihara & Sörensen (2004) argues along this line:

> "For example, the concept is typically used in such forms as 'mobile technology', 'mobile office', and 'mobile work'….All of these usages of 'mobile' refer to some sense of geographical movement or remoteness from a certain fixed point or location. …However, such usage of the concept ignores another important aspect of the original meaning, referring to transformation or motion of objects, states, conditions, or structures." (p. 183-84)

Summing up, there is a growing literature on "mobility" in social science, focusing on the dimensions of the concept as such, focusing on its relevance in enterprise contexts where different work processes are in focus, and focusing on shifts and changes in mobility as an effect of the introduction of wireless technologies and applications. Some of this research shows temporality as one of the (underlying) dimensions of mobility, despite the fact that shifts in time-space dimensions are dominated by descriptions and categorizations related to the latter, space. *Synchronization* and aspects of *coordination/interaction* are two of the most frequently mentioned. Taking temporality one step further, we now present some central temporality dimensions – activities of time – which often are affected by the introduction of new wireless technologies in enterprises. These will be followed by empirical illustrations.

4. Organizations and Temporality

The centrality of time can be linked to a number of universal functions that time serves in organizations like in all social contexts (Sztompka 1993). The multitude of approaches to and perspectives on time and temporality in social and economic research signals an important conclusion; time is a multifaceted "element" of business operations which cannot be captured easily within the frames of one or even a few chosen perspectives, concepts, descriptions or thought-patterns. We use the concept of *temporal profile* to capture the overall temporal characteristics of ongoing businesses affected by new wireless technologies. The term was introduced by Sztompka (1993) who stated that ”…every social event or social change has its own ’temporal profile’, a combination of four temporal characteristics: sequential structure, duration, localization in a wider sequences, and repeatedness or uniqueness…” (p.55). In organization and strategic management research, (e.g. Bluedorn & Denhardt 1988; Adam 1995; Ancona et al 2001) similar ideas have been presented. Ancona et al state for example that ”…(one category of temporal dimensions) maps activities to time. Examples are rate, duration, allocation, scheduling, and entrainment… (p.515)”. A number of universal dimensions of time are elaborated on by Sztompka (1993), Lee and Liebeenau 1999, and Ancona et al 2001).

From the contemporary literature in the field, we will below suggest different general notions of time. They are all build on the prevalent time discussions in sociology (e.g Sztompka 1993), organization research (e.g. Pfeffer 1992), market strategy (Andersson & Mattsson 2006), and insights from the empirical studies of the implementation and use of wireless technology in enterprises in 21 different industrial contexts, a set of temporality dimensions are elaborated on. Hence, our method to figure out important activities to time in this context could be said to be based on a kind of qualitative “factor analysis”.

Temporality is discussed in terms of the four general notions of time in enterprises implementing new wireless technologies: *synchronization, coordination, sequencing,* and *differentiating.* These notions could be said to represent both different activities (practices) to time and how different actors relate to time (see Ancona et al 2001).

As so much in daily life, also organizational, business life and work processes are in many parts determined by various ways of representing and dividing up time and hence the use of resources. This applies both to internal work operations in enterprises and to various dimensions of exchange processes between enterprises, e.g. how firms measure and value the time spent on certain service activities. We can assume that the introduction of new technologies, e.g wireless technologies, will have effects on such stable structures of measuring, involving also processes of introducing new structures of measuring time, and using various time related measures to organize various work processes (our profiles).

- *Synchronization*: A large part of organizational life is filled with collective actions Things are done together by often large numbers of people. Organizational work processes require collective action, interaction and communication. For such actions to occur people sometimes must find themselves at the same place at the same time, or they have to be coordinated in space during a certain period of time. This is in line

with e.g. Weilenmann's (2003) discussion on synchronous and asynchronous activities discussed described above. For example, or example, a complex work process like e.g. a building construction process stretching over a period of time require certain moments and elements of synchronization between people and between people and machines/artefacts within and between enterprises. "The greater the interdependence of actors (here: enterprises), the greater the necessity for temporal synchronization" (Lewis and Weigart 1990:96 see Stompka sid 51). Hence, when new wireless technologies are implemented some it their effects on temporality will be related to the synchronization of activities in work processes.

- *Coordination:* Synchronization leads into the second aspect of temporality in work processes, coordination. *W*e regard it as a more encompassing activity than synchronization. The example of the building construction process shows the importance of coordination in and between enterprises. A large number of work processes are related and interdependent and need to be coordinated to lead to a common goal: "To build a house, the foremen, bricklayers and plumbers must come to work at the same time and organize their day by the clock, so that there will be a logical interrelation of tasks and no mutual interference or obstruction." (Sztompka 1993, p. 51). The division of work in enterprise contexts leads to a need for coordination. The mechanisms by which such interdependencies are handled can be greatly affected by the use of new technologies, whether such coordination involves direct interaction between actors or not. Wireless technologies, e.g. in combination with various Internet platforms, portals etc., will in different ways affect this second temporality notion in enterprises, coordination.

- *Sequencing:* Both synchronization and coordination are strongly linked to our third temporality notion, sequencing. A work process in an enterprise setting most often involves a logic where certain activities or events follow one another in sequences. These sequence relate the individual actions within a time order and to phases or stages in an overall work process. Sequencing is dependent on coordination because coordination between different sequences in different work processes often involve more than one actor, and coordination within a sequence is in enterprise settings often affected by unforeseen conditions. (Coordination is thus dependent on sequencing. If concurrent interdependent sequences are in conflict with each other, coordination is different from a case when such sequences are complementary.) Certain activities in work processes cannot be done earlier or later in such sequences, and sometimes people have to wait (or rush) as a consequence of changes in such sequences. Wireless technologies can have effects on this temporality notion of work processes in enterprises, e.g. by compressing the sequences.

- *Differentiating*: Like in social life, organizations involved in various work processes divide up and demarcate time, allocating certain resources to certain activities, while spending other resources on other periods of time. The introduction of new technologies in work process, like in the case of measuring above, will most likely have effects on established patterns of time differentiation within and between organizations and their work processes. A traveling salesman or service technician

equipped with a new powerful wireless technology will be able to differentiate the time spent on different activities in their daily work in partly new ways.

Bringing to surface these dimensions of temporality and time functions, they can help us see what time function(s) in the existing enterprise work processes that new wireless technology can affect, or even, might be aimed at. We will also link these activities of temporality to two closely related practices; measuring and timing.

- *Measuring*: As so much in daily life, also organizational, business life and work processes are in many parts determined by various ways of measuring and dividing up time and hence the use of resources. Measuring could be said to be an activity to represent temporal activities. This applies both to internal work operations in enterprises and to various dimensions of exchange processes between enterprises, e.g. how firms measure and value the time spent on certain service activities. We can assume that the introduction of new technologies, e.g wireless technologies, will have effects on such stable structures of measuring, involving also processes of introducing new structures of measuring time, and using various time related measures to organize various work processes. Measuring as part of temporality also gives us a link to the fact that time and temporality in enterprises also are the subject of (social) construction, i.e. actors do things and are at the same time part of and outcomes of different practices (Bourdieu 1977, Giddens 1984).

- *Timing:* Sequencing leads into our last temporality notion, timing. Timing refers to when an activity is performed, not in isolation but in a dynamic context. ‘‘When’’ matters for the outcome of work processes since conditions change over time. Timing refers to a number of points in time when an act could have been taken and actually was taken (Andersson & Mattsson 2005). Timing relates separate acts/activities in a work process to each other (e.g in terms of a sequence of acts.) There is only one point in time or during one period that certain activities can be performed. For example, timetables structure the processes in transportation and logistics. Wireless technologies have had important effects on e.g. work processes in transportation industry settings, affecting and refining the possibilities for timing

Next we illustrate how our proposed temporality dimensions of “mobility” can be affected by the introduction of new, wireless technologies and sketch how different temporal activities may have impact on the way we measure temporal dimensions and the act of timing.

5. Empirical studies wireless enterprise applications in practice

Empirically, the project embraces some 20 industries and organizational settings, in the enterprise market for wireless services (Table 1). The case data bank includes both cases

which have been performed within the research project, and cases which have been collected form other sources. The aim has been to start with the "user environment", i.e. to select a wide variety of enterprise settings to be able to compare different organizational circumstances and settings, settings in which the new wireless technologies are implemented. The cases are of varying length and depth, and the majority is collected from one of the most progressive markets for mobile enterprise applications, Scandinavia. (Compare also Barnes' (2003) survey and enterprise case from the New Zealand market). See Table 1 for a list of the enterprise cases of this study.

TABLE 1 ABOUT HERE

In the next section, some observations on changes in temporality dimensions as an effect of the implementation and use of mobile solutions in organizations. The comments build on empirical studies in four of the 21 cases collected: 1) The Plumbers, a case on small plumbing (including some painters) companies ("The Tradesman and SME Context"), 2. Graninge, a case on mobile workers in forestry ("The Forestry Industry Context"), 3. The Hospital Pharmacists, a case on head pharmacists' work in large hospitals ("The Health Care Context"), and 4) Taxi Stockholm, describing the case of a large, city taxi company ("The Transportation Context"). Condensed, introductory versions of the cases are presented, each followed by comments on some of the observed effects on some of the temporality dimensions of the effected work processes.

6. Mobile enterprise solutions and changes in temporal profiles

6.1 The Plumbers: mobility in the tradesman and SME context

The case of the Plumbers is in essence a one-year project of developing mobility with the help of new ICT technologies in a group of ten small SME companies, all small plumbing firms. (Part of the process also included a set of painters and electricians). The underlying aim was to start from the business processes and communication needs of the plumbers. In a set of introductory sessions the steps in their work processes were described and analyzed. As a result, a set of central work situations ("scenarios") were formulated, some of which often were connected to some form of communication problem, internally between the plumber and a dispatcher or other unit in the company, with wholesalers of components, or with the customers. Based on these scenarios and the lists of identified needs for improved communication, a set of seven potential suppliers of new mobile devices, and software adapted to the plumbers work processes joined the development work. This resulted in a set of new mobile solutions, with varying content, depending on the level of technological maturity in each of the ten SMEs. It also resulted in new development work being initiated in the seven suppliers of mobile solutions.

The work and communication scenarios describing important work situations describing situations where new mobile solutions could improve efficiency and/or effectiveness in the plumbers work, and where new solutions were tested, included for example: 1) Bringing the right spare parts and accessories to the job: with the help of new

communication technology and supporting software, plumbers could be better prepared for a job before coming to the customer. Thus, a reduction of travel time based on better information about the job in advance was needed. This included the possibilities to influence customers to use MMS or a voice-mail that could be included in the work orders (taking pictures of the faulty parts), better connections with wholesalers and retailers of parts. 2) Registration of new and finished jobs: In many small companies, owners/administrators also work in the field, leaving little time for various registration activities (e.g. billing, time registration etc.). Many small SMEs requested communication platforms (including mobile devices, mobile e-mail, and administration software) that in parts could automatize some of these activities for personnel with both fieldwork and administrative responsibilities. 3) Control of available personnel: Much fieldwork is connected to emergency calls from customers, creating a need for quick communication with field workers on their geographical position and availability. Group SMS to mobile devices and "push-to-talk" technology were developed and suggested as important solutions, reducing the time spent on communication to each individual fieldworker. This was also connected to the need to quickly find the right address and distance. Route planning systems connected to mobile GPS equipped mobile terminals in the cars were solutions implemented and tested. 4) The need for more efficient communication and exchange of administrative information: Several time consuming problems in the SME companies work concerned the handling of administrative routines: order confirmation, time registration, billing procedures (including signatures), control and confirmation of jobs performed, and more. Electronic confirmation of orders via mobile devices was one solution implemented: consignment notes were electronically sent to the receiver of the goods (and services) e.g. on building construction sights, and when received/performed, confirmations or back orders could likewise be sent back electronically from the same mobile device.

These, and several other of the most time consuming activities in the plumbers work processes were identified and matched with administrative software, hardware and service solutions, all adapted to the use of mobile devices (GSM phones, 3G phones, PDAs or laptops).

Temporality effects: All scenarios outlined as situations where new mobile solutions could improve work routines in the SMEs had effects on the existing temporal profiles. Overall, it was anticipated during the planning and preparations and during implementation and stabilization of use of the new technologies that *coordination* of both internal contacts (between travelling service technicians and home organization) and external contacts (between service technicians and customers and also intermediaries – wholesalers and retailers). It also affected the *sequencing* of different steps in the work processes, and the *synchronization* of certain activities (e.g. using the mobile to improve the pick-up of hardware parts at certain points in time in contacts with the intermediaries, in order better coordinate better the activities related to physical distribution with the performance of the service activities.

6.2. Graninge: mobility in the forestry industry context

Graninge Timber AB is a Swedish forestry and sawmill company. The company implemented a wireless information system to improve their supply chain management.

The project started in the late 1980s when the company became interested in using radio-technology to enhance coordination between units operating in the forest (harvesters and forwarders), and the main office for management and planning of transports. The problem was work coordination, and the need to reduce time spent searching for saw logs out in the forest. This pre-phase was called the mobility quest phase. The initial formal project included a pre-study (pilot) and a second phase for implementing and rolling-out the solution. The pilot project consisted of a steering committee with participants from the main actors involved; and was carried out in close cooperation with nine operators. The pilot included a definition phase consisting of mapping current operations and a design phase when the specification for the base system was developed and designed. Some add-on functionality was also discussed. The system development activities for the mobile side included a prototype to get feedback from machine operators on the interface and functionality at an early stage of the pilot. Users were from the beginning involved in the design of interfaces and routines. They carried out the testing of the prototype so that additional development could be made before the equipment was tested in the final pilot. The specification of the system was difficult due to the fact that previous experience did not exist within the area of the forest sector. During the project users had the opportunity to give their viewpoints about the systems. (One example is that during the work with the detailed specification of the routines for the vehicle computer the need for a possibility to print out salary cards in the machine was realized). The, the roll-out decision included the total work force of approximately 100 machine operators that would start using the new mobile system for reporting activities from the forest. Computers were installed in the harvesters and forwarders. Project leaders installed the software and demonstrated the application for the users. All together, the training session covered one full day. Operators now were able to send fax (this was before Internet became widespread) and to some extent messages could be sent between machines acting as a rudimentary and very primitive form of e-mail system. The implementation proceeded slowly and with parallel systems initially. Regarding the usage, operators were obliged to send rapports to the sawmill. This fact encouraged usage and increased the technical skills of the operators. Through the usage of the system more information was available.

Temporality effects: One of the main aims of the new mobile technologies was to change and improve the coordination of production activities in the forest and the physical distribution of the timber (picking up and transporting the timber). This led to the shortening of certain activities in the overall shorter sequences of the work processes. In the plans were also discussed the possibilities to change the coordination with the end customers. Similar to the previous case, *synchronization* was also affected by the introduction of new logistical routines supported by the new technology. For example, actors involved in harvesting and in transportation/distribution, could be made to come together, synchronize, and coordinate their activities at more precise moments in time. The coordination and the temporal synchronization of e.g. foresters' and the transporters' activities were improved with the new technologies, shortening e.g. waiting times to perform certain activities, reaction time to start doing certain activities, and thereby also shortening the length of time to perform certain activities. Hence, improved coordination shortened the overall *duration* of the activity chain, from the point of harvesting, to distribution and further into the production processes.

6.3. The Hospital Pharmacists: mobility in the health care context

The empirical foundation of this study include accounts of both professional end users, pharmacists in large hospitals, and the supply side, represented by the founders of one focal supplier of mobile offerings for pharmacists. In 2003, the supplier launched the first products – mobile devices and software adapted to the needs of pharmacists - on the Swedish market, their socalled SafeMed concept. It was introduced at a few hospitals in Sweden. Two users, pharmacists working together with other professional groups at the University Hospital of Linköping in Sweden were early adopters. Their role at the hospital was relatively new. Earlier, pharmacists did not participate in the rounds at the hospital. In their new work role they work together with physicians, nurses and others during the rounds and also participate in the hospital's expert panels in the medication committees. Here they participate in developing the recommendations for what medicines to use under different circumstances, based on functionality, assortment, price etc. They had searched for various mobile services that could enable them to better perform their job. The process during which the SafeMed Pocket was introduced and developed can be categorized into four phases: 1) Initial development of the service offering, 2) initial customer contact and intensified initial interaction, 3) co-development of the mobile offering, 4) establishing new routines of usage of the mobile system.

The supplier took the initiative to introduce the system in the hospital organization, actively participating in the development of the mobile offering. The main benefit of the offering was to enable efficiency in the users' interactions with other professional groups at the hospital. They regarded their not yet established role as a challenge. They believed that communication and understanding between different professional groups at the hospital were insufficient. They also believed that enabling and supporting processes for the whole healthcare system were inefficient. They had to spend a lot of time on these issues. The pharmacists used the new mobile support system in different ways in the interactions with MDs and patients. In their interaction with MDs and other professional groups at the hospital they often brought the mobile device forward and used it as a tool for more efficient use of time, and to ensure accuracy in information to MDs, patients and nurses. However, in their interaction with patients they stepped aside when using the system and very in some cases not showing the mobile devices. Their interaction with other pharmacists was also in some cases complex. The mobile device was regarded as "a luxury". Medical doctors were in the beginning not very interested in the system.

Later, the pharmacists were involved in the co-development of the mobile device and software. For instance, they contacted the supplier regarding features to make measurements of the functionality of e.g. a patient's kidney. This was later included in the mobile software. They increasingly believed that the mobility of the system was essential for their work. While it served as a complement to stationary alternatives, which offered larger displays and more user-friendly typing possibilities, much of their work time required mobility and accessibility. Later, the pharmacists believed that the new mobile solution would change the prerequisites of their work processes They also believed that there were many additional features that in time could be included in the system. One such feature was the enabling of better communication with MDs through the system.

Temporality effects: One of the many effects on the temporal profiles of the work processes in this case was to *shorten the time* for certain decisions in the work processes of the hospital pharmacists. *Speed* in the decision processes could be increased. Furthermore, the use of the mobile system also had impact on various aspects of *coordination*, linking in new ways the work processes between the hospital pharmacists and other professionals in the hospital work environment: including doctors, nurses, patients and others. By simplifying the work procedures during the actual rounds when meeting the patients together with the doctors and nurses, the hospital pharmacists could in parts also change their own way of dividing up their own work time and work procedures. In other words, they were able to *differentiate* their work time in new ways. The close interaction and exchange of medical information during the hospital rounds, also made possible a shift in the *synchronization* with nurses, doctors and patients. Important medical information could be exchanged between all four parties at a specific point in time.

6.4. Taxi Stockholm: mobility in the transportation context

The case describes the implementation of a new technological platform in a taxi company, Taxi Stockholm.One part of the new platform is mobile equipment in the cars.

The allocation of available cars is critical for the taxi company. *Taxi load* and *estimated time of arrival* are usual parameters guiding the allocation process. Allocation, at Taxi Stockholm, also takes into account fairness to drivers to balance customer and employee satisfaction index. These two metrics, together with profitability per car and hour, represent the overall corporate goals. Complex algorithms are therefore needed to allocate the mobile resources, and to take into account the fact that customer need for cars is highest when few drivers are available, i.e. early morning on weekdays and late midnight on weekends. Around 75 per cent of the dispatch work goes through the call centre and 40 per cent is completed via the *Interactive Voice Response System* (IVR) i.e. routed automatically. Taxi Stockholm is therefore highly dependent on its technological platform to be able to run business on a daily basis.

The new technological platform of Taxi Stockholm is build upon four different systems where the dispatch system is one of these four components. The other three systems are Telecom, Radio and Mobile Equipment.Reservations pass through the customer service centre and are relayed on to drivers via the taxi dispatch system. The *Mobile Equipment* represents technology located at each particular taxi. A number of elements constitute the driver's daily work-toolset: the taximeter (TXM), the radio equipment (each taxi has a transmitter and receiver installed in the car to communicate with Taxi Stockholm's central system), the printer/laser scanner (to print receipts and to scan credit cards), the mobile terminal (to communicate with the central dispatch system), and the GPS, the positioning system that tracks the company's taxi fleet.

Co-ordination between the call centre and the customer is required during the contact and confirmation process. Customers are often interested in the estimated time of arrival of the taxi, approximate information about tariffs of the services, etc. Cars need also to be co-ordinated during the allocation process. Information regarding location and status of the car is sent to Taxi Stockholm's headquarters.

Idle taxi drivers located at a primary zone are assigned a queue number on arrival. This means that, within the primary zone, the driver's waiting time is the allocation criteria to get a new customer. Proximity to customer is not evaluated at a primary zone because the estimated time of arrival does not usually differ between drivers within the same zone. Moreover, the process is fair to drivers. If the primary zone has no available cars, allocation proceeds to select a taxi from a backup zone. This time the queuing criteria is disregarded, and selection performs on a proximity basis. This guarantees customer satisfaction and reduces the estimated time of arrival. If still no available car has been allocated the dispatch system starts a bidding process broadcasted to idle cars. All cars, then, get a list with area numbers and unattended customers. Pressing a zone code and the send button on the cars mobile terminal will assign the driver the job. Finally co-ordination to contact the allocated car is also needed. Information about the address where to meet the customer, special instructions to the drivers, tariff based parameters, etc. must be forwarded to the cars.

One main achievement has been the reduction of the distance between the vehicles and the customers. Another positive indicator of the project has been the increased taxi load achieved. In short, the main benefits associated with the wireless dispatch system presented in this report are:1) For Traffic Control Office: real-time information retrieval advantage, location based retrieval advantage, improved information retrieval from mobile resources, real time notification advantage, 2) for taxi drivers: better information accessible, new services available, improved work environment, 3) for customers: reduced estimated time of arrival, faster reservation process, detailed information about reservation process.

Temporality effects: The temporality effects described in the final par of the description, affected most parts in the network of actors connected to taxi transportation. In general, in each sequence of activities, from the ordering of a taxi by the customer to the point when the customer was let off at the final destination, the new technological system (including the wireless parts) helped reduce time slacks in the system, shorten lead times, and improve the overall coordination. Hence, speed of service to end customers could be improved. The duration, e.g. various waiting times could be reduced. Overall, the generally improved *coordination* of the cars in the taxi fleet was ion parts based on changes in the *differentiation* of time, linked to changes in the allocation of certain resources (taxis) to certain activities. Behind theses changes were also extensive efforts to build in new models and systems for *measuring* time, preceded by new detailed processes of analysing the use of time and resources. New ways of analyzing (measuring) the spatial coordination of actors, activities and resources were in time were important in the pre-studies.

7. Discussion: interdependencies between temporal dimensions in work practices

The case examples indicate that the implementation, use and stabilization of mobile systems in enterprises will have effects - sometimes radical effects - on various temporal dimensions of work processes in the enterprises. In addition, a close look at the effects on the work processes in these and in other cases in the study, show that very often two or

more temporal dimensions are strongly linked and interdependent. Changes in one temporal dimension will lead to changes in other. Secondly, the implementation of mobile technologies also had effects on the temporal differentiation – the division of time and work in the work processes – which was often connected to the institutionalization of new ways of measuring time embedded in e.g. new software. Lastly, it was also obvious in the cases that the outcome of the shifts in the temporal dimensions, was in different ways linked to the actual timing of the implementation of the new mobile technologies.

7.1 Changing temporal interdependencies when changing enterprise mobility

One of the most apparent interdependencies between temporal elements that were surfaced when changing enterprise mobility in most of the observed cases concerned the coordination, synchronization, and sequencing of activities. Hence, in the case of the SME companies connected to large building construction operations (painters, electricians, plumbers etc.), the introduction of new Internet planning systems (open platforms for all actors involved in the process), and connected new mobile systems, indicated the potential for radical effects on coordination, synchronization and sequencing of work processes. Traditional building construction processes – characterized by continuous alterations in existing plans and work schedules – were built on established sequencing of activities (certain plumbing and electrical installations had to be done before the paintwork etc.). Constant changes in work plans created stops and waiting times in the work processes. With the help of integrated new open Internet platforms and connected mobile technologies, radical shifts in the interdependencies between coordination, synchronization and sequencing could be achieved. Improved coordination with the new communication technologies (changes in plans could be performed on-line) led to shifts in the synchronization of different work processes (different workers could be at the same place at the same time to perform certain activities), which in turn led to shifts in the order in which certain activities could be performed, i.e. in the sequencing of activities. Changes in the coordination of various back-office activities (e.g. architects using the Internet platform when making changes in the original plans) and the various mobile field activities (the logistical flows into the building construction sites, and the mobile work flows on the construction sites), altered the possibilities to perform certain activities concurrently (synchronization), leading to needs to alter established patterns of sequencing activities in the work processes.

7.2 Changing differentiating and measuring (i.e. for registering the time used in different work processes) of activities when changing enterprise mobility

Many of the new mobile enterprise systems implemented affected the possibilities for field workers to change their way of differentiating different work activities (e.g. between service work and administrative work), and in some cases, also change the differentiation between work and leisure time. This was in some ways made possible by new ways of measuring (representing) time spent (new built in software in the mobile devices for time reports) and by GPS systems. Hence, changes in enterprise mobility indicated in many

cases strong interdependencies between changes in the differentiation of time in work processes and changes in the control, and measuring of time in the work processes. The introduction of new mobile devices was in most cases linked to the introduction of new software adapted to the work processes of the particular enterprise context. In several cases this software altered parts of stable structures of measuring work processes, introducing new structures of measuring time, and using new time measures to organize work processes. This in turn often had effects on established patterns of time differentiation within and between organizations and their work processes.

Cases suggest that new mobile technologies often imply intensified attention to measuring the effects on the temporal aspects of changed (increased) service levels. This encompass for example in the plumbers case, the BT case and the taxi case above, attention to measurements of: for example: 1) waiting time to obtain service, 2) reaction time to deliver service, and 3) length of time of the service. Different measuring practices could be regarded as different ways to inscribe practices, to know, and maybe to know in advance; to control.

7.3 On change management: Timing changes in enterprise mobility

The introduction of new mobile technologies will affect existing, stable structures of temporality in the work processes within and between organizations. Finally, it can be observed that this has implications for another important temporal dimension; the *timing* of the change management processes when the new mobile solutions are developed, implemented and stabilised. Pfeffer (1992) states that:"Timing is (Almost) Everything. In utilizing the strategies and tactics of power and influence, it is crucial to determine not only what to do but when to do it.....consider the important but often neglected time dimension of timing. Actions that are well-timed may succeed, while the same actions, undertaken at a less opportune moment, may have no chance of success..." (Pfeffer 1992, chapter 12) From a strategic, change implementation perspective, there are numerous situations appearing over time when enterprises must take actions to change. *When* such change actions appear may determine the successive development of the change, and the effects on the work processes (Andersson & Mattsson 2006).

Related to different measuring practices to know and to try to figure out things in advance, timely judgment-base decisions cannot be depicted by using clock time only, because impromptu situations do occur irrespective of the clock (see for example Rämö 2006). However, timing seems to live in symbioses with different activities to time. New ways of coordination and synchronization might have impact on timing.

This also includes interdependencies with sequencing. For example, *sequencing* is dependent *on coordination*, because very often the introduction of new technologies requires changed coordination of *different* sequences of activities. For example, it might mean changed coordination in the sequences of production and physical distribution activities, or changed coordination of sequences of physical distribution and use/consumption activities. Due to the fact that in the context of wireless enterprise application the coordination between sequences always involves more than one actor, improved, more efficient, sequencing will depend on the ways in which coordination between actors is managed. If concurrent interdependent work sequences are in conflict

with each other, coordination will be different from a case when such sequences are complementary. In addition, sequences relate individual actions within a time order and to phases or stages in work processes. Sequencing might thus affect timing because sequencing might change the pre-planned timing of actions, e.g. due to the changed conditions when a new wireless system is being implemented.

Although not part of the focal problems of the cases studies, it could be observed that the timing of the introduction of the new mobile solutions seemed to be of importance. While “the time was not ripe” in certain enterprises, applying a “wait and see and wait to build acceptance” strategy, other enterprises adopted a clear follower timing strategy, waiting for the results of the implementation by certain, dominating “lead users” in their respective line of business.

Summing up, one implication for enterprises involved in processes to develop new work process routines supported by new mobile solutions is that they need to have an understanding of the effects on temporality, on ”the temporal logics” of the stable work processes and organisational structures. Enterprises need an ability to handle and manage both the change process of implementation (and its temporality dimensions), and the stability of the ongoing work processes at which the change process and mobile solution is aimed.

8. Further research

Our illustrations show that time and temporality play important roles, i.e. *serve certain functions*, in all work processes in all types of enterprise contexts. Temporality serves mainly the role to *coordinate* individuals, groups, divisions etc. within and between organisations. To this coordination function of time, we have tentatively argued that a number of other important temporal activities belong, e.g. synchronization, timing, and sequencing. Changes in enterprise ”mobility”, as an effect of the implementation and use of new mobile communication solutions will include for every enterprise important effects on these temporal activities. It may be assumed that every work process develops its own *temporal profile* in the specific enterprise context where it takes place.

Furthermore, building on a previous discussion by Andersson & Mattsson (2006), some potential links between timing, sequencing and coordination *in connection with change processes (as timing and measuring practices) when new wireless technologies are implemented* need to be investigated. In line with this reasoning, the timing of such implementations can influence the sequencing of the implementation process because specific actions in business operations in enterprises can be seen as imperfectly pre-planned as a sequence. Sequencing also affects timing because sequencing might change the pre-planned timing of actions due to changed conditions. Furthermore, sequencing can be dependent on coordination because coordination between sequences during implementation involves more than one actor in business network contexts, and coordination within a sequence is affected by unforeseen conditions.

A topic for further research is to analyze more closely and in detail, the characteristics of the temporal profiles and different activities to time before the implementation of the new mobile solutions, and how the effects on the temporal profiles when implemented

and used. Such analysis could also include other central, temporal dimensions of enterprises' work processes, before and after implementation of mobile systems: the *speed* with which certain work processes are performed, the *duration* of work processes, the r*epeated ness* and *linearity* of (i.e. basically the possibilities to standardize) certain work processes linked to both timing and representational practices like measuring. Another topic is to scrutinize how different representational practices, different ways to measuring different temporal activities, might generate new information to act from. Such a dynamic analysis could investigate temporal profiles in a more dynamic and realistic way compared to a conventional analysis "just" focusing on workers´ geographical movement.

What is important is maybe not to find out a more or less accurate activity to time according to a specific context, or the most proper thing to measure, but to understand how different temporal profiles will start different knowledge processes in a dynamic way that could be both releasing and prohibiting.

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Industry	Case	Innovation	Industry	Case	Innovation
Manufacturing	BT Industries	Information System Implementation	*Pharmaceutical*	Astra Zeneca International	Clinical Trials
	Sandvik Coroman				
	Sandvik Trucks Dispatching	Mobile Information System			
Consulting	QED (Pseudonym)	Distributed Collaboration	*Agriculture*		
	Göteborg IT AB	Mobile Meetings			
	Business Creators	Marketing and Technology Management			
Public Administration	Göteborg IT AB	Mobile Meetings	*Health*	Medical Practitioner U.K.	Mobility of Paper Records
	Radio Sweden	Mobile News		Karolinska Hospital	mobility in Health Care, logistic handling
	London Underground Station Staff	Design of Collaboration Technologies		IS Sweden	Information System
	Mobile Parking in the Netherlands	Mobile Parking		Läkarbåt i Skärgården (Swe)	Mobile Doctor
	Mobile City @ Stockholm	Citizen Benefits		Örebro Hospital (Swe)	Tablet PC
Transport & Logistics	Japanese Mobile Fluid	Internet Mobile Phones	*Construction*	Construction Site in the U.K.	Remote Mobility
	Taxi Stockholm	Information Mangement			
	Allbröd	Mobile Distribution		NCC & Kista Science Tower (Swe)	Intranet Access, WLAN
	Ryska Posten	New Technology Management			
Forestry	Graninge	Meaning Creation with Mobile Data Systems	*Media & Entertainment*	Radio Sweden	Knowledge Management
				Metro	IT-implementation
				Mobile Solutions for the Music Industry (Swe)	Mobile Business Model Evaluation
Security	Svensk Bevakningstjänst	Communication and Information Systems	*Insurance*		
Banking			*Education*		
Research			*Energy*	Göteborg Energi	Geographical Information System
				Fortum	Communication and Information Systems
Retail & Wholesale	ICA	RFID Technology	*Other*	Mobile Workspaces	Designing for Mobility
				SnowCard @ Airports	Coordination Technologies
Automotive	Volvo Group	Knowledge Management	*Telecom*	Business Creators	
	Scania Infotronics	Mobile Information Management			
	GM OnStar	Vehicle Telematics			

Table 1. List of total set of cases in the mobile enterprise study