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Improving Time Management in the PDA

-A Design Suggestion

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Abstract:
Many of those who buy a PDA today do it for the purpose of time management. The PDA is meant to replace other artifacts like paper diaries and notebooks but in practice the PDA cannot be used as the sole resource for time management. We think that to succeed in making time management with a PDA more useful the design has to be grounded in an understanding of the existing technology and how it is used in practice. We achieved this understanding of the time management with a PDA by conducting an ethnographical study to find out how the PDA is used in practice, making a technical investigation of the PDA and cooperated with the PDA users throughout the design process. In this thesis we describe our design suggestion that improves the applications for time management in the PDA and take it a step closer to be the replacement for other time management artifacts that the users wanted.

Keywords:
PDA, Time Management, Participatory Design, Ethnography, Mobile Computing, Computational Power

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1. Introduction

This thesis is the result of twenty weeks work during spring 2002 which constituted our bachelor degree in the People Computers and Work Program (Människor Datateknik Arbetsliv, MDA) at the Blekinge Institute of Technology in Ronneby, Sweden. The first half of the project time was spent in Brisbane, Australia in cooperation with people at University of Queensland and the other half in Sweden. The People Computers and Work program is divided between computer science and human work science. This division is reflected in our work where we have taken much consideration to the human side of the technology we study.

1.1 Aim of the project

The aim of this project has been to produce a design suggestion for improvements of the existing time management applications in a PDA to increase the possibility to use it as the sole resource for time management. The design suggestion is based on the use of the PDA from the users point of view. Therefore we did not commit ourselves to a specific company or organization since that allowed us to work free from any possible agenda they might have and concentrate our work on design ideas rather than software development. Our work resulted in a number of mock-ups and animations to visualize the design suggestion. In this thesis we present the design suggestion with the intention to give a basis and ideas for further development in time management in the PDA.

1.2 The Plan of the Thesis

We have structured this thesis in the following way. In chapter 2 we write about background information for the project. We describe our focus, delimitations and a number of methods in our design process. Chapter 3 gives a brief overview of the PDA, its history, the latest models and future directions in the technology. Chapter 4 will describe how we did an ethnographic study of the use of the PDA and what we found out from this study. In chapter 5 we give a more detailed description of our focus for the design suggestion. Chapter 6 describes the design work during the project. In chapter 7 the design suggestion for time planning with the PDA is presented. And finally, in Chapter 8 we sum up our project with a conclusion.

2. Background Information

In this chapter we will give a short note on how the circumstances affected our work. Then we describe how we chose our focus and what limitations there are to the project. We will also shortly discuss some of our methods that were important for the design process. All these will serve as background information about the project.

2.1 A Note on Discovering Other Working Conditions

It must be said that our travel to the University of Queensland in Australia made us realize that other circumstances had to be dealt with concerning our project. Apart from the improving of our English, the difference of working condition between our home department and the Australian university obliged us to rethink what we knew. The taken for granted condition of investigation had to be rethought and it made us aware of many more issues that we did not realize before. For example, the language difference forced us to be more concentrated and attentive during the interviews with the PDA users. The circumstances influence on our work served as useful lessons for the future since we learned a lot about working without the protecting environment of our home school. It was good that we put ourselves in this situation because it forced us to find new ways of working by taking our previous experience and adapt it to the current conditions. We would like to take the opportunity to thank the people we worked with at Queensland University in Brisbane, whose friendly and helpful attitude more than once solved our problems.

2.2 First Formulation of Design Issues

In Brisbane, our initial project idea was to work on gestures in interaction with computers. We were supposed to build on earlier work from earlier MDA students who had done their bachelor degree on this topic (Eriksson and Svensson, 2001). Early in the project we participated in a meeting with a representative from an important business company, which is the national phone company. This company is a sponsor to the project about gestures. During this meeting our discussion concentrated on mobile telephones and PDAs. The main industrial interest was to find a context for the use of gestures with these technologies like for example to start a call or end a call by gesturing. We thought that the risk with this approach was that we could end up "creating" a need for the gesture technology. It appears to us that reversing the process, i.e. looking at technology in its context first, would be helpful to see if we could find a niche where people need the support of this gesture technology to pursue the topic on gestures.

In cooperation with our supervisor at Queensland University we decided to do an investigation of the use of the PDA and then hopefully find a context for the gesture technology with it. First we gathered information about the PDA through a technical review. To find out how the PDA is used today, why it is used, and who the users are we worked with twelve different PDA users, who we will refer to as our informants. The informants were of different ages, sex and had various levels of computer experience. Most of them came from an academic environment but other occupations were also represented. The idea of working with the informants was to understand why they use a PDA and how it is used in practice. During this investigation we found a number of interesting issues, themes and patterns in the use of the PDA. These where:

- Perceived problems in the interaction with the PDA by using graffiti etc.
- Technical matters like synchronization and battery life
- Other possible applications and areas of use for the PDA like for example instant messaging
- Convergence of technologies like the third generation of mobile telephony and PDAs
- How people use the PDA with a specific attention to time management.

We choose to look deeper into how people use the PDA with a specific attention to time management. This choice of focus was made because the user's point of view indicated clearly that this was their primary use for the PDA and therefore important. The investigation revealed that almost every PDA user we had worked with had bought their PDA for time management purposes but had encountered limitations, irritations and problems when using it. While most users still think using a PDA for time management is very useful, it does not really fit how they want to manage their time. The PDA that had been bought to replace earlier artifacts for time management like paper diaries, have become merely a complement to these. We decided to find out more about this problem. By doing so, we had a design agenda in mind. The idea was to see if we could improve the design of the time management applications to better support people's ways of managing their time and increase the possibility to use the PDA as the sole resource for time management.

2.3 Delimitations in our Work

Given the fact that the project spanned over only 20 weeks, we had to manage time constraints. We delimited our work in accordance to make it manageable. Within the focus of time management we concentrated our effort (1) at improving existing applications in the PDA by trying to develop a better way of presenting the information on the screen and improving the reminder function and (2) not making an implementation of the design suggestion but instead create animations to visualize our ideas.

2.4 Reflection On Methods in Our Design Process

We see nearly every activity we do during a design process as a method to gain an understanding of the ordinary. We will here describe the different methods that are usually not seen as methods for design, how we used them and why they were important for our design process.

2.4.1 Self-learning

In order to get some background knowledge about the PDA we borrowed one from our supervisor in Australia. The PDA was a Palm Pilot III and contained the same applications as those that could be found in our informants' PDAs. To learn to use a PDA was useful because it made it easier to understand the things the people we studied talked about and showed us. Instead of having to ask the informants for detailed descriptions about how they performed basic tasks like adding appointments in the date book we could concentrate on how they used this feature. It was also useful to have a PDA accessible when we discussed questions that had come up from the interviews with the informants. The PDA allowed us to go back and recreate the conditions of use to see what the informant had meant. This saved us a lot of time since we did not have to go back and ask for an explanation about everything we had not understood.

We think it is important that we as designers should not show our expertise or taking on an overly positive or negative attitude to the subject to be able to get the informants' point of view. At one stage we cooperated with a person who did another study about the PDA. This person had another background and a different approach to this subject. The person was a PDA user and therefore had knowledge and opinions about it. During the interviews these opinions sometimes became apparent in the form of leading questions, which could have influenced the informants' point of view. By using the PDA we ourselves also naturally began evaluating the technology and have negative or positive opinions about it. We became concerned with how we would unconsciously let these opinions influence us during the ethnographical study. While this can be a problem self-learning was a good method to make the study more effective and as a consequence gave us more time to gain deeper knowledge about the PDA.

2.4.2 Time Planning in Our Project

To be able to carry out a design project in a limited time period it is important to have a time plan. We used the time planning as a method to estimate our project and divide it into manageable parts. This estimation helped us to structure our learning about the PDA, the design process, and the practical work. The time plan consisted of two parts. (1) A project overview, which was more an outline than a detailed description of how we should work, (2) a more detailed weekly overview that was created at the beginning of each week and showed what had to be done each day of that week. Because we only planned in detail on a weekly basis we could adjust the time plan to unexpected events and still keep the overall picture of the project. We think that the successful time planning depends on that we were careful not to plan the whole project in detail which gave room for the unexpected events that we knew inevitably would occur.

2.4.3 Communication – Creating a Basis for Group Work

Map of themes

It was important to have a common picture of the design process between the two of us throughout the project. This was nothing that came natural; we had to share our thoughts and discuss them extensively with each other in order to come up with a common picture and avoid misunderstandings as much as possible. We think that by seeing the importance of communication we worked much harder to maintain it. When good communication was established the work process became smoother and more effective. To help us achieve the level of mutual understanding that we wanted we created artifacts that were used as basis for our discussions. For example we created a map showing the different themes and patterns, which we had come up with during analysis. This visualization was then used as a mental aid in the discussion about the various themes and patterns and made it easier to combine our thoughts. The communication was also supported by the time plan because it gave us a concrete picture of the project to talk about.

2.4.4 Writing As a Tool For Reflection

We did not only use writing to produce a report about the results in the end of the project. We also used writing as a way to remember and organize all information, thoughts, ideas, and questions that came up. This helped us to avoid chaos where these would get lost. The writing has also helped us to keep a history on how we thought in the beginning of our project and how that changed over time to be able to see how our work progressed. Structuring our material by writing about it also gave us a chance to get an overview of the project. In addition, the texts gave us a way to share our work with other persons outside the project like for example our supervisors. The writing then becomes a reflective method that supports our work process because it forces us to reflect on our work and make the abstract visible (Hammarén, 1995).

3. About the PDA as a Technology – A Technical Review

This chapter gives a brief introduction to the current technology of the PDA and future directions in this area. A review of what have been said about PDAs and the reasons behind the design of these artifacts would be useful to understand some design solution concerning these. But we start with what a Swedish journalist from the magazine Datateknik wrote about what he wanted a PDA to contain.

> *…Send computer mail instead of calling! Then I can take care of the message in peace and quiet, think about a line, and also get documentation of what have been said. Therefore the computer mail and voice mail is enough on my B2 (Black Box). On the other hand I would like to have a wireless receiver for small amounts of data. And while we talking about radio receivers we can just as well add a jack for headphones so the B2 may function like an FM-radio. To be able to dictate would be nice. With a special button for recording you can make notes of ideas and tasks quickly. In contrast to tape recorders the B2 save the point of time for the recording. The sound clips can then be listened to, archived or thrown away, or be sent to someone else electronically….*
>
> *(Magnusson P. 1994, Datateknik Nr 14) Our translation*

This is only one of many speculations during the history of the PDA. Different actors, from the industry to the consumers, have speculated about what it could be used for and what it was good at. These speculations were fueled by the fact that there was no clear area of its use yet. The generically natured PDA was still looking for its niche.

3.1 History

It is generally accepted that the forerunner to the PDAs is the Psion Organizer[1], which is the world's first volume-produced handheld computer. It was released in 1984. The intention with this device was to be used for information storage. It had an alphabetic keyboard and a sliding plastic cover. Basically it was just a flat-file database and clock feeding information onto a one-line LCD-display[2]. This primitive device was the beginning of the evolution of the PDA and inspired others to begin develop the idea about handheld computers.

3.1.1 Apple's Newton: The first PDA

Newton MessagePad

The Newton MessagePad[3] was the first PDA introduced in 1993 by Apple Computer. It was developed to be the new technology of pen-based computing. The thought was that it should be as easy to use as pen and paper and that this technology would attract a lot of people because of its simplicity. Another group of people, that Newton was designed for, was the economically strong mobile workers for which the PDA would replace the desktop computers. These two areas, the simplicity and the PC replacement for mobile workers, were thought to be the key to the success of the PDA. It was supposed to create a new growth market for computers but did not become the expected success (Allen J. 1998). Users responded negative to the technology because of its limitations and as time went by the computer industry started to change the view on what the PDA was supposed to be in order to succeed. Now the PDA was seen as a wireless communication tool, something that is reflected in the following quote from a well-known business magazine.

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[1] http://3lib.ukonline.co.uk/historyofpsion.htm 2002-04-24
[2] LCD (Liquid Crystal Display) is the technology used for displays in notebook and other smaller computers
[3] http://www.msu.edu/~luckie/gallery/mp130.htm visited 2002-05-16

> *" . . . a vision of anytime, anywhere communications. The premise is that wireless digital networks, feeding information to powerful handheld phone computer-fax hybrids, will alter the way people live and work."*
>
> *(Business Week, 1993, April 5)*

The computer industry held on to the view of the PDA as a communication tool for a while but the success was still absent. The success did not arrive until 1996 when a new shift in the view of what the PDA was supposed to do emerged. This time the success was instant.

3.1.2 PDA in the Market again: Palm Pilot vs. Pocket PC

Palm Incorporated[4] released their Palm Pilot in the beginning of 1996. This company set the new view on handheld computing to be a complement to the desktop where synchronization of data between the two was the main issue to be resolved. Microsoft also released handheld computers in 1996 based on this view. Where the design of the Palm Pilot steered away from the desktop metaphor Microsoft's product more acted like a small personal computer to be used together with computers running the Windows operating system. These two big fractions in the PDA industry, Palm on the one hand with its focus on the personal management, and on the other hand Microsoft focusing on making a small pocket sized personal computer, has kept their focus. Over time the numbers of PDA manufacturers using the two operating systems have increased and new models are released frequently. The improvements to these models are mainly better hardware, which permit to get for example longer battery life and the introduction of the color screen. Software has been released in new versions, which allows more software to be available in them like tools for audio, fax, games, image and photography, spreadsheet, etc. Despite the development in both hardware and software, the focus has remained the same for the two directions; Palm sticks to simplicity and open development with focus on personal management and Microsoft tries to create a pocket-sized personal computer.

3.2 Current Models

We chose the two latest models from the leading companies in the market, Palm Pilot m515[5] from Palm Inc. and Compaq's Ipaq Pocket PC H3870[6], to represent the current PDA technology. On the surface the two look similar, it is hard to see what tells them apart. Inside, the operating system and software are what makes them different from each other.

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[4] http://www.palm.com Visited 2002-05-16
[5] http://www.palm.com/products/palmm515/ Visited 2002-05-16
[6] http://www.compaq.com/products/handhelds/pocketpc/H3870.html Visited 2002-05-16

3.2.1 Palm Pilot m515

Palm m515

This is the latest model from Palm Incorporated. The models in this generation of Palm Pilots are all equipped with a suite of Personal Information Management (PIM) software, including date book, address list, to-do list and memo pad. They have infrared beaming capabilities and additional software like an expense manager, a calculator, note-taking applications, and games. The screen is backlit and has a size of 160x160 pixels. In addition to the basic range of equipment the m515, comes with a color screen capable of showing more than 65000 colors, a universal connector that allows connection of for example a GPS-receiver[7] or a portable keyboard, and a viewer for Word, Excel and Power-Point files.

3.2.2 Compaq Ipaq Pocket PC H3870

Ipaq PocketPC H3870

Ipaq Pocket PC H3870 is the latest PDA model from Compaq. Like the Palm Pilot it has a standard set of software that includes a PIM with a date book, to-do list, memo pad and a calculator. The Pocket PC also comes with pocket versions of Microsoft Word, Excel and the web browser Explorer. For entertainment a media player capable of playing for example movies and mp3 files is included. The color screen of the Pocket PC has more than 65000 colors and is slightly larger than the Palm Pilots screen (320x240 pixels). This model of the Pocket PC uses an infrared port but in contrast to the Palm Pilot it is also Bluetooth[8]-enabled. It is also possible to expand the Pocket PC with for example a GPS-receiver or an external keyboard.

3.3 Future Directions for the PDA

Until today the difference between the two directions, Palm Pilot on one hand and PocketPC on the other, has been clearly marked. However, the two has begun to resemble each other more and more which can be seen in today's models where both has color screen, expansion possibilities, a PIM, software like office applications, games, entertainment and improved hardware. New features and applications are increasingly added to the PDA and lately there has been a cross fertilization with mobile phones. This has led to a development where the mobile phone and the PDA compete with each other on the same market. One example of mobile phones that has a PDA in it is the Kyocera Smart Phone[9]. This "smart phone", besides acting like a regular mobile phone and a PDA, makes web browsing and e-mail possible. The PDA Palm i705[10] is a similar device from which e-mail and the World Wide Web can be accessed. The big difference is that this device cannot be used as a phone. What these two have in common, according to us, is that they blend the different technologies together to create a new kind of appliance, i.e. the wireless communication device. This is what the industry once considered the PDA to be. That time they failed and there is still some way to go to succeed to make this reality. The wireless communication devices suffer from a number of flaws; most important is the slow data transfer speed. The arrival of the next generation of networks for wireless technology, the so-called Third Generation Wireless Technology (3G)[11] could change this since it allows a higher bandwidth and this is what the industry is trying to make their devices ready for (Sacher H., Loudon G, 2002, p.17-23).

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[7] The Global Positioning System (GPS) consists of 24 Earth-orbiting satellites. These satellites allow any person who owns a GPS receiver to determine his or her precise longitude, latitude and altitude anywhere on the planet

[8] Bluetooth is a standard that allows any sort of electronic equipment - from computers and cell phones to keyboards and headphones -- to wirelessly make its own connections, without any direct action from a user.

[9] http://www.kyocera-wireless.com/kysmart/ visited 2002-03-10

[10] http://www.palm.com/products/palmi705/ visited 2002-02-12

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[11] http://www.3gnewsroom.com/ visited 2002-04-11

4. The Use of the PDA In Its Context

That we as designers investigate the technology and think about how the product will work in its environment and what the users want is not enough to create a good design. When working with technology, whether the work is to create a completely new artifact or improving an existing one, it is important to study the setting where the technology will be, or already is used. This is important to get an understanding of the artifact from the users point of view and to try to come as close to them and their world as possible. To get the understanding of when people use a PDA, how they do it, why, and if there are problems with the use of it we did an ethnographic study. In this chapter we describe how we did the study and what we found out from the analysis of it.

4.1 How We Did The Study

Our ethnographic study focused more on design than on the traditional sociological and anthropological purposes (Blomberg J. 1993, p.123). We tried to adjust the methods we used to this precondition. The methods in an ethnographic study are not templates ready to be used and the use of them does not automatically reveal fantastic answers to how an artifact should be designed. What the methods can do for the design is to let the designer understand the ordinary (Garfinkel H. 1984, p.1). We worked with the following ethnographical methods to collect the material and then analyzed it to get an understanding of how people use the PDA in practice.

4.1.1 Observations

Our first step in the ethnographic study was to observe the use of the PDA in the public. We conducted the observation in a place where we could observe the user without their knowledge so we could catch the undisturbed natural use of the PDA in this setting. We chose a number of spots in the city were lots of people pass by like café areas, crossings, and a meeting point. Almost no one was observed using a PDA in the locations where we observed and when they were, it was just for a short time as for example to check today's schedule. This has to do with the use of the PDA while on the move. It also seems that it is not that common to own a PDA something that makes the brief moments of use even harder to catch when you are in a public place.

Observations are a flexible way to get an objective view on a phenomenon like the use of the PDA. To use observations during an ethnographic study is common and has a great advantage towards other methods like interviews because sometimes what the user say they do is not always what they do in practice (Blomberg J. 1993, p.130). This has nothing to do with lying; the distinction is nothing they are aware of. An example of this was when one of our informants talked about the voice recognition software in his PDA. The informant stated that it was useful for example when driving a car. He could then talk to his PDA in order to make it read out today's schedule aloud or perform something else.

"…It is also another cool thing it does, is a., it actually got voice recognition, from IBM via voice. So if your like in a car or something and you want to check a day and you can't look at it, you can speak to it…"

From video transcript: 2002-02-20, 0:01:16

When he showed us this feature it did not work. He explained that the basic commands required the user to talk with an American accent. Because the informant is Australian this did not work very well and he explained that this fact had annoyed him a great deal so that he did not really use the feature.

We think that it is important to shape the observations to what is being observed. In our case the approach to observe the users interaction with the PDA, in combination with interviews where we discussed their use of PDAs and then ask them to do things they usually do with the PDA suited us best. But participating observation brought a problem. If we created the scenarios and then asked questions about this there was a risk that we influenced their natural interaction with the PDA and that the information could be misleading. We tried to avoid having this influence on them by asking them to do what they usually do instead of just creating scenarios for them that we thought would be interesting for us.

4.1.2. Interviews

To get more detailed knowledge about the use of the PDA we decided to do a number of interviews with some PDA users. We contacted a group of twelve people who represented these users. This group mostly consisted of people from the academic environment, both students and teachers. In the group were also an architect and a computer worker. We tried to make the group as diverse as possible to learn how the use of the PDA varies between people with different backgrounds. We also interviewed two people who had stopped using the PDA. They were included in the ethnographic study as an important addition since they gave us a different perspective on the use of the PDA than from those who use it regularly. The people we interviewed used different PDAs ranging from the early Newton, through various models of Palm Pilot to the Pocket PC.

In ethnography the interviews comes in many different forms and is considered an important method (Fetterman, D. 1998, p.37). The interviews were a useful method to learn how people use their PDAs. There is a notion among ethnographers that says "asking highly constrained questions before enough is understood about the situation likely will produce poor quality answers" (Blomberg J. 1993, p.134). That is why we used intentionally unstructured interviews with open-ended questions in the beginning. We wanted to get a broad picture of the use of the PDA. Instead of asking a lot of questions we let the interviewed decide what to talk about and take the role as a leader of the interview. Those questions that were asked were based on what the informant found interesting. In this way we did not narrow down the question before the informants had talked about what is most important for them.

When we had the broad picture of the use of the PDA and had decided on a focus the form of the interviews changed. We needed to inform the design rather than to get general information. We started to constrain the questions and structured the interview more since we knew what kind of information we wanted.

4.1.3 Using Video For Analysis

Video can be used in a number of ways to gather field data and be material for analysis (Jordan B., Henderson A. 1995). We took advantage of this by videotaping the interviews and observations. By doing that we got a memory aid for the interviews as well as a second chance to catch details that we might have missed during the interviews while taking notes. Whenever we needed to go back we could rely on the videotape as memory aid while the notes taken during the interviews quickly deteriorate from memory. The video camera could also catch a visual picture of the situation and give a broader focus. Things that we did not notice during the interviews revealed themselves during later analysis. If we had only relied on our own impressions and not videotaped simultaneously we could have missed out on important information.

During the interviews we used the video camera more as a mental aid than an extra eye. Since the camera was primarily used as this mental aid we tried to place it as far back as possible to detract attention from the camera and focus completely on the interview. This placement also enabled us to reconstruct the situation better because we had a very broad focus. To focus on the interviewee's face would not recreate the feeling from the interview. Still we are aware that we did not catch all we wanted to. In contrast to the broad focus we used for interviews we narrowed it down when we studied the interaction with the PDA. In that case it was harder to decide on what to focus on, what happened on the screen or to catch the whole interaction between the PDA and the informant.

We used the video camera a lot during our ethnographic study and one of the effects was that we quickly generated a lot of data in the process. It is a very time consuming task to analyze video and because we did not have unlimited time we decided to go through the tapes to find common themes and patterns in the use of the PDA and to complete our field notes about each interviewed person. At the same time we did a content log of the videotapes showing where the different issues, themes, patterns, and interesting things could be found in order to avoid having to go through all the video to find an occurrence of for example a theme later. Once the content log was completed it was much easier and faster to go back to an interesting event and examine it closer for detailed analysis and transcriptions of particular clips.

One disadvantage with videotaping is that the camera can make people feel uneasy. Several times when we videotaped the different informants we noticed how uncomfortable they were when we started the camera. This resulted in that the interviewed started acting in front of the camera and was more reserved. He or she tried to figure out what they were expected to say more than exactly how they felt. One way to reduce our interviewee's discomfort about the camera was to explain how we would use the video material. This seemed to help a bit and make the interviewed feel a little bit more relaxed. Our experience is also that after a while the interviewed tend to forget the presence of the camera without measures being taken.

4.1.4 Using "Rapid Ethnography"

Traditionally, ethnographic work is distributed over a long period of time but in our case we had the 20 weeks time limit. In an attempt to fit our ethnographic study into these 20 weeks and also produce a valid result we tried to take ideas from something called "rapid ethnography" (Millen D. 2000) and incorporate them into our own project. This customized version of ethnography is aimed at providing reasonable understanding of the users and their activities given significant time pressure and limited time in the field. To work in parallel, Millen argues, saves a lot of time because the work is much more effective.

The idea to try "rapid ethnography" came up during one part of the fieldwork when a person from the University of Queensland joined us because he was also interested in the use of the PDA. Since there were three of us during the interviews this naturally led to one person holding the camera, one doing the interview and one observing and taking notes. Reflecting on this approach we feel that our group of ethnographers working together were an effective way to collect data for our ethnographic study. The negative side of being three interviewing one person was that we noticed that the interviewed could feel uneasy, this was especially noticeable when we were in small rooms like offices and we think it is a good rule not to be too many in these situations.

By using rapid ethnography we could manage to get a satisfactorily insight into the daily use of the PDA within our time frame. In order to structure our material and get a more comprehensive view of how the PDA is used we tried to organize it in different areas to elucidate the different perspectives on the use of the PDA in practice. The different perspectives were; the physical interaction between the user and the PDA, technical matter in the use of the PDA, communication through the PDA, and time management with a PDA. These areas were divided into a number of related issues, themes and patterns.

4.2 The Physical Interaction Between the User and the PDA

The design of the PDA has influenced the users physical interaction with it. The pen-based input has followed through the development of the PDA and though there is some alternative ways of entering data, with for example a keyboard, the stylus is the way users interact with the PDA mainly today. One consequence of this is that the PDA is used mostly as a read-only device. From the interviews we could also see that the PDA is often used with both hands and required a great deal of attention when used, which is also connected to the issue with pen-based input.

4.2.1 Input

The PDAs we have studied all have in common that you enter data and navigate the applications by using a stylus[12]. The main form of entering data with the stylus is by using graffiti, a sort of alternative alphabet that the PDA can translate into ASCII[13] text. One of the informants told us that entering text into the PDA using the graffiti was the last way out like for example when he was out of the office and bumped into someone who wanted to arrange a meeting with him. It was not that the graffiti was impossible to use. What bothered him was that it is a slow process to enter for example a meeting using the graffiti. He thought that it was much quicker and smoother to write the meeting down on a piece of paper with a pen and then transfer it to the stationary computer when back at the office.

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[12] An instrument used on a surface on the PDA as input to write text or draw lines and to navigate the applications.

[13] A standard for the format of text –files developed by the American National Standards Institute. ASCII consists of 128 possible characters that covers each alphabetic, numeric, or special character.

"…-Usually because am in another meeting. I'm taking notes in that meeting.. I just write of the bottom of the notes, you know, next meeting whenever. Later on I enter that in the PC which is quicker than bringing out this [pointing at the PDA]…"

From video transcript 2002-02-14, 1.11.31

The average user only learned the basic characters in the graffiti alphabet. This put further constraints on the usage of the graffiti. The users solved it in various ways from ignoring the characters they had not learned and only enter fragmented text which would be made more detailed after synchronizing with a desktop computer to replacing these characters like the ampersand by writing "w/" instead. One way to work around the problem with these characters and also an alternative way of entering text is by using a software keyboard where you click with the stylus on the character you want to enter. This feature is perceived to be even slower than graffiti and was only used for the special characters that the users had not learned.

There are software for handwriting recognition for the PDA but they require that the user writes nicely, otherwise the software will not recognize the words. One informant had these problems when she used her PDA with handwriting recognition software. Her handwriting was as she described, very scrappy, and it was hard to recognize the word she had written down as an example. The fact that the word, which was totally clear to her, was unreadable to us shows that it is hard to create handwriting recognition software that will recognize every conceivable way of writing the different characters in the alphabet. The variation in how different people write them varies too much for this to be possible. The informant who had the problems with this asked what the use of handwriting recognition is if you are forced to adapt your handwriting to the PDAs requirements? In this aspect the graffiti serves better as the written language bridge between the user and the PDA because it may be harder for people to change their handwriting than to learn how to write the graffiti alphabet.

One of our informants who were using a Pocket PC had downloaded voice recognition software to his PDA. He said that this enabled him to interact with his PDA using voice commands but there was a big drawback since he had to change his accent to be able to use it. While the informant was from Australia and therefore had an Australian accent the PDA was programmed to recognize American accent. The difference in pronunciation between the accents resulted in that the PDA had difficulties recognizing our informant. He did not think that it was worth using an American accent to be able to interact with the PDA in this way. We think that voice recognition software is hard to implement because of the same reason as for handwriting recognition. People's talk differs as much as their handwriting and no one likes to change the way they talk to meet the requirements of a computer.

4.2.2 Two Handed Device – Concentration Demanding Interaction

When using basic interaction for example viewing today's schedule only one hand is required to operate the PDA. However, the PDA requires more attention than for example a paper diary as soon as the interaction becomes a little bit more advanced like for example showing details for a meeting. The stylus has to be used to navigate through different applications and this requires more attention to the PDA and the user's both hands are occupied.

4.2.3 Read-Only Device

The way most of the informants use their PDA is like a "read-only" device. By this we mean that they access data rather than create it. Examples of this use are to find a person's phone number, have a quick glance at today's schedule or at their to-do list. When the user transfers e-mail they use it merely for reading. The memo pad, which is an application for notes on the PDA, is used for reading abstracts for meetings, jokes, e-books, and lists of things. The list on how to use the PDA for reading purposes is long but to generate data is usually seen as an awkward and slow process. This results in that the informants rather use other artifacts like ordinary paper and pen to write down notes in meetings or entering data on their desktop computer when in the office and then synchronize this data to the PDA. The users often express that graffiti is the last way out. Generating data with the PDA is considered cumbersome and is generally avoided in comparison to for example a paper calendar where the resistance to write things down does not exist. While the interaction with a paper calendar is used for both writing and reading, the PDA is most useful for reading.

4.3 Technical Matters in the PDA

Technical matters in their use of the PDA were another issue that our informants talked about. The PDA technology comes from the computer industry and this can be noticed in the technology's power consumption and fragility. Another technical matter that affected the informants' use of the PDA was the synchronization issue. The PDA is designed to be used in conjunction with a desktop computer and the transfer of data between the artifacts presented both problems and advantages.

4.3.1 Limited Battery Life

The different models consume various amount of power depending on the PDA is equipped with for example a color screen. Simply put, the more advanced technology the more power consumption. Older Palm Pilots with a monochrome screen had a longer battery life but the problem with these was that the user had to have fresh batteries available for change. The newer models like the Pocket PC run on rechargeable batteries. Here the problem is that the battery runs out in a shorter period of time and has to be recharged by a power outlet.

Several of our informants had experienced problem with the battery. The battery problem was the reason why two of our informants had stopped using their PDA. In the first case the informant became irritated because he had to change his batteries regularly. In combination with other irritations the battery issue contributed to that he finally gave up using his PDA. In the other case the scenario was similar but this informant had a PDA with a rechargeable battery. When this battery became worn out she had to keep the PDA plugged into the power outlet. Also in this case the battery issue was what finally made her give up and stop using her PDA. Being in a lot of meetings at the time she did not think it was very useful to have a PDA that she could not bring with her because it had to be connected to the power outlet all the time to work. When our informants bought their PDA they did not consider limited battery life. But later on it affected our informants' perception of PDA technology in a negative way. The informants who had bought their PDA for time management purposes was dissatisfied with the power consumption issue. They compared the PDA with a paper diary where these problems do not exist.

4.3.2 The Synchronization of Data

Synchronization is when the data in the PDA and the desktop computer is transferred to each other to exchange the latest information in both artifacts. The various PDA models have different ways of achieving this synchronization. Early models like the Newton used a serial connection. Newer models use infrared communication or a cradle, in which the PDA is placed and synchronized through the push on a button. In our analysis we found advantages as well as disadvantages with synchronization. The great advantage is that it removes the trouble of updating the data manually between different artifacts in an easy way. One problem that several of the interviewed talked about was synchronizing in multiple locations, for example at home and at the office. They said that this could lead to confusion when one location's data is not synchronized with the PDA and forgotten for a while. The risk for conflicting data then increases, i.e. different versions of, for example, events in a schedule. Another problem relating to synchronization was bad support for alternative desktop organizers than Microsoft's or the one shipped with the PDA and bad support in operating systems like UNIX. This was one of the reasons why two of the interviewed had stopped using their PDAs. The synchronization was not possible with their computers at their offices. While there where problems related to the synchronization almost all interviewed persons appreciated the ability to transfer other data from the computers to the PDA since it enables them to bring for example their e-mail or short texts like abstracts for meetings or a flight schedule.

4.3.3 The Fragile PDA

The PDA is a small computer and a computer is built from fragile components. Unlike the desktop computer a PDA is often carried in the pocket or in a bag. This way of handling the fragile PDA results in that it wears and sometimes breaks. Though the informants tried to protect their PDA as far as possible by having them in special cases those who had owned their PDA for a while often had problems with this fragility. The screen, for example, is touch-sensitive and merely by using the stylus to enter text it gradually wears out to the point where it starts to become irritating. The graffiti is no longer recognized or produce the wrong character, the stylus gets stuck, and so on. Another informant complained about memory loss. Sometimes her PDA would shut itself off and she would lose everything in it. Our informants worn out devices are not isolated cases. A quick look at the PDA community PDAGeek.com's site for horror stories[14], where PDA users share stories about how their devices broke, is further evidence of the fragility issue. The informants expect the PDA to be as durable as other things they carry with them like diaries or phonebooks but this is not the case. That the informants experienced this as a big problem indicates that the choice of material for the technology is important.

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[14] http://www.geek.com/pdageek/pdahorror/ visited 2002-05-02

4.4 Communication through the PDA

Some of the basic application that is included in the PDA specifically the e-mail software and the address list reminds of the time when the industry wanted the PDA to be a wireless communication device. Our informants used the applications but not for direct communication with the PDA.

4.4.1 Using E-mail in the PDA

E-mail View

The users who sometimes worked outside the office appreciated that their e-mail could be transferred to the e-mail application in their PDA. Since much communication in a work place is done through e-mail this function comes in handy as an archive that the user can bring with him or her. An example of when this is useful is in meetings where a discussion over the contents of a specific e-mail could be brought up. The user would then easily find that e-mail without having to print it or remember it from memory. But this application was almost always used for reading. It seems like the process of writing and sending e-mail with the PDA is too awkward to be worth doing. In part this is because of the slow input methods, and in part because it is too much work to hook up and configure a mobile phone to the PDA using an IR-port or serial connection to send the e-mails.

4.4.2 The Digital Address List

Address List View

This application was much appreciated by the users and works much like a paper address list. But the digital version makes it easier to find and get all the details about a person through the search function. Another advantage with a digital address list is that it is easier to update information about a person. A lot of the information that can be found on the business card can change quickly, like a new title or a phone number. To update the address list instead of changing the text directly on the business card is a much easier process. To use the address list as business cards may not have been the intended use from the beginning but seems to be a good support to keep the contact addresses updated.

4.5 Time Management with a PDA

One area of use that all informants had in common was time management. This is what a PDA is mainly bought and used for. Time management in the PDA is mainly done with the date book application and the to-do list. Every event in the date book and task in the to-do list may have a reminder. The reminder function was of central concern for all users. Another significant theme that emerged during the study was that the PDA was seldom used as the only resource for time planning. It was a component in a larger system.

4.5.1 The Date Book

Date Book

The screen of the PDA is small and that is something that is reflected in the users thoughts about the date book application. Most users thought the date book was the most useful application in their PDA and that it supported the task of providing them with a quick overview of today's schedule very well, for example checking which room a meeting is in while in the elevator. When the task was to plan time the problem with the small screen became more apparent. To plan time with a weekly or monthly overview was something that many users preferred.

"…my mental model of my diary was not its (the PDA) model. So there was a mismatch in the impedance: it wants daily with the 15 minutes, I wanted a weekly with much more casual approach to timing…"

From video transcript, 2002-02-13, 0:04:45

There is a possibility to have these views in the PDA but they do not provide sufficient information for time planning. For example, the Palm Pilots overview shows events in the date book using only blocks that has to be selected to reveal what they are about. This have the effect that users tend to plan their time at their desktop computer that has a lot more screen space or use a paper diary instead. But at the same time the users want more detailed overviews they are also happy with the size of the PDA, which makes it fit in for example a shirt pocket and makes it easy to carry it with them. This creates a contradiction between how the user wants a small device and at the same time that it provides a big workspace.

The format of the date book also raised complaints. Some informants said that they have a hard time defining end time for certain tasks during a day. For example, when scheduling an appointment for a dentist it can be hard to tell when it is over. Since the date book requires an end-time there is no good way to handle this. The informants solved this problem by ignoring to set the time. The PDA then set the end-time to the default value, which is one hour.

4.5.2 The To-Do List

To Do List

To make lists of things to do or that is connected to a certain project is something that everyone does in order to manage their time. The support for this task in the PDA proved to be something that the users did not like very much. The big part of the complaints concerned the relation of the to-do list application to the date book application. In the PDAs these two applications are separate tasks and it is not the way people manage time in reality. Instead of separating the two, users wanted to be able to see them both at the same time. The need to see both of them at the same time is expecially important when they are planning their time. Most informants did not use the to-do list application in the PDA. Instead they had worked out alternative ways of writing down their tasks. Some used paper diaries or notebooks, and other's kept them in the computer. Common for all of the ways were that they enabled the user to see both the schedule and the to-do lists at the same time.

Another use of lists of things to do is to keep separate lists for things to do connected to specific projects. Many informants created these lists and they were often written down in notebooks, paper diaries or in text files in the desktop computer. In the Palm one can filter tasks according to a category and accomplish the project specific lists. However, since the to-do list application was not very often used this function could not be taken advantage of.

4.5.3 The Use of Reminders

The to-do list and the date book have a reminder function that allows the user to set a time when an alarm should remind him or her about the event or a due date. The reminder is generally thought of as a good function but presents a number of annoyances for the users. They say that it is a great advantage towards paper diaries because the paper version has no way of reminding them with sounds. The people who use a paper diary have to provide their own cues for when a task is due. Aside from looking in the paper diary to see if there is a task that has to be done this is solved in other ways. Informants would put Post-It notes in appropriate places or place documents connected to some task in a way so that they reminded them of what had to be done when they looked at it. To use objects in the physical world as external memory (Norman, D. 1988, p.72) is often used by people as memory aid. The digital reminder in the PDA provides a way to make use of external memory. That can come in handy if there are a lot of things to do or if the task is due in the distant future.

Although the informants say that they have a need for reminders they often complain about the one Palm provides. The reminder in Palm works in the following way. For every event in the date book and to-do task one reminder signal can be set at a specific time. When the signal starts a note appears on the screen showing what the current reminder is about. However, this does not always seem to be the way people want to be reminded about things. One of our informants for example talked about the problem with finding himself with four deadlines in the same day because the reminder only reminded him on the day of the deadline. Instead of this he wanted a sort of gradual reminder that visualized how much there was left to the deadline. He would also like to see that the reminders could warn him if many important due dates were set at the same time like for example the four deadlines. Some of the informants that had a crowded schedule were annoyed by the constant beeping the PDA produced. This annoyance was so strong that even if they really liked to have a reminder function they stopped using the one provided by the PDAs.

4.5.4 The PDA as a Component in a Time Management System

The read only property and the limited screen space of the PDA results in that instead of simply replacing earlier used artifacts for managing time the PDA becomes a complement to these. Every user has created their special way of managing time with their own collection of artifacts. Since it is considered awkward to use the PDA for input the informants used other artifacts like paper diaries, notebooks, and stationary computers to compensate the awkward input with the PDA. Alternative artifacts also give them a better overview over time than the small screen on the PDA. For example one informant used his laptop computer to enter appointments because he preferred a weekly overview when planning time and he did not like to enter text using the graffiti. He also used paper diaries to enter his to-do tasks and did not use this application in the PDA. He said that the to-do list is not well connected to the date book and that he could never remember to look at them in his PDA because of this separation. Another informant uses his laptop to enter appointments or writes down a quick note in a paper diary if he is outside the office. But instead of having his to-do tasks in a paper diary he uses the PDAs to-do application. He thinks that it is better than lists in paper because he likes the reminder function.

5. The Problems in Time Management in the PDA

The information from the study and the review of the technology gave a good insight in how, why and when the PDA is used. What is most important for the informants was that the PDA supported them in their time management. The usage of the PDA with attention to the time management clearly presented a number of aspects that could be improved. There were limitations in how the information is presented on the screen and the benefits of the computational power (DiSessa A. 2000) is not used to its full capacity in the reminder.

The problems with the time management applications are nothing that has emerged recently. The design of them has not changed noticeably and has largely been neglected during the development of the PDA. The commercial development of the PDA has instead been aimed at other objectives. One is creating new areas of use, like for example communication. This is exemplified in the latest models of Palm Pilot and Pocket PC, which have capabilities for wireless communication for e-mail and Internet access. Another objective has been to improve hardware; batteries last longer, screens are brighter and the amount of memory increases. Also, a number of solutions in attempt at making the physical interaction between the user and the PDA better like foldable keyboards[15], virtual keyboards[16], handwriting recognition software and small "thumb-keyboards"[17] have been developed.

While these improvements certainly attract new users and contribute to make the PDA a better technology, the need for improvements of the time management applications that was most apparent in the study, remain unnoticed by developers. We are aware of that some of the improvements that have been made in other areas affect time management in the PDA positively. For example longer battery life was something users considered an improvement to time management in the PDA. But longer battery life or easier input alone will not make it possible to use the PDA as the sole resource for time management. That is why we decided to concentrate our efforts at creating a design suggestion for an improvement to visualization of the information and make better use of the computational power to improve reminders.

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[15] http://www.palm.com/products/accessories/keyboard/index.html visited 2002-05-02
[16] http://www.senseboard.com visited 2002-05-02
[17] http://www.handspring.com/products/treo/ visited 2002-05-16

6. The Design Work

The ethnographic study showed that there was a great variation in how people managed their time. This suggested that in our work to improve time management applications in the PDA it was important to support the versatility of the users and their need to use the PDA in their own way. It is impossible to make the design so universal that it fits every person's need. But in an attempt to make the improvements appropriate for as many as possible we chose to work with several different people from different areas using PDAs. In this way we could for example compare how a tightly scheduled professional preferred to view their time to how a student with less crowded schedule preferred it. The design work was based on what we had found out from the informants during the ethnographic study and also used the information from the investigation about the technology and ongoing research in this area (Aaron M., Chen E. 2002; Bellotti V., Smith I. 2000). But we also wanted to involve the informants in the design phase to ensure that the design suggestion was well grounded in their interest. To make that possible we used methods from Participatory Design (PD).

> *"The fundamental principal of participatory design, is to let the users take an active part in the design process and let their voices be heard. They play a part in the decision-making regarding their future lives in a work place, instead of having other people make these decisions for them."*
>
> *(Greenbaum, 1993)*

In PD there are a number of methods, techniques and tools that supports the cooperative work with users when designing an artifact. In our choice of methods we made sure that the diversity of the users was represented.

6.1 Profiles

Since we interviewed 12 people it was hard to keep a clear picture of everyone's use of the PDA. Already during our analysis of the ethnographic study we decided to create a profile for each person that would give a short description of what type of person the interviewed is and how they manage time. This gave us a good overview of the differences between the interviewed, especially how they used the PDA.

Although the profiles were useful during analysis of the ethnographic study to come up with themes and patterns the really good use for them was in the design phase. When we for example encountered problems in a design decision we could use the profiles to quickly compare the informants different opinions instead of having to go back to the tapes. The profiles came to serve as a substitute for the informants who we had no longer access to, a sort of "mock-up" participants. When we talked about a design decision we could "summon" the informants, and by using the profiles for the persons trying to find out their opinion based on what they had said during interviews. We felt that this is not the ideal way to deal with participation, but since we could not have them with us throughout the project this was as close as we came to participation without them being present.

The profiles did also constantly remind us that we had to take the versatility of the user into consideration in the design. It is maybe not possible to design an artifact as complex as a time manager to fit everyone perfect but using the profiles made us question design decisions more. We became aware of the tradeoffs for the taken decision. If we for example decided on a design suggestion that rewarded a crowded schedule which fit person's who have a lot of meetings etc. people who where not that busy might find the design suggestion unfit for them. This provided us with measurements for if tradeoffs were justified or if they were not acceptable.

6.2 Future Workshop

We wanted some kind of bridge from the analysis to the design as one of the first steps into the design phase. We sought for a method that would help us with the bridge and at the same time give us, in collaboration with users, some initial ideas for the design. We also wanted to involve new people to "test" our conclusions from our analysis in order to see if we had come to the right conclusions and to have a possibility to find out about things we had missed earlier in our study and incorporate these in our findings.

The future workshop with a slight modification was suitable for these needs. A future workshop according to the model Löwgren & Stolterman[18] presents is constructed in the following way. The whole method is divided into three parts; the critique, the imagination and the implementation phase. In the critique phase the participants are divided into groups that discuss a subject, in our case time management, and try to find what problems there are and what is negative with the situation today. These problems are then formulated into short statements. In the next step, the imagination phase, the groups come up with wild ideas on how their situation could be. The ideas do not have to be realistic at all and it is not allowed to criticize anyone. The phase ends with the groups choosing a number of the ideas to bring into the next phase, the implementation. During this phase each group presents their wild ideas and discuss them in a more realistic way. As a conclusion to the future workshop a plan is put together that specifies what has to be done to reach the vision, when it should be done, who should do it, and so on. The first two phases suited us well because it would be a sort of brainstorming with new users and also supply us with additional user opinions on the subject of time management. The third phase, however, we changed because we did not want a plan on what we should do and it was not the participants who should do anything. But we did not want the users to feel half done after they had formulated the vision either. We decided to craft our own third phase, which came to be the visualization step. We thought that by visualizing their vision, we would let them take a step back and in a creative way reason on how they could get it to work in the physical, not the imaginary world. The objects they created were also something we could bring with us into the design phase in an easy way, they became objects to discuss over and get ideas from.

We invited six persons who had not been involved in the work previously to participate in the workshop. The participants of the workshop provided a lot of interesting ideas and insight into their way of managing time and also planted some early design ideas in our heads. When we put the material together we noticed that the insights into their way of managing time gave us more a verification of what we had already seen rather than completely new aspects on the topic. We felt that further analysis of the material would get us nowhere.

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[18] Löwgren J., Stolterman E. 1998, p.108-109

> *"Although there is no fixed rule concerning when one has observed enough, a general principal is that when you're no longer surprised by what you're observing, you've probably seen enough."*
>
> *(Blomberg J. 1993, s.132)*

Design sketch (from Workshop 2002-04-04) showing how a reminder would be distributed to different artifacts like PC, PDA or mobile phone

The feeling that further investigation would take us nowhere together with Blomberg's advice made us feel assured that the information from the investigation about the use of the PDA we had gotten so far would give us a good starting point for design. Besides giving us this indication the groups' sketches and design ideas coupled with the discussion that followed incorporated the participants into our design work from the start and enabled us to construct a number of concepts connected to the problem frame with their help. The workshop served as our bridge to the design phase.

6.3 Mock-ups

Cardboard mock-up of design suggestion

In an early phase of the design work we wanted to try out our thoughts and ideas on potential users. One way to do this is by discussing the design with them but discussions are abstract and it can be hard to convey the ideas. To make the discussion more concrete we used mock-ups, which are rough models of the design made from, for example, paper. From what we had found out from the ethnographic study and the ideas from the future workshop we created models for our design suggestion from pieces of cardboard and made screenshots from paper to explain the ideas. These mock-ups gave us a physical object to talk about the design with. Instead of only discussing our solution we made them visible through this physical object. If we for example discussed ideas about the presentation of the information on the screen in the PDA we could show a cardboard box with the overview of a week. It was a lot easier for the informants to understand our thoughts and ideas and it was also useful for us in the project group as a physical object to discuss around the design.

6.4 Prototype

Once we had a fairly good idea about how the improvements to time management in the PDA should be done we made prototypes in form of animations to visualize them. We wanted to create the animations for two reasons. First, they would be useful for further refining of our ideas in cooperation with our informants. The mock-up had provided an object to discuss about our ideas with the informants in a rough way but lacked the ability to show these ideas in detail. The ideas were still quite abstract and it was hard for the informants to see how it would really work. The animations also forced us to think more about how the design suggestion would work in reality. Secondly, we wanted the final version of the animations to be a complement to the thesis to give a visual picture of our design suggestion. We were careful to still be open-minded when we showed the animations to our informants by trying to avoid making the mistake of concentrating on elaborating the details of our current ideas instead of questioning their underlying premises (Mogensen P. 1991, p.35). If we concentrated on details we could loose the opportunity to get more feedback on our design suggestion that could improve our prototype.

The final prototype is available on the World Wide Web at the address:
http://members.tripod.com/JonasGlenneflashprototype/index.html

7. The Design Suggestion – Improving Time Management in the PDA

The prototype was the end of our design work and visualized our design suggestion. The objective with the design suggestion has been to increase the possibility to use the PDA as the sole resource for time management by (1) improving the presentation of the information on the screen for the time management applications and (2) further refining of the reminder function by taking more advantage of the computational power. In this design suggestion we have also considered how the changes we have done can result in changes in other ways, like lowering resistance against using graffiti, which in turn increases the possibility to use the PDA as the only resource for time management.

7.1 Visualization – The Presentation of Information On the Screen

To make it easier to plan time with the PDA some improvements to the presentation of the information on the screen has to be done. There are four different parts that we have concentrated on for this improvement:

- The date book and to-do list applications have been merged into one view.
- We provide the option to list all tasks that are connected to a specific activity
- We offer an alternative to the rigid time format in the date book that better suits the merging of the to-do list and the date book
- We provide a better overview by showing a weekly view and using two screens

These four parts are what we believe to be the main reasons why the informants found it hard to plan time with the PDA. We propose a number of changes in the design for each part that together represents our design suggestion for improving the presentation of the information on the screen of the PDA.

7.1.1 The Merging of the To-Do List and Date Book

The date book and the to-do lists are separate applications in the PDA. The informants liked to see them simultaneously when viewing and managing their time since both to-do tasks and date book events have to be taken in consideration when planning time. One informant, who was a teacher, used a paper diary for his to-dos. The date book in the PDA was then used in combination with this paper diary. In this way he was able to see them both at the same time. He thought that by keeping the information visible he could constantly be reminded of things he had to do. In the case of the teacher, he had simply stopped using the to-do list in the PDA because he could never remember to look at the separate to-do list.

> *"A few years ago I used to use the to-do's but I found that I never looked at them, so they didn't help, so I stopped using them. So my to-do list is completely empty."*
>
> From Video transcript 2002-02-15 *1.21.34*

Merging of to-do and date book

Our design suggestion provides the user with the overview of seeing both the to-dos and the date book at the same time as the teacher wanted. In this way the to-dos time more nicely with the date book and allow the informant to use the PDA for the to-do tasks also. We can partly understand the separation of the existing applications because there is a difference between tasks. A meeting that has a day and time connected to it is not the same as a to-do task without these connections like for example sending someone a postcard. But this difference does not mean that they cannot be shown at the same time. It is important for the users in time management to see all tasks at the same time and that is what we want to change, not the difference between the tasks. In our design suggestion we distinguish between three different types of tasks. We have a task that is connected to both a day and time, tasks that are connected to a specific day but not time and tasks that are not connected to a specific day or time. All tasks that are connected to a day, whether they have a time or not, are shown in the square that represents that day. The tasks that are not connected to a specific day or time have been placed in a separate square that represents the week. These tasks involve things that have to be done sometime during the week, that span over several days or have to be done in the nearest future. Regardless of which type the tasks are they are all shown at the same time on the screen.

7.1.2 Activity Lists – The Need For Separate Lists For Different Activities

There are times when it is desirable to list tasks for a specific activity, like for example a project. This was what one of our informants thought would have been useful to use the PDA for. However, while her PDA could list the different tasks in either the to-do list application or the date book application according to a category, she wanted a single activity list that combined all tasks, regardless of application, in one list. In this way she would have been able to see the whole list of tasks that are connected to an activity.

"…I don't run a single to-do list. I have many activities that I am involved in and I tend to run separate to-do list connected with different activities...The things related to that topic of that meeting and not all the other things about, you know, returning my library books and all the other things…"

- From video transcript, 2002-02-14, 0:10:15

One informant, who was involved in many different projects, used different notebooks for each project where she would list what to do for the specific project. She said that it helped her to structure her work and for example see what is left to do. This function already exists in the date book and the to-do list application but it is not possible to combine these into one list.

The need for these activity specific lists is something that we have incorporated into our design suggestion. For every task, regardless of which type it is, there is a possibility to choose from a list of categories or define a new one. It is then possible to choose a category and list all tasks. In that way the user can see the whole list of things connected to that category.

Activity List

7.1.3 The Alternative To the Rigid Time Format

"Well, I started with the date book. I wanted to display a full day, eight to five...that was our starting point"

(Bergman E. 2000, s.85)

Date Book

This quote from an article where one of the creators of the Palm Pilots interface explains how he thought when he started to design for the tiny screen of the PDA. The daily view presents the time as a timed schedule where every event has a descriptive text, a start time and an end time. There is also a choice to make an event an all-day activity in which case the descriptive text appears at the top of the screen next to a small diamond symbol. Many of our informants liked this view because it provided the daily schedule at a glance but were unhappy with the schedule-format where they were forced to give an event a start and end-time. Those who did not like the rigid time format were people whose work was not strictly structured with meetings and so on. One computer worker said that the rigid time structure of the PDA did not fit the more relaxed view on time in her working environment.

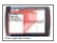
"...Diary function was based around a day and it was based around a 15 minutes intervals. Now I'm not a person whose jobs involve seeing, doing things on 15 minutes graduation. As you probably know, around the university you tend to have meetings on the hour more often than not and typically they tend to be fairly long meeting of a couple of hours. So I don't really need fine details for any given day..."

- From video transcript, 2002-02-14, 0:06:15

Another informant, a student, was satisfied with the rigid time format since he plans from day to day and he plans his time with the daily overview. The start- and end-time was his way of estimating how long something would take. In contrast to the student, the computer worker with the more casual view on time did not like to decide on an end-time because she could seldom say when for example a meeting was going to end.

"Also, its insistence on having to know when things finished. Often I just writes start times cause often I don't know when something's going to finish and I find it a bit annoying that it expected me to always have to tell that…"

-From video transcript 2002-02-14 0:04:15


A less rigid time format

Our design suggestion gives alternatives to the rigid format in the existing applications by allowing a more flexible time format. The time intervals are simply removed from the left column. Instead the user is given three options for each task; no time, time point and both start- and end-time. These three options is an attempt to cover the different possibilities for an activity. If there is an activity without a specific time for when it has to be done, like for example cleaning the car when it is possible during the day, the no time option is chosen. Then that task will be shown on the screen without any time connected to it. If the activity has a specific start time but the user is uncertain about how long it will take, like for example a dentist appointment, the time point option is chosen. The activity is then shown on the screen with the start time. The user may also choose the original start-end format. Some tasks, like for example a students' lecture, have a known start- and end-time, and then this last option is appropriate for this kind of tasks. This option also supports the student who liked to use the end-time to estimate the time for the task. It is important to have this flexible time format because all tasks are different and not always suitable for the rigid time format that the existing application has.

7.1.3 Providing Overview – Adding a second screen

Weekly view in the Palm Pilot today

The weekly view in the current date book application show the events during the week as blocks. To be able to see what each block represents the user have to click on them with the stylus to bring up a small description of the event on the screen. When an all-day activity is put in the date book the block covers the entire column. This gives an approximate picture of how busy a specific day is during the week. However, this way of visualizing time on a weekly basis does not fully support time planning for users. One informant who used his laptop to plan his time said that he is forced to use the laptop simply because the small screen of the PDA cannot give him the overview and information he needs.

"…This [his laptop] also has the good advantage of letting me see a week at a time, quite nicely. Try to see a week at a time in this [his PDA] thing is a bit too crammed to get a good view…"

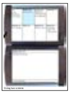
From Video transcript 2002-02-13, 1:12:09

What the users need to see is what the different blocks represent. They want to be able to judge when there is enough time to plan a new activity. Another informant who also discussed the subject about the weekly view in the PDA with us exemplified this when he talked about the large number of short meetings he had. He liked to look through the day and find meetings, which could end earlier or be moved because something more important had to be scheduled. With the existing weekly overview in his PDA he had to click on every block to see its content and he thought that this was time-consuming.

The limitation to the weekly view also leads to high level of navigation as compared to what is accomplished when adding a new task. To find free time for an appointment and add it to the date book requires a lot of navigating. This is in strong distinction to the paper-based calendar where it is easy to flip through pages to find free time and then write down the appointment. It is difficult to avoid the navigation because of the limitations of presenting large amounts of data on the small screen. A teacher who used an Ipaq described the awkward process of adding a new appointment from the weekly view to explain why he preferred his laptop when planning time on a weekly basis.

"…You know, doing this dragging out of space that's going to be your appointment. Hold it down press, new appointment, whatever, I find that to be very painful…"

-From video transcript, 2002-02-15, 0:03:15


Using two screens

Our design suggestion seeks to enhance the weekly view in the PDA by giving a constant overview of the week where all tasks are presented as text. We also want to reduce the level of navigation. The single screen that the PDA has today does not allow this. It is simply too small to give a constant overview of the week and present the occupied time in another form than the blocks. To meet users need for a better overview we added a second screen to the PDA.

In the PDA with two screens one of them is reserved for the constant overview and the other show a selected day. The lower screen is also used as input screen where the user adds new events and tasks. The double screen solution leaves some more screen space for the overview. We decided to take advantage of the extra screen space by exchanging the blocks with the same information that was shown in the daily view but only show the beginning of the description and the optional time of the task. The decision to show only the beginning of the description was based on a discussion with one informant about handwriting. She said that she would recognize what the task was about from only seeing a word she had written in her diary.

> *"…When I look at this, I have no problem knowing its bridge because I can recognise my own handwriting. Um… yeah… its contextual of course… clearly I mean…. Seven thirty on a Monday night is something that I often do…"*
>
> -From video transcript: 2002-02-14, 0:22:35

The fact that she could attach meaning to a single word like "bridge" in her diary, she knows that the word means that she is going to play bridge on Monday with her friends, suggests that it is better to partly see the descriptive text compared to a block that just gives the user the time for an event.

We think that the presentation of the information decides people's interaction with the PDA and that it influences how and when they put data in it. Since there is no good way to get an overview in the PDA today people generally avoid planning ahead with their PDA. The changes we have suggested, the double screen with the better overview and reduced level of navigation, will play an important role in increasing the possibility for the user to plan their time using the PDA as the only resource. At the same time users wanted more space for the information they did not want to make the PDA bigger. They saw the small size of the PDA as a great advantage. In our design suggestion we take the size of the PDA in consideration. It is based on the same size as the Palm Pilot or Pocket PC. Today, the PDAs are often carried in a case that protects the screen. Our idea is to replace the lid of the case with the second screen and make it fold like a lid. In this way the size of the PDA is maintained and at the same time the screens are protected. We are aware that the technical feasibility and economical aspects of adding another screen are not fully explored but we know that there are technologies under development like for example LEP-screens[19], which is a sort of thin plastic screen, that would be suitable for this purpose. Our intention, however, is to give a design suggestion for further development in the field of PDA, not making a complete implementation. Therefore we have chosen not to investigate the technical feasibility and economical aspects in depth.

7.2 Improving the Reminder Function

The reminder function is in theory a good use of the computational power but in practice it was problem ridden. The function that was supposed to remind about important things to do was annoying and frustrating. To make the reminder more useful for the users we have improved it in two ways.

Reminder in the date book

- Made the reminder more flexible by offering more alternatives

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[19] http://www.cdtltd.co.uk/ visited 2002-03-20

- Brought awareness issues into consideration

We think that by doing so the reminder will be able to more successfully be the memory aid it has the potential to be.

7.2.1 More Reminder Alternatives

The date book events and the to-do tasks in the current applications for time management in the PDA have a built in reminder. For the date book this reminder is set to go off at a specific time point and may be repeated at a specified interval. The to-do tasks do not have a reminder that can be set in the same way. Instead they have a due date that will remind on the same day the task is due. Both the reminder in the date book and in the to-do list have the same sound. This sound can be changed but has to be the same for all events and tasks. When the reminder alarms a message will be shown on the screen telling what event or task the reminder is about.

One problem with the reminders are that the time point of the reminder may have been set a while ago and later when for example a meeting is booked the time for this meeting and the reminder may collide. It is hard to check all reminders to see if there is one or more that set to go off during the time for the meeting. This was especially a problem for one informant who had a very crowded schedule. She had stopped using the reminder because of annoyance of the constant reminder beeps.

"…-I tend not to use the alarm, umm, 'cause I have so many appointments that it would go off every hour and that's a pain in the neck…"

-From video transcript, 2002-02-18, 0:58:50

Another informant complained about the lack of possibilities to modify the reminder to fit the task. He is a teacher that supervises different projects and also a Webmaster. The parallel work creates many deadlines, which he wanted to be reminded about. He said that while it can be enough with a single beep to remind him about going to the dentist tomorrow, a busy week with multiple deadlines is a more complicated story where he said he needed to have a sort of gradual reminder.

"…-It would be nice to be able to assign, it's not a reminder, but assign some type of time constrain, to be memo section a little bit better than what you can, …I appreciate that actually… cause that is why you can say I'm gonna' do this and this is done in three weeks, so you got to hang on… you put that in today. In about two weeks time I remind you again to say, hang on…. you know, you still got to do this…."

-From video transcript, 2002-02-19, 0:09:25

It is not enough with the single beep for all tasks. There has to be a way to allow the user more alternatives to be reminded if it is going to be a useful function. One alternative that goes beyond sound as a reminder is to take advantage of different ways people remind themselves. For example they put Post-It notes in places where they are seen or write larger text for an important event in the paper diary. The text in the date book and to-do application in the PDA uses the same size and typeface. The visual difference that was achieved in the Post-It notes and larger text is then lost. One informant who used a lot of post-it notes as reminders described why she liked them.

"…-Slipping in bits of papers, sticking in Post-It notes, so you know, receipt to be claimed for my health fund. You know, this tends to build up a kind of, you know, to do list stuff I need to be remembered…"

-From video transcript, 2002-02-14, 0:07:37

The Reminder Function

In our design suggestion we have tried to take more advantage of the computational power in the PDA. We wanted to give the user more possibilities to be reminded. Instead of the single beep that is used in the current reminder function we chose to allow the user to specify how, when and how many times to be reminded depending on the task. For example, if a dentist appointment is made long in advance the user may choose to be reminded the day before but also to be reminded a second time an hour before the appointment. In this way the user has more control over the reminder than if a single beep is the only option. In addition to this our design includes more control over the sounds produced. While the current reminder function only allow a single sound for everything our design suggestion allows the user to choose sound for a specific category or unique task. A reminder about the dentist could use a unique sound or important deadlines could share another. In this way the user can get an idea about what the task is about without taking the PDA out of the pocket. To make use of the visual reminder from the Post-It notes that an informant liked we provide visual cues as well. In the overview and daily view the text of the timed task that is closest to the current time increases in size and changes color. In this way it is distinguished from the other tasks and this draws attention to it. By a quick glance the user is reminded of what to do next. With these improvements to the reminder function we make use of the computational power by combining visual cues and sound for the reminders to give users a more flexible way of adding reminders to specific tasks.

The week-tasks

The improvements to the reminder are useful for tasks that have to be done on a specific day and time. For the tasks that are not connected to a specific day and time, those who are placed in the separate square that represents the week, another form of reminder is needed. One informant exemplified these "week-tasks" by talking about how he should correct a number of examinations. These examinations had to be done during a two weeks period. While he had the two-week deadline he did not want to correct all his examinations on a specific day. Another informant who kept his to do tasks in a paper diary checked the past two weeks every new week for unfinished week-tasks and moved the tasks he had not taken care of previously forward to the current week. Beside the constant visual reminder available through the overview where these "week-tasks" are included our design suggestion has a reminder option that is special for them. When the user creates a week-task the choice to be reminded on a weekly report can be made. The tasks where this choice has been made are then presented in the weekly report at the beginning of a new week if they have not been done and can be transferred to the current week.

7.2.2 To Add Awareness or Not?

While the design suggestions for the reminder add flexibility to the function the problem with the user being disturbed at inappropriate times is still unsolved. One PDA user who had a crowded schedule talked about that the reminder would constantly go off at inappropriate situations. As a teacher he wanted to be reminded about different lectures but at the same time not be disturbed when he gave lectures.

"The reminder is problematic because it can disturb, for example during a lecture. One cannot be sure where one's going to be. You could be in the car or in school during a lecture.

-Transcript from interview, 2002-02-13, 1:14:04

In theory it seems to be very useful to add awareness to the reminder function. Then the PDA could tell when it is appropriate to remind the user. However, the research about awareness to control annoying ringing tones from mobile phones (Milewski A., Smith T. 2000; Hinkley K. et. Al. 2000, 2001), which is a similar problem, has not resulted in a good solution. It seems to be hard to construct a device that automatically knows that you for example are in a meeting and do not want to be disturbed. We do not think that it is possible to add awareness to the PDA in this way and have tried to solve the awareness issue in another way.

We saw a need for the user to be able control the behavior of the reminder in the PDA but do not believe in that awareness is the way to solve it. Instead of adding awareness we have tried to make it easier for the user to let the PDA know how to act in different situations like for example meetings. Our suggestion for solving this is based on an existing function in mobile phones called "profiles". The profile tells the phone what kind of ring tone is appropriate for the current event and how to handle calls. If the profile is set to the alternative "meeting" for example, the ring tone is quiet and the phone use visual messages, vibrations or other ways of bringing attention to the user instead.

Our design suggestion does not try to make the reminder intelligent like the efforts in the research about awareness for mobile phones. Instead we have chosen to incorporate the profile function from the mobile phone in the PDA and let the user choose these profiles in an easy way. In the phones it is often required to navigate in a menu to set the profiles. The advantage with the PDA is that it has more screen space, which was something we took benefit from. Instead of navigating through a menu the user simply chooses the profile icon that always is available and is presented with a number of choices. The user then selects the choice he or she wants. While this suggestion does not add any intelligence it gives the user more control over how the PDA acts.

The profiles in the PDA

7.3 Graffiti – An Important Part of Time Management

While these improvements are the most important to make the PDA better from a time management perspective there are other aspects of the PDA technology that are factors for how people use the PDA for time management. The great resistance towards the input of data in the PDA is a good example of an obstacle that has to be overcome before the PDA can truly be used for time management in the same way as a paper diary.

There have been a number of attempts at finding new ways of input data in the PDA to improve the efficiency and ease of input. However, we think that the solution to the users resistance is not to find another way to input data. It seems like the problem with input is built into the technology and is very hard to change. Instead of concentrating on finding new ways of entering data, the efforts should be at removing the resistance against using graffiti for the PDA by making it more valuable as a time manager.

Most informants talked about the graffiti as a slow and awkward process, not something that was impossible to use. Graffiti is not a completely different technology from writing with a pen and paper. The difference is that the user has to learn a new set of characters that represents the alphabet and that the writing is done in one place. The new character set may be awkward for beginners but to learn to write graffiti is in a way much like learning to write with pen and paper. In the beginning it is slow and cumbersome process to produce written texts, to write with pen and paper is nothing that is learned over a night. In contrast to the graffiti, many accept the initial trouble of learning to write with pen and paper. They do so because the use of being able to write is worth the while. Likewise, to learn using the graffiti must be worth the effort. To use the PDA for time management must be at least as good and easy as using a paper equivalent. The PDA has to provide a good overview, be as easy to navigate and allow flexibility in time management like a paper diary before users see the PDA as an adequate substitute for them and consider it worth the while to learn, and use, graffiti. This is why we have focused our design suggestion on improving time management with a PDA through the presentation of the information on the screen. If our design suggestion increases the usefulness of the PDA the effort of learning, and using, graffiti is going to be worth the while.

8. Conclusion

The PDA have made it possible for people to bring computational power from the desktop into their daily life. We believe that this computational power has potential to enhance different aspects of daily life but that it is important that the use of this computational power is grounded in people's interest and practice. But the development of the PDA has been guided of what could be possible more than what would be useful. The industry concentrates on new areas of use for the PDA instead of having an interest in what people really need and let the development be guided by these needs. We are not negative to the different areas of use but object to the practice of thinking them up instead of building them on people's real interest and practice.

Working from this point of view we found that most of our informants saw time management as the primary use for a PDA. The informants bought their PDA to replace their paper diaries and other artifacts they used for time management but in practice they used it together with the other artifacts. Our questions were, why is it that the PDA have not replaced the other artifacts and how can we increase the possibility to use it as the sole resource for time management? The work with these questions resulted in our design suggestion. It is an attempt to improve the design of the existing applications to better support people's ways of managing their time and to take full advantage of the computational power in the PDA. By doing this we think that we have increased the possibility to use the PDA as the sole resource for time management.

While the design suggestion is grounded in the informants' reality we are aware of that there are other aspects to take into account when developing IT-artifacts. Ergonomic and economic aspects could present practical problems and has to be further investigated before the PDA can be developed to be the sole resource for time management in reality. The focus on time management in the design suggestion also made it hard to predict the consequences for other areas of use for the PDA. The PDA is a generic device where different applications are used and this was nothing we wanted to change with our design suggestion. We tried to take the generality of the PDA into account as much as possible but did not have the opportunity to fully explore the consequences for the other areas of use when we added another screen to the device. If there is a desire to preserve the generality of the PDA when using our design suggestion these consequences has to be taken into account.

Finally, there is so much time and effort invested in people's current way of planning time and organizing their life that it is just not a matter of throwing away paper diaries, note books, and other things they use. The way people manage their time is nothing that is shaped over a night. The old habits have to be changed and information has to be transferred to the new system. The PDA has to provide advantages towards the old system to make the effort of changing their ways of managing time worth the while. We think that the PDA has the potential to be as good as a paper equivalent for time management but we also think there is a possibility to surpass it by taking full advantage of the computational power in the PDA. The reminder is a good example of what is possible with the PDA that the paper diaries cannot do. Today its functionality is too limited and the design does not fit people's need of a reminder. It has to be improved before the PDA can offer more possibilities than the paper diary and the improvement has to be grounded in people's interest and practice. It is only when people can see that the PDA can offer more possibilities than paper diaries that people will find it well worth the while to change to the new system from the old and justify the high price. We believe that our design suggestion takes the PDA a step in the right direction to make it possible and worth the while to use it as the sole resource for time management.

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10. Appendix

10.1 Example of Profile

Name: XXX xxx[20]
Profession: Xxx
Uses: Palm PDA, Lap Top, Desktop computer
Type of person: Xxx sometimes travels in her work. She seems to be a very structured person and really enjoys taking advantage of technology.
Organizes Time: Previously Xxx used paper diaries and notes to organize herself but she did not like to carry everything around. Nowadays she has a Palm Pilot to organize her life and she thinks that it is really easy to use and likes that it is so small. She says that she always bring it with her wherever she goes. The PDA is the only artifact she uses for organizing her time and she only synchronizes it with a laptop once every month. The data in the laptop is only for back up purposes.

Whether she is in or out of the office Xxx always enters text for appointments directly in the PDA with the stylus. She says that she is a medium level user of graffiti and can do quite advanced characters. She likes when things look nice in her PDA and therefore she always corrects the errors she makes while entering text. Besides the date book Xxx also uses to-do lists, which she tries to keep categorized. She avoids using the reminders since she has so many meetings and important tasks. The PDA would beep constantly if she used them. Instead she looks at today's schedule every morning to get a picture of how busy the day is. If it is busy she rather look at it more frequently than use the reminder. One thing that Xxx does not use is a mobile phone. She keeps all the phone numbers and addresses in the address list instead.

Some other functions she uses are the memo pad and sometimes the calculator. Xxx would gladly try out some new software like the game Tetris but feels that she has not got the time to look them up. When Xxx is out traveling she uses an application she has downloaded called City Time. This is a program that tells the time in the place where you are. She also uses the expense application in the Palm to keep track of her traveling expenses. What she really likes with this application is that it saves her a lot of trouble sorting out the receipts.

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[20] The name and profession of the person is withheld for integrity reasons