

CASE STUDY: USE OF THE MOBILE TOOL HANDYMAN FOR MOBILE WORK

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ABSTRACT

Mobile electronic equipment such as laptops, PDAs and mobile phones have the recent years become very important tools for managing mobile work more efficient. In this paper we present a case study of such a tool called HandyMan. We have looked at how five Norwegian companies use this tool, how they synchronise their mobile device with other systems, how they deal with ad-hoc tasks, and what the major benefits and problems are. The motivation for this case study is to identify typical issues that must be taken into account when designing a system for supporting mobile work. In the case study we found that the non-functional requirements are very important in the design of a mobile system. Also requirements to the mobile device itself are very important to a system that should be used in a hostile environment. There are also organisational issues that must be considered before introducing a mobile system in a company. Lastly, we identified a need for better off-line support to help the users to know when to synchronise and charge, and to handle ad-hoc tasks.

Keywords: Mobile work, case study, mobile devices, mobile process support, mobile workflow.

1 INTRODUCTION

Mobile electronic equipment such as laptops, PDAs¹, and mobile phones have the last years become very important tools for handling mobile work more efficient. In some occupations, mobile equipment are used to enable work when traveling, e.g. on trains, in planes and generally when being out of the office. For other occupations in sales, plumbing and electricity installation and maintenance, a mobile terminal can help the worker in managing their daily routines, replacing paper-based forms with electronic-forms, and to make it possible to issue bills directly at the customer. Although mobile terminals can make the working day easier for

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¹PDA: Personal Data Assistant.

some occupations, it also introduces some problems.

Before starting to design a system to support mobile work, it is important to look at issues that are important to users of such systems, and what the main concern are when using a mobile work support system.

This paper presents a case study of usage of the mobile working tool HandyMan in five Norwegian electrician companies. The focus of the case study was to see how the tool was used, what the advantages and disadvantages are using the tool, how the workers synchronise the tool with back-bone system, and how the workers handle ad-hoc tasks. Through these questions we would like to identify guidelines that must be taking into account when making and introducing a system for mobile work. Also we wanted to identify areas where it is possible to improve mobile support in current and future systems.

2 AN OVERVIEW OF THE MOBILE TOOL HANDYMAN

The HandyMan software is made by the Norwegian company ePocket Solutions ASA that was established in 1996. Today, approximately 800 craftsmen and 200 companies in Norway use the program HandyMan. When the company started they wanted to make applications for mobile work, but they did not know if they were going to aim for transport, garbage collection, elevator or the electro installation business. ePocket decided to make tools tailored for electricians because such work usually involves paper work that later must be entered into the data system, management of many different items, and need to make quick decision process involving a lot of money.

HandyMan runs on PocketPC (Windows CE) devices. The tool manages memos, time usage, and stock of materials. In addition, the tool ensures that the worker remembers to go through all necessary steps of the process provided by a check list of things to remember (workflow). The

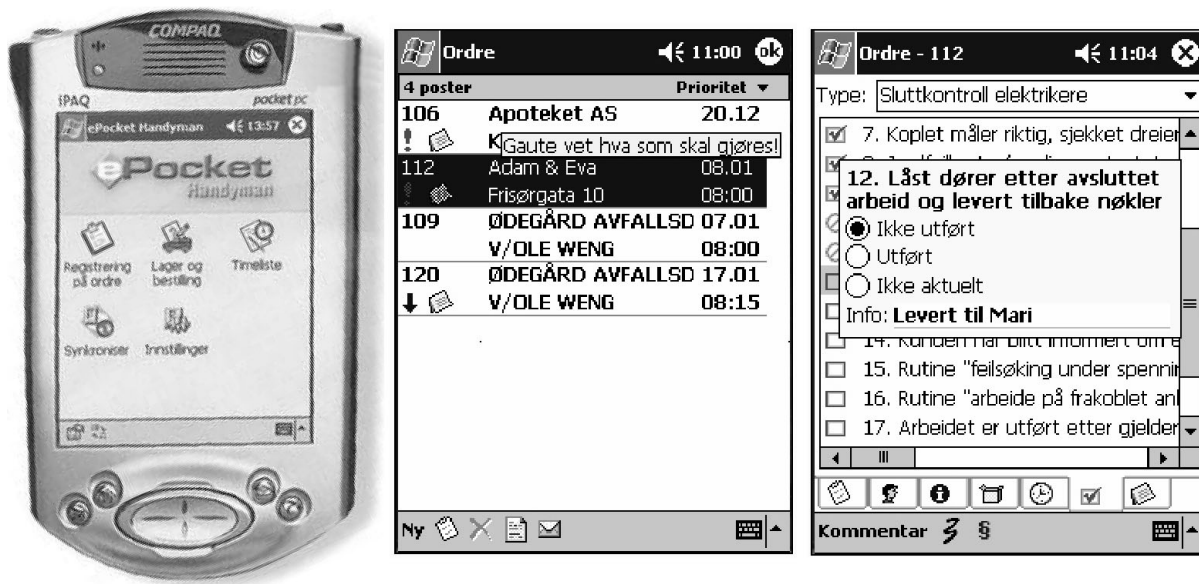


Figure 1. Screenshots from the HandyMan tool (the text is in Norwegian)

main menu of the tool consists of five icons as shown to the left in Figure 1:

1. **Register task:** Here the worker can access all tasks to be carried out in the next work period as shown in the screenshot in the middle of Figure 1. Information such as the name and address of the customer, special messages from the office, and priority of the task are available here. When performing the task, the worker has to follow a fixed workflow that ensures that all step of a predefined process have been carried out. For each step of the process, the worker has to check the completed items in a list. A screenshot from this check-list is shown to the right in Figure 1. One example of such a step is to check if the doors are locked and the keys are delivered back to the customer after completed work.
2. **Stock and orders:** This tool helps the worker to get up-to-date information about inventory of the service car, the main stock, and at the merchant. If the product is not in the service car, an order can be sent directly to either the main stock or the merchant. The program will also order products automatically to the service car if the inventory is below a certain minimum stock. It is also possible to use a PDA with a bar-code scanner for registration of products.
3. **Hour usage:** This tool lets the worker register how much time that has been used on the different tasks. The tool also makes it possible to register how much should be charged for the tasks based on the price per hour, the driving distance, and the product that have been used.

Further, HandyMan gives all the information needed for making an invoice.

4. **Synchronisation:** The HandyMan tool can be synchronised both with the customer support system and the economy system. When synchronising the PDA, the performed tasks are uploaded to the system and new tasks are returned to the PDA. The synchronisation tool let the worker tailor the synchronisation between the PDA and other systems.
5. **Preferences:** The preferences tool is used to tailor HandyMan tool for each worker.

3 THE CASE STUDY

The goal of the study formulated according to GQM [1] was:

Analyse the usage of tool HandyMan for the purpose of identifying requirements and problems for support systems for mobile work from the perspective of software developer in the context of the working environment of electricians.

The case study was conducted in five Norwegian companies, here named Company1 to Company5². This was a qualitative study where we wanted to get an idea of how the mobile work tool was used in daily work. The five companies in this case study were picked out from a list of companies and contact information provided by ePocket. The data of the case study was collected through interviews of employees in the five companies. We did not have a predefined hypothesis

²Some of the companies did want to include their names in the case study.

for this case study because we wanted to dig out experiences from using a system that supported mobile work. Based on this choice, we made five questions without any strict forms for the answers to collect qualitative data. The following five questions were used in the interviews:

1. Q1: How is HandyMan used in a typical day for you?
2. Q2: How many employees have a PDA in your company?
3. Q3: How can you synchronise HandyMan with the other parts of the company's computer systems?
4. Q4: What are the problems and the advantages of using HandyMan?
5. Q5: How do you handle ad-hoc tasks?

3.1 ANSWERS TO Q1 (USAGE)

All electricians told very similar stories of how a normal day at work typically would be. They all found which customer to visit next by looking up on the PDA. After they had completed a task, they used their PDA to register information about the task such as hours used, what had been done, and what products they had installed (material usage).

Electricians at Company1 have been using HandyMan on their HP Jornada for two years. Customer support registers all the tasks and gives the jobs to the electrician with the right qualification. The customer support provides the PDA with all the information an electrician needs to do his work. The electricians are specialised in different fields, like industry or fire brigade.

Company2 has used HandyMan on Compaq IPAQ PDAs for two and a half year. They use it to register hours worked, kilometers driven and road toll. All expenses are calculated directly from information gathered from the PDA.

The representative from Company3 did not know what a PDA was but he used the word *HandyMan* when he referred to the PDA. He told that the name of his HandyMan was HP Jornada. Employees at Company3 use the email program nearly as much as HandyMan.

At Company4 only those that drive a service car equipped with an equipment stock used HandyMan. They run HandyMan on Compaq PDAs.

All the electricians have different habits when out working. Company5 encourages the

electricians to register as much as possible when they still are at the customer since the electricians then have everything clear in mind. Usually the electricians write down a paper draft that contains information of the different product that the electricians most often use, and then they typed the information into the HP Jornada PDA. Some electricians use other programs, such as notebook.

3.2 ANSWERS TO Q2 (NUMBER OF USERS)

The number of users at the different companies are summarised in table 1.

3.3 ANSWERS TO Q3 (SYNCHRONISATION)

The electricians at Company1, Company2 and Company3 can synchronise HandyMan using modems and mobile phones or cradles³ at their office. In Company1, most of the electricians synchronise their PDA approximately three times a week, but they can do it more often.

At Company2, the electricians usually synchronise once every two weeks, but lately Bluetooth has been introduced to some users, making the synchronization online and invisible to the user. One of the reason to the introduction of Bluetooth, was probably the uncertainty about how often they should synchronise. If an electrician does not do it often enough he can fail to obtain important information.

At Company3 they try to synchronise as often as possible so they do not miss any information. Today, it is usual to synchronise once a day.

Electricians at Company4 do not have a mobile phone or any other equipment that makes it possible to synchronise away from the office. They need to visit their main office every time they want to download or upload any information. The electricians synchronise not more than once a week. One employee at Company4 knew it was possible to synchronise without doing it at the office, but he had not bothered to learn about or buy the right equipment. He thought it was more important to get the PDA to function properly before they bought more equipment.

The electricians at Company5 also have to visit the main office every time they synchronise. As a rule, every electrician synchronises at least every Monday morning. Normally the employee

³A cradle is connection point that enables data to be transferred between a PDA and a PC typically using the serial or the USB-port. Cradles are also often used for recharging the PDA's battery.

Company name	# of users	Comments
Company 1	55 of 55	Earlier, the company had two main offices. After the introduction of HandyMan, one of the offices has been shut down. This resulted in better management of the company processes.
Company 2	12 of 60	Company2 sees the need for a PDA for every electrician and will soon provide 30 more electricians with PDAs.
Company 3	6 of 6	Every electrician had a PDA.
Company 4	6 of 80	Only six persons at the company have a PDA, but they will expand the use soon. Note that this company only had 6 PDAs because they were evaluating the use of HandyMan in the company.
Company 5	4 of 4	Every electrician had a PDA.

Table 1. The number of employees that has a PDA in the five companies

meets up at the office every morning and they synchronise their PDA at the same time.

3.4 ANSWERS TO Q4 (PROBLEMS AND ADVANTAGES)

Every person interviewed mentioned that the PDA made it possible to record the information only once. Earlier, the information was recorded by writing it down on paper and later to transfer it manually to the systems at the office.

Company1 complained that the program sometimes could hang, but this was not a big problem. In addition, the employee thought the device was very fragile and did not tolerate rain, wind and shocks. That's why electricians often sit in their car when they register information on the PDA. It is often very cold in where they work. At -20 degrees Celsius (-4 Fahrenheit), electricians had very often problems with the PDA. When the device is cold, it is very slow. Another challenge mentioned by Company1 is to remember to charge the battery on the PDA.

Company2 thought the program was very stable and operated very well. One feature they hoped would come was to invoice the customer directly while the electrician was still at the customer. "But that is just a dream"; said the representative from Company2 about that feature.

Electricians at Company3 register everything on the PDA when sitting in the car. This is the same procedure as earlier when they registered everything on paper. The electricians do not bring the PDA outside the car because they are afraid it will be destroyed.

Company4 appreciated the control HandyMan provides over the stock product of the service car.

Company5 had also a problem with the

PDA in cold surroundings. On the other hand, the sunshine made it difficult to see the screen outside. A person from the company told us that most electricians actually use paper anyway after the introduction of the HandyMan tool. He said that one problem was to convince elder workers to use a new device instead of paper. Also they had discovered some compability problems between the program on the PDA and the backbone system. One problem reported was that the PDA could not handle the database of 75000 item inventory. To solve this problem they had manually to pick out about 30000 items of the total to be installed on the PDA. This caused compability problems between the system running on the PDA and the main system. As a conclusion, Company5 was considering replacing the PDAs with portable PCs that did not have the compability problems.

3.5 ANSWERS TO Q5

(Ad-hoc tasks) If a day is planned to every detail in advance of that day, it is not necessarily to synchronise the PDA that day. The electrician only needs to synchronise at the end of the planned period. If a neighbor of one of the customers wants help, the electricians have to register a new task. This new task is called an ad-hoc task.

Company1 and Company2 do this kind of synchronization process the same way. They manage ad-hoc tasks by calling to the customer support, which will issue an order number. When the electrician synchronises the PDA he receives the order. Now he can register information from the work on his PDA. Neither electricians from Company3, Company4, or Company5 have the possibility to receive information on their PDA when they are away from the office. If an ad-hoc task occurs, the electrician will perform it and

record the information about the task on paper. The customer support is then informed about the task and prepares the system for it. Next time the electrician synchronises he receives that task on the PDA and he must fill in the information that he wrote down earlier. Company4 find this method cumbersome, but it is the best way to solve it at the moment.

All the five companies were asked to estimate how many tasks could be regarded as ad-hoc tasks of the total. It was a bit surprising to see that their estimate was between 0% and 30%. This means that the electricians most likely must manage ad-hoc tasks every day. One company claimed that they rarely had any ad-hoc tasks. The reason for this could be that the company had stricter routines for managing in-between work.

4 DISCUSSION

Many advantages and problems with the use of HandyMan was discovered through the interviews with users. A summary of each question is given below.

- **How is a typical day for you, in the light of the use of HandyMan?** The program provides the electricians with all information they need to perform work the next few days. One company did not know what a PDA was, but was familiar with the term HandyMan.
- **How many employees have a PDA in your company?** The number of employees at the companies using PDAs ranged between 4 and 55. In most companies, the majority of the employees had a PDA. Only one company had very low coverage of PDAs. The reason for this was that they were evaluating if they should use PDAs as a part of the company strategy.
- **How can your PDA be synchronised and how many others do also have a PDA in your company?** Two of the companies only synchronised at the main office and they both used the cradle when synchronizing. The frequency of the synchronising was different from company to company. Some did only do it once every second week, others had the PDA connected to the mobile phone so they were be on-line all the time.
- **What problems and/or advantage does the PDA give you?**

Problems: The electricians express an uncertainty about how much a PDA can tolerate of shock, water and coldness. Coldness makes the PDA very slow. Sunshine makes it difficult to see the screen.

Advantages: Makes it possible to record information only once. Control of the contents of the service car.

- **What do you do with ad-hoc tasks?** In two companies they must call the main office and request a new order. The electricians will then synchronise and receive the new order on the PDA. In the three other companies they must visit the main office to download the order to the PDA. Meanwhile, the electricians will write all important information on paper.

From the summary above, we can notice that what is described as the main problems of usage of HandyMan are non-functional issues like the robustness of the device itself. For outdoor work, most PDAs will suffer in a hostile environment because of rain, snow, cold weather, bright sunlight, lightning etc. Problems with rain and snow can be solved by making PDAs with some coating that can handle such conditions. This can however cause a problem with regards to the usability of the system, since this means often that you need extra protection on the screen. This extra protection could cause the touch sensible screen to be less responsive. Also protection against rain and snow could make it harder to hear sounds from the PDA e.g. for alarms. There are no easy solution to handle could temperatures that will cause the PDA to slow down or don't work at all.

In section 3.1 (usage of HandyMan), one company still use paper to make notes at the spot before transferring this information manually to the PDA. The whole idea behind the HandyMan tool was to be able to enter all data directly on the PDA. One reason for using paper before entering the data on the PDA could be that the workers are afraid to wreck the device if they bring it outside their service car. Also it could be that the HandyMan tool does not allow to make draft information, or that the usability is no good enough for making fast drafts. Another possibility is that the workers do not know the tool and the possibilities properly, or that the company does not stress that the workers should follow strict procedures.

In section 3.3 (synchronisation), only one company had made a rule for when they had to synchronise: *at least every Monday morning*. In some other companies, some workers were afraid that they would miss important information because they did not synchronise their PDA often enough. One way to avoid some of these uncertainties is to make procedures for when the workers need to synchronise their PDAs. If e.g. everyone has to synchronise their device every Mon-

day morning and every Wednesday morning, the electricians and the people working at the office will adjust and work according to these synchronisation points. Another possibility is to be always online by synchronising the PDAs via Bluetooth and a mobile phone. Then all parties involved will know that the information should be up-to-date. The disadvantage with this approach is that to enable Bluetooth on a PDA and a mobile phone will drain much more battery power causing the mobile devices not last a day without a charge. In addition, when using these devices in cold weather the situation would become a lot worse.

In section 3.4 (problems and advantages), most electricians were concerned about if the device would cope with the hostile environment and the bad performance in cold weather. Also some were concerned about forgetting to charge the PDA. One solution to the last problem could be to introduce procedures for when to charge the PDAs. Also it is possible to charge the PDAs as often as possible i.e. in the cars. Another possibility is to introduce a display in HandyMan for estimated time of usage is left.

In section 3.5 (ad-hoc tasks), most workers did not use the system for dealing with such tasks. It was a surprise that Company1 and Company2 that also used online synchronisation of HandyMan via mobile phone, had to call customer support to make an order number. This is probably because of some lacking functionality in HandyMan, or because of limitations in the customer support system. For the other three companies, paper was used to deal with ad-hoc tasks. This indicates that there is no support in HandyMan for adding tasks at the spot and handling such tasks off-line. Ad-hoc tasks should not be threatened as exceptions since they are a part of the normal working day (10-30%), e.g. support for registration of new customers etc.

5 RELATED WORK

In [2], Kjeldskov and Skov study the usability of PDA-based mobile collaborative system for operating a large container vessel. The study describes how an experiment using computer students was conducted to study the usability of the mobile collaborative system. To ensure that the collected data was useful, two different approaches were used in the experiment: Heuristic inspection and usability testing with think-aloud. The first approach involves testing the basic design of an interface using few resources without involving users, while the second is an observational study where the users should say what they

think while using the system. The conclusion of this study was that the two different approaches resulted in different findings and were useful and complimentary. Our paper describes results from interviewing people using a mobile system and not directly observing their behaviour. Also our study not only focuses on usability but has a broader focus.

6 CONCLUSION

In this paper we have presented a case study of the usage of a tool to support mobile work in five Norwegian companies. We have found that the introduction of a mobile working tool must be planned by the organisation by e.g. introducing procedures for when to synchronise the mobile unit with the backbone system, for recharging the mobile devices and for handling ad-hoc tasks. We also noticed that the system we studied had limited support for ad-hoc task management. Another finding was that the major concern of all workers was on how much the mobile device could cope with rain, snow and cold weather.

As a conclusion of this paper, we will present five guidelines that must be considered when designing a system for mobile work:

1. **Working environment and device:** It is important to check the working environment and the available devices before starting to design the system. For some hostile environment there might not be any device that is suitable (e.g. very cold), and thus a system with a mobile terminal cannot be used.
2. **The system must give the worker additional functionality:** If the mobile work system does not provide any additional useful support that makes the work more efficient, it is likely that the worker will go back to the previous solutions such as paper. On the other hand if the company saves money on using such a system, the workers can be forced to use such a system even they will not see the benefit themselves. This is generally not a good solution and both the worker and the company as a whole should benefit from the system.
3. **Usability must be top priority:** Since most mobile workers are used to work with paper in the field, the usability of the mobile work tool must be very good. A cumbersome tool is not very likely to be used. Usability is often more important on mobile devices because of the small screen and limited input devices.
4. **A mobile work tool must be flexible:** Most mobile work is characterised by ad-hoc tasks.

It is very important that the tools can cope with such tasks in an efficient manner. Ad-hoc tasks must not be regarded as an exception but as normal! A mobile work tool should be able to perform all tasks both offline and online. Even though some mobile devices have the capability to be online all the time, the need for offline operations arise e.g. when being outside an area covered by mobile network or the user chooses to be offline to save battery power.

5. Organisational procedures must be in place: When installing a mobile work tool at a company, it is very important that the workers get a proper education of the tool. This is true for all systems, but is probably even more important for a mobile work support system. The reason for this is that many mobile workers work alone, making it hard to ask a colleague for help when using the system. Further, the process of the workers should be adapted to the mobile work tool. This means that there should be procedures rules for when to synchronise, recharge batteries, and for how to handle ad-hoc tasks.

In the project MOWAHS [4], we are looking into issues regarding how to support mobile work using mobile tools on mobile devices. We

have defined a framework for characterising mobile work in order to elicit requirements and priority of requirements when developing a mobile work support system. Future work will look further into issues regarding mobile work and how to design proper tools for such work.

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