MOBILE BUSINESS PROCESSES: CASES FROM SWEDEN AND THE NETHERLANDS

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ABSTRACT

Identifying and assessing the benefits of mobile technology in a business context is often problematic. In this paper we start from the position that the benefits of mobile technology are hard to quantify in isolation, and that the unit of analysis to identify value should be the business process. An exploratory case study approach is used to identify the benefits of mobile technology at the level of the business process. We describe two cases from Sweden (vehicle dispatching and timber supply chain management) and one case from the Netherlands (mobile parking). We then illustrate how benefits of mobile technology are contingent to the difficulty of coordinating mobile actors. Next, the value of mobility is contingent to the costs of *not* being able to coordinate during the period that the actors are difficult to reach. Finally, we assert that it is also related to the costs of available *substitutes* for mobile technology in a business process.

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INTRODUCTION

Mobile technology is becoming increasingly available in all parts of the world and its usage by consumers is now widespread (Barnes 2002). Following this almost instant success, many organisations have been promoting the idea that mobile technology can also be deployed for business purposes. However, researchers have argued that the business value of mobile technology is often problematic. In particular, the rapidly changing technology and the dynamic nature of the telecommunications market complicate the development of mobile enterprise applications (Tarasewich, Nickerson et al. 2002). Some have concluded that "the uncertainty surrounding mobile computing can be offputting for many senior executives who prefer to make technology decisions in a more stable environment and who would like to see a clear business case for their investment" (Smith, Kulatilaka et al. 2002). As is the case with most emerging technologies, the direct costs associated with mobile enterprise applications are quickly recognised, but the benefits are much less clear. For this reason, there is a need for research on the possible benefits of mobile technology in business contexts.

In this paper we explored the business benefits of using mobile technology *at the level of the business process*. Benefits of technology are typically hard to express in isolation, and don't usually make sense without taking into account the business process. Here, we define a business process as "a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs" (Davenport 1993). Work activities are carried out by "business process actors", which denote either employees, customers, or systems. Our research has examined how mobile technology could benefit actors in a business process.

There is virtually no existing theory on the benefits of using mobile technology in a business context. Of course, this can partly be attributed to the novelty of the subject. Recently, theoretical frameworks have begun to appear that aim to classify mobile applications (Varshney and Vetter 2001), as well as descriptive empirical cases for mobile consumer applications (Eklund and Pessi 2001; Kar 2002; Rangoe, Renga et al. 2002). Empirical studies on mobile enterprise applications are still very scant, and for this reason we adopted an exploratory empirical research approach.

Our aim with the exploratory research was to study a small set of real-life "mobile business processes" (i.e. cases of business processes in which people used mobile technology as a major part of their day to day work) and draw general conclusions about the way these processes benefitted from mobile technology. This paper describes the processes in more detail and integrates their benefits in the form of three propositions, as a guide for further theory building, and eventually, theory testing. In doing so, we aimed to assist managers and researchers that actively seek opportunities for using mobile technology.

The rest of this paper is organised as follows. First, we discuss our research method in more detail in the next section. Then, we present the three cases. Each case description covers the business process, how the mobile technology was used, the benefits that were derived by using the technology, and the issues that surrounded implementation of the technology. We then proceed with a discussion of the underlying principles in each case, and derive three propositions. Conclusions and recommendations complete the paper.

METHOD

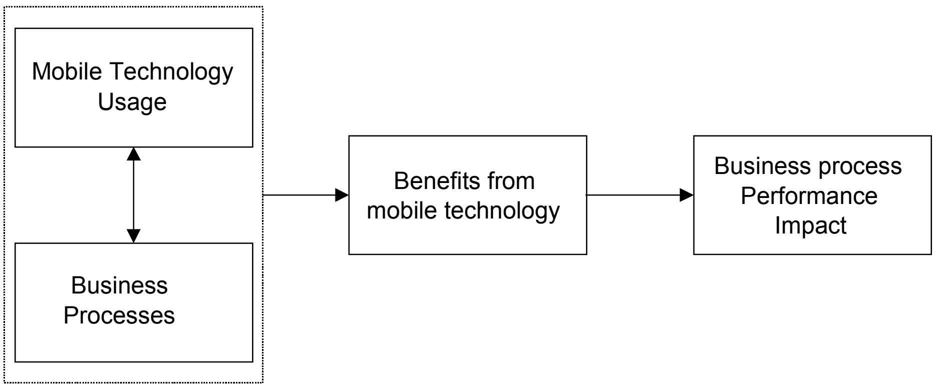
A multiple case study was adopted to further explore the relationships between mobile application usage and business process performance (Yin 1994). Specifically, we selected business processes that met two primary criteria: (1) proven mobile technology was demonstrably used, and (2) the technology was used in the core of the business process, not in the peripheral parts.

Eventually, we selected three cases for our study. It is fair to say that in the final selection, motivations of site accessibility also played a significant role. A great deal of mobile business processes we identified were either (1) in a very early stage of the life cycle, (2) abandoned prematurely, or (3) considered too confidential by the companies involved. A significant amount of our time went into reviewing candidate business processes that were eventually discarded because they looked promising but after close inspection did not meet our requirements.

We studied the cases from September to November 2001, and used public material, interviews, business process modelling, documentation and personal experience for our data collection. Case study reports were reviewed by the interviewees, and two expert sessions were organised to discuss our findings. The project involved international cooperation between <insitutes disguised>. This was materialised by five joint meetings in Sweden and the Netherlands during the fall semester of 2001.

A research framework based on the elements described above was developed to guide the field study and the data collection of this study, cf. (Yin 1994). This „blueprint" for our case studies is depicted in Figure 1. The figure expresses the notion that both business processes and mobile technology together determine the benefits that are derived from mobile technology. These benefits, in turn, may impact business process performance.

FIGURE 1: Preliminary research framework used to study the cases



The three cases we studied were Taxi Stockholm (Sweden), Scaninge (Sweden) and Mobile Parking (Netherlands). They will now be described in more detail.

TAXI STOCKHOLM

Taxi Stockholm AB is a taxi driver company owned by Taxi Trafikförening, a 101-year-old Swedish cabdriver cooperative with a membership of about one thousand taxi owners. Operating in a deregulated market, Taxi Stockholm runs by far the largest taxi circuit in Sweden, with over 1,500 vehicles, and a total capacity of around 50,000 transport requests per day. Year 2000 drivers completed 9.3 million trips representing a turnover of SEK 1,500 million. Taxi Stockholm employs 163 people and has 3,840 cabdrivers associated. Year 2000 revenue was 9.1 million SEK.

Taxi Stockholm's heart is located at Luntmakargatan 64 in Stockholm where the dispatch system matches around 25,000 transport requests per day with available cars. Reservations pass through the customer service centre and are relayed on to drivers via the taxi dispatch system.

The technological platform of Taxi Stockholm is build upon four different systems whereas the dispatch system is one of these four components. The *Telecom system* is the interface used when the customer proceeds with a Taxi reservation. Once the customer transport need has been registered, the *Dispatch System* matches the requirement with an available car. This system represents the heart of the Taxi business. Next piece of technology is the *Radio system* keeping track of Taxi Stockholm's entire taxi fleet. Finally the *Mobile Equipment* constitutes technology located at each particular car and represents the driver's daily work-toolset.

Today it takes around six seconds to allocate an idle car from the instant the customer contacts Taxi Stockholm's call centre. The underlying dispatching process can be divided into four different steps as described here. First, a customer contacts the call centre through any of the channels available (telephonist, Interactive Voice Response, Internet etc). Secondly, the *confirmation of location* process starts. The main objective is to identify the origin of the customer. Thirdly, the dispatch system allocates a car. Finally the car is contacted and it picks up the customer.

This particular process has a number of mobile actors which need to be co-ordinated, namely the customers and the drivers. The call centre, situated in the heart of Stockholm, carries out the allocation of customers and taxi drivers. The origin of the customer is the main parameter that influences the allocation process. Drivers are located in a particular taxi zone. Taxi Stockholm divides Stockholm into 200 zones. A zone with a customer, that has required a taxi, is denoted a *primary zone*. Each zone has a number of adjacent zones called *backup zones*..

Co-ordination between the call centre and the customer is required during the contact and confirmation process. 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. Another co-ordination pattern arises in order to contact the allocated car. Information about the address where to meet the customer, special instructions to the drivers, tariff based parameters, etc. must be forwarded to the cars.

Based on a number of requirements the company has identified an opportunity to improve the dispatching process through the use of improved mobile technology based on GPS, radio communication and information system technology. Better load balance, automatized checking process and future customer information requirements represent the main change drivers.

There are a number of benefits associated with the implementation of the technology. Frequency re-allocation and upgraded data-rate have increased the capacity of the radio network by 50%. The main benefit is increased information flow, which enables improved coordination of resources. The installation of GPS equipment in the cars allows for automatized checking process into a zone. With the previous system, drivers used to check into a zone manually. This process was inefficient and the reason for reduced car load. For example, drivers were aware of the high demand on the route Kista – Arlanda (route joining a dense industrial suburb with the Airport). Many drivers on their way to Arlanda checked in the Kista zone, even though they were still at the airport. Available cabs arriving to Kista were allocated high queue numbers on check-in at the area. A large number of available taxis left therefore the zone, discouraged of getting any customer although no free cabs were available at Kista because they had not arrived yet.

Finally, the new information system performs a large number of measurements. The company has been able to identify savings by a reduction of the distance from vehicle to customer by 20%. Other benefits for taxi drivers are better information access, new services available and improved work environment. Customers experience reduced estimated time of arrival and faster reservation process. The traffic control office is able to perform real-time information retrieval from the cars and at the same time benefits from location based retrieval advantages, improved information retrieval from the mobile resources and finally, real time notification advantages are also achieved.

SCANINGE CASE[1]

Scaninge timber AB is a forestry and sawmill company located in the Northern part of Sweden. At the time of the study the company's name was Graninge Skog & Trä AB, today an energy supply company that sold the forestry and sawmill line of business summer 2000. Scaninge is, at the moment, owned by Graninge AB (40%) and Svenska Cellulosa AB (60%). Operations are based on four sawmills located in Sweden. The turnover in 2001 was 1,800 MSEK.

The company implemented a mobile information system to improve their supply chain management. The project (SKINFO) started 1987 when the company became interested in using radio-technology to enhance co-ordination between units operating in the forest (harvesters & forwarders) and the main office for management and planning of transports at Bollstabruk.

Due to demands on quality and timely delivery, increased information was needed to secure lower stocks and fresher pulp. Paper producers e.g. demand the timber to be no more than three weeks old when it enters the process. The company experienced a number of problems that led to the implementation of a company wide mobile solution. Some problems were timber wasted when it is left too long in the forest, or when the dimensions requested by customers do not make the best use of the timber in stock in the mill, secure timber in-flow to keep the mill going on, etc. The idea behind the introduction of mobile data technology was, therefore, that the process from harvest to delivery could be more efficient and deliveries more timely if the value chain could become more integrated.

The business process in focus for this study is operations for timer production from start to delivery at the sawmill. In the forest, trees are felled, trimmed, cut in appropriate lengths and piled together for transport to the sawmills. A truck picks up the log at the

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[1] [1] The empirical data for this case study was collected by G. Nilsson for the purposes of his master study at the Stockholm School of Economics. Used with permission of the author.

roadside and takes them to the sawmill. In the sawmill the timer is measured, sorted and processed. Finally the sawn timber is stocked until a customer picks it up.

In the 1990s Graninge divided its woodland region into five different districts. An inspector responsible for timber production managed each district. The districts were sub-divided into two or three forests areas supervised by foremen responsible for the on site operations. At each particular forest area, a number of machine operators harvested and forwarded timber. Trucks collected timber dispersed over the whole harvest area and transported the logs to the sawmills.

There existed a number of geographical constrains in order to carry out the process. The administrative unit, where data was registered, is located away from the forest units. Moreover the operating land was 245,000 ha. productive woodland, and there existed a need for regular information exchange between units at the different locations both on the move (such as the transport units, i.e. trucks, harvesters and forwarders) and on different locations (inspectors that supervised the different forests districts).

Volume planning was developed out of a central database with information from the reports from each forest district. Inspectors made regular visits to the forest areas to co-ordinate the production of timber and prepare reports that were sent to the central information system for update. At the districts, production was carried out according to monthly delivery plans that had to be forwarded to the foremen at the forests areas. Before the implementation of SKINFO re-arrangements of timber production required the inspectors to make regular visits to the different areas to communicate changes in the production plans.

Three types of reports were therefore forwarded to the central office at Bollstabruk: production reports from each forest area, salary reports from the workforce in the forest and machine reports regarding information about repairs, machine status, need for spare parts etc. Moreover transport and route allocation was required to avoid timber waste along the roadside of the forest areas.

After the specification requirements were made the company decided to install a system based on Mobitex for the radio communication and Telesofts' MobiBase-module for communication with the central information system. Telesoft developed the first module in a DOS-based environment for easier testing. Prototypes were installed in a number of mobile units based in the forest so that machine operators could give their comments on the interface during the implementation phase.

A number of opportunities were achieved through the implementation of SKINFO, according to the case above. Increased detail level of delivery plans by re-calculations in the case of operation disruptions was achieved by means of coordination between machines out in the forest and the operations office. Another advantage was volume reports from harvesters and forwarders on a daily basis. This opportunity impacts directly on transport management, relevant progress & status reports from production and roadside stocks and deviation reports to the sawmills. Finally, better computer based planning system facilitating the work for *work leaders* by enabling information access on different locations and on the move was achieved. The overall improvement can actually be expressed as faster and more effective changes on production management.

MOBILE PARKING

"Mobile parking" is a term used to describe situations in which car drivers use their mobile phones to pay for the occupation of a parking space. The business process follows the following steps. First, users register with parking authorities for participation in the project. This is most often done by returning a leaflet to the municipality, but can also be done through a website. Upon successful registration, participants can pay for parking through the use of their mobile phone instead of using a parking meter.

When they arrive at a designated parking space, the driver calls a central information system (either using Interactive Voice Response or Wireless Application Protocol). This system identifes drivers by their mobile phone numbers and authenticates them using a PIN number. When correctly authenticated, the system then logs the parking arrival time and asks for the parking zone that the driver is in. Zones are displayed on poles alongside the street. The driver is "free" to go after the system has confirmed the logging, but has to put a mobile parking transponder behind the windshield in order to show a parking enforcer that the driver paid the parking ticket through the mobile phone.

When drivers return to the car and aim to leave the parking space, they need to notify the system again. The system logs the departure time accordingly. Now, the system has all the necessary data to assemble the parking bill. It uses a parking tariff function supplied by the municipality to calculate the fee. The inputs are the zone, the arrival and departure time, and the user classes, such as those having special parking permits. The system uses the address that the driver has provided during registration to be able to send the bill. A special clearing house then takes care of the collecting of the money.

In our case, we focused on a mobile parking project in the Netherlands that was carried out during the fall of 2001 in the city of Haarlem. To accommodate mobile parking, the city also introduced a novel mobile application used by parking enforcers as they walk around the neighbourhood. This mobile business process will now be described.

Enforcers inspect all “regular” cars the usual way, i.e. by checking the parking ticket behind the windshield or the parking permit behind the rear window. However, if they spot the mobile parking transponder (a credit card) behind the windshield of the car, they can check whether the car is legally parked through their mobile phones. After the enforcer has logged on to the mobile application, he or she can transmit the city and the zone. The application will check its ongoing transactions database and return all licence-plates that are currently operational in this zone (the „white list“). The enforcement application has been optimised for the Ericsson R380 smartphone, which has a relatively wide screen. A screenshot is depicted in Figure 2. A lightweight printer on their belt connects with the phone using Bluetooth and it prints a parking ticket when the enforcer decides that the license plate of the car is not in the white list.

FIGURE 2: Screenshot mobile parking application

```
           Aangemeld in zone
Er zijn 7 kentekens aangemeld in
Eindhoven zone 1: Centrum op het
tijdstip WO 19.17u:
36-DF-HL    PF-LH-18
47-AA-BR    TX-FS-93
91-YS-RE    SV-HR-38
HR-RA-21

Zoek kenteken: <>  OK
Ververs deze pagina
Andere zone
```

The business process benefits for the mobile parking case are as follows. From the perspective of the car driver, the benefits include greater convenience, and savings because drivers only pay for actual time parked (with parking meters, drivers usually overestimate the parking time). Of course, parking authorities do suffer loss because of this, but gain because the number of parking meters (who are very costly to maintain) can be reduced. Surprisingly, one of the greatest benefits the enforcers saw in their application was the fact that mobile phones were very lightweight compared to the „system“ they use now. Their former system was a wearable device consisting of a PC and a printer. It weighted 3.5 kilogram and they had to carry it around for around 4 hours. Since there was no backlight (and hence could not be accessed during the night), carrying around a flashlight was also required.

DISCUSSION OF FINDINGS

Each case focuses on a specific business process and the complementary mobile technology. In this section, we will study what they have in common. This will be done using three propositions that we have derived from the case studies.

> ***Proposition 1***
>
> *A business process can benefit from mobile technology if coordination is required between business process actors who are (temporarily) difficult to locate*

In the cases we studied, mobile technology is applied for the purpose of *coordination.* For clarity of exposition it is useful to distinguish between one *central* actor and several *decentralised* actors. Central actors coordinate the business process, and decentralised actors carry out the business process (they are, to a certain extent, „subject“ to coordination). The following table depicts who the coordinating actors and operating actors are in each case.

TABLE 1 Business processes, coordinating actors and operating actors

Case	Business Process	Coordinating actor	Operating actors
Taxi Stockholm	Taxi dispatching	Call centre	Customers Taxi drivers
Scaninge	Supply chain management	Management & Planning Transport Office	Harvesters Forwarders Trucks
Mobile parking	Parking enforcement	Municipality	Customers (car drivers) Enforcers

Mobile technology is used because it solves coordination problems that arise when the operating actors are difficult to locate by the coordinating actor. In each of the three cases, the coordination actor is at a fixed location, and the operating actors are at variable locations. The location of the coordination actor is stable and hence certain, and the locations of the operating actors are dynamic and uncertain. Because of location uncertainty, operating actors are difficult to reach. Mobile technology alleviates this difficulty by making the actors "accessible" to the coordination actors. In all three cases, the business process can "continue" because the actors are traceable even while they are on the move.

In the three cases, we could see that mobile technology enabled coordination adjustments because it allows 1) location-based and/or 2) real-time information be exchanged between coordination actors and operational actors. Therefore, we can argue more specifically that a business process can benefit from mobile technology if a) knowing the location of the operating actors is required for coordination purposes, and b) timeliness of information retrieval or information access is required for coordination purposes. The first condition follows directly from the observation that location is unknown. The second condition follows from the first, in that sending information to or receiving information from an actor can only occur if the location of the actor is known.

Our cases provide empirical evidence that mobile technology has addressed the difficulty of coordinating operating actors. Table 2 displays the specific coordination problems for each case and what the mobile benefits were.

TABLE 2 Coordination requirements, location properties, and mobile benefits

Case	Required for coordination (from the viewpoint of the coordinating actors)	Location attributes for operational actors	Mobile benefits
Taxi Stockholm	Locations of taxis, locations of customers, real-time notification to taxis	Location a priori unknown both for customers and for taxi drivers	Access to locations of taxis Notification to taxis
Scaninge	Real-time access to daily work done Real-time notification of revised production plans to region chiefs	Locations known (at least to some extent), but no fixed line infrastructure available	Access to daily work done, notification of production plans
Mobile parking	Customers Real-time notification of white list to parking enforcers	Locations known, but moving between zones	Freedom of movement Access to white list

Proposition 2 ("price of non-mobility")

The benefits of mobile technology are related to the opportunity costs of not being able to coordinate during the time when actors are difficult to locate

Severeness of the missed coordination opportunity turned out to be an important driver for the perceived value of mobile technology by the case study participants. It is not that mobile technology *by itself* contributes to value, it is simply that without mobile technology there would not be coordination in the first place! If operating actors are "on the move", they can no longer be subject to real-time or location-based coordination adjustments. In each of the cases, this problem was critical.

This finding also has implications for business processes in which operating actors are *sometimes* on the move. A typical example is the employee on an international business travel. The value of mobile technology for this employee is dependent on the severeness of him or her not being able to communicate with head office during this time. One of the interviewees with which we discussed our findings spoke in this context about the "price-tag of non-mobility", indicating that the *opportunity costs* of not being able to be coordinated determined the eventual value placed on the mobile application.

> ***Proposition 3***
> *The benefits of mobile technology are related to the attractiveness of substitutes to solve the coordination difficulty. Substitutes include fixed terminals, predetermined fixed locations, and the usage of different coordination modes (typically standardisation)*

It is important to recognise that mobile technology is not the only solution to the coordination difficulty. The cases demonstrate that substitutes are available and will be used. First, the process owners could install fixed terminals along the way so that coordination adjustments could take place there. The parking meters are an example of this. Second, operating actors could go to a pre-arranged location to make themselves known. Taxi ramps are an example of this. Third, the lack of coordination adjustments could be circumvented by more stringent coordination *before* the operating actors go on the move. These are usually called "standardisation" coordination structures (Mintzberg 1979). The attractiveness of each of these substitutes also impacts the added value placed on the use of mobile technology.

CONCLUSION AND RECOMMENDATIONS

In this paper we have been concerned with the value of mobile technology at the level of the business process. We have examined the value of mobility and business process performance using three cases from Sweden and the Netherlands. A number of generic findings were condensed from the empirical evidence available.

Based on the findings, we can conclude that a business process can benefit from mobile technology if coordination is required between difficult to locate actors. The value of mobility is contingent to the costs of *not* being able to coordinate during the period that the actors are difficult to reach. It is also related to the costs of available *substitutes* for mobile technology in a business process.

These findings have implications for practitioners who seek to identify opportunities for mobile communication in their business processes. We believe such an identification process need not be haphazard and can in fact be structured: our findings suggest that a systematic analysis of actor locations in a business process, and the difficulty of coordinating them can be productive. Spotting substitutes is one element of this identification process, and "complicating" the existing locations another (so that the mobile technology can enable the business process to continue even in more difficult to reach locations). A useful area of further research would be to develop a step-wise method to seek mobile opportunities for existing business processes.

We realise that our analysis has been bottom-up, and that another selection of cases would likely have produced a different set of findings. For example, we have not been able to explore a case with a *mobile* coordination actor, but clearly these business processes exist (consider for example Airforce One). We would encourage other researchers to study other mobile business processes, and see how and why these applications contrast with our findings.

The value of mobile technology at the level of the business process is still a relatively unexplored area. We believe that the three cases that we have studied offer some insight into the relationships at issue, but we also acknowledge that we are not yet in the "theory testing" stage. Nevertheless, our research has been a first step towards a better understanding of the relationships between mobile technology and business process performance.

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